## OP-090 [Bee Biology]
## Conservation status of the honey bee subspecies native to the Mediterranean islands

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The Mediterranean islands have been a stage for honey bee diversification, hosting four of the 31 recognized subspecies: Apis mellifera siciliana in Sicily, A. m. ruttneri in Malta, A. m. cypria in Cyprus, and A. m. adami in Crete. However, owing to small population sizes, island subspecies are particularly vulnerable to introgressive hybridization when exotic queens or colonies are introduced into their geographically isolated territories. While previous genetic surveys—typically based on mitochondrial and/or microsatellite markers—have provided valuable insights, the current conservation status of these subspecies remains uncertain.

Here, we sequenced the whole genomes of 327 samples collected from Sicily (n=97), Malta (n=79), Cyprus (n=37), and Crete (n=36), along with probable source populations (A. m. intermissa, A. m. sahariensis, A. m. media, A. m. anatoliaca, A. m. macedonica, A. m. cecropia, A. m. ligustica, A. m. carnica, A. m. caucasia), to provide a comprehensive and up-to-date assessment of the ancestry and diversity patterns of these insular subspecies. Whole-genome data were analysed using the software Admixture and additional analytical tools to explore ancestry and introgression patterns.

For A. m. siciliana, 32 out of 97 samples (32.99%) exhibited high purity levels based on a threshold of 0.9. The situation in Malta was more concerning, with only 11 out of 79 samples (13.92%) classified as pure A. m. ruttneri. The most severe admixture was observed in Crete, where just 2 out of 36 samples (5.56%) were identified as pure A. m. adami, highlighting extensive hybridization with mainland subspecies. Meanwhile, A. m. cypria appears to be the best-preserved Mediterranean subspecies, with genetic integrity largely maintained except in the northwestern population, which exhibited shared ancestry with mainland A. m. anatoliaca.

Overall, our findings highlight the urgent need for conservation efforts across these islands. While the native subspecies remain threatened by hybridization, their preservation might still be possible, provided that further importations of non-native colonies are effectively prevented.

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# Honey bee subspecies

31 Subspecies

4 Main lineages

A lineage
O lineage
C lineage
M lineage

# Honey bee threats

## Climate change

Wildfires, habitat shifts, phenological mismatches…

## Use of pesticides

Toxicity, chronic stress …

## Introduction of foreign pathogens and parasites

*Varroa destructor*, viruses, Nosema …

## Importation of honey bees

*A. m. ligustica, A. m. carnica,* Buckfast, and *A. m. caucasia*

# Islands’ Intrinsic vulnerabilities

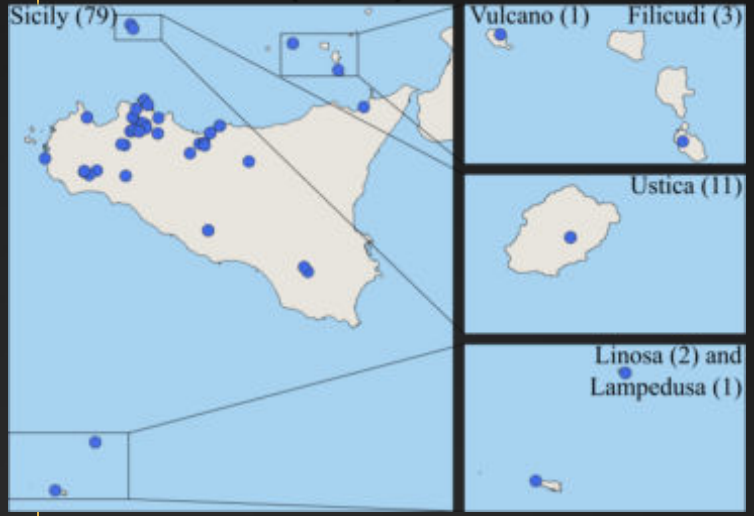
- Reduced & fragmented ranges
- Low population sizes & genetic diversity
- High susceptibility to genetic erosion

# Questions

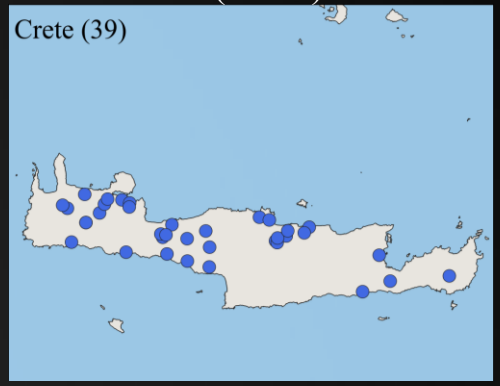
- What is the current conservation status of *A. m. siciliana, A. m. cypria, A. m. adamii,* and *A. m. ruttneri* subspecies as revealed by whole-genome data?
- Which are the main introgression sources for each subspecies?

# Sampling

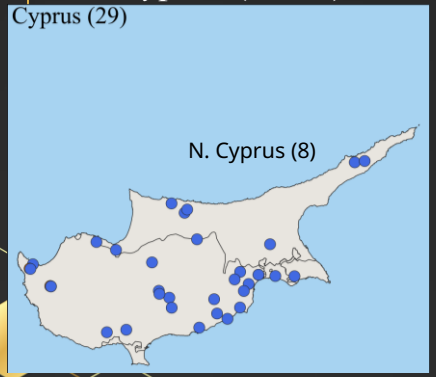
*A. m. siciliana* (N=97 individuals)



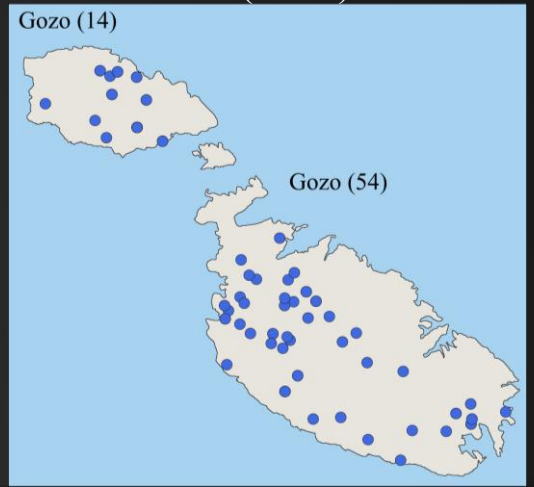

*A. m. adamii* (N=39)




*A. m. cypria* (N=37)

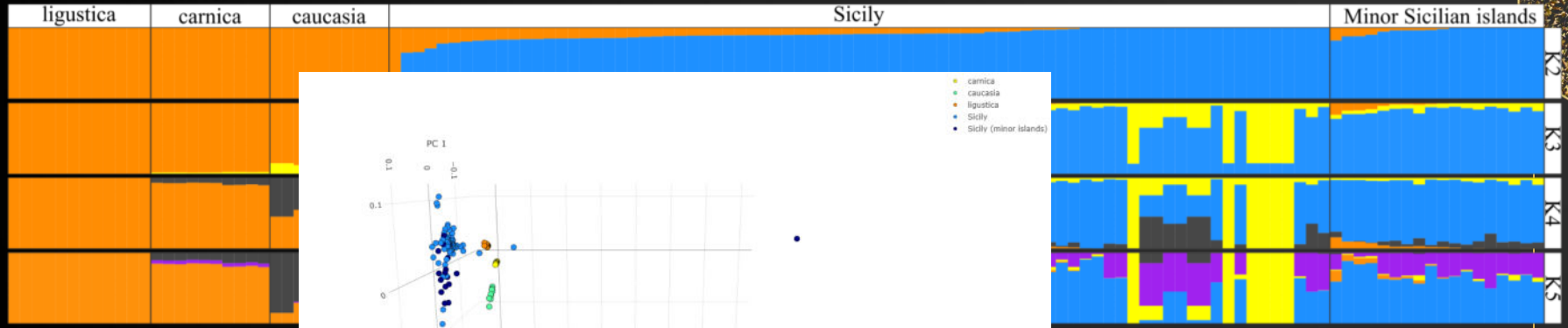


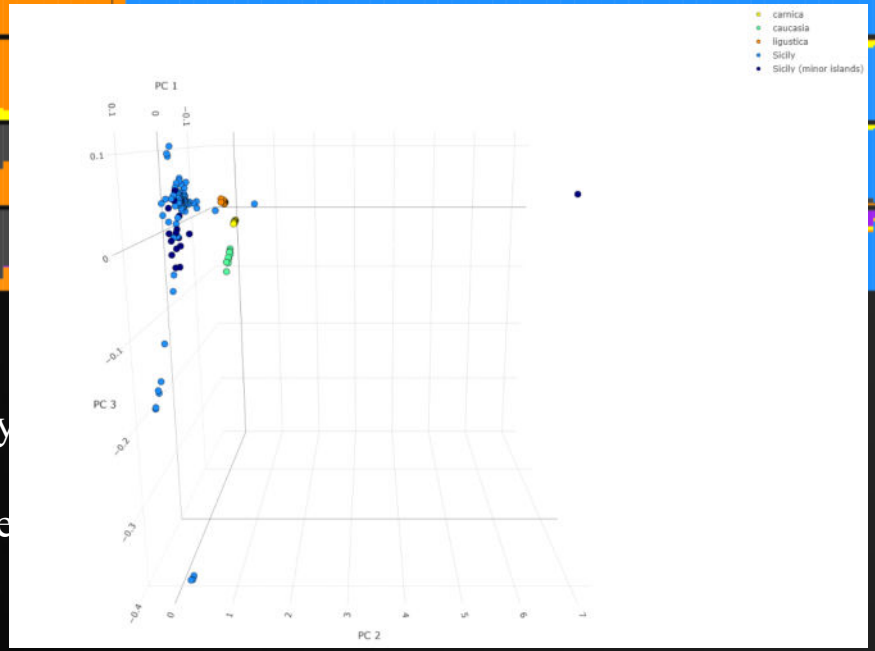

*A. m. ruttneri* (N=80)

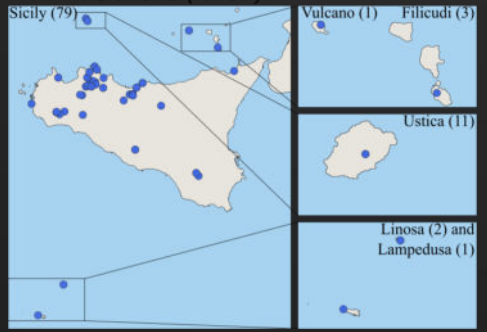



Illumina NovaSeq 6000 platform and a paired-end 150 strategy
Coverage 11X-31X: Average 21X

# *A. m. siciliana*




- Median purity
- 58.76% of the

*A. m. siciliana* + *A. m. ligustica* (N=12) + *A. m. carnica* (N=10) + *A. m. caucasia* (N=10)

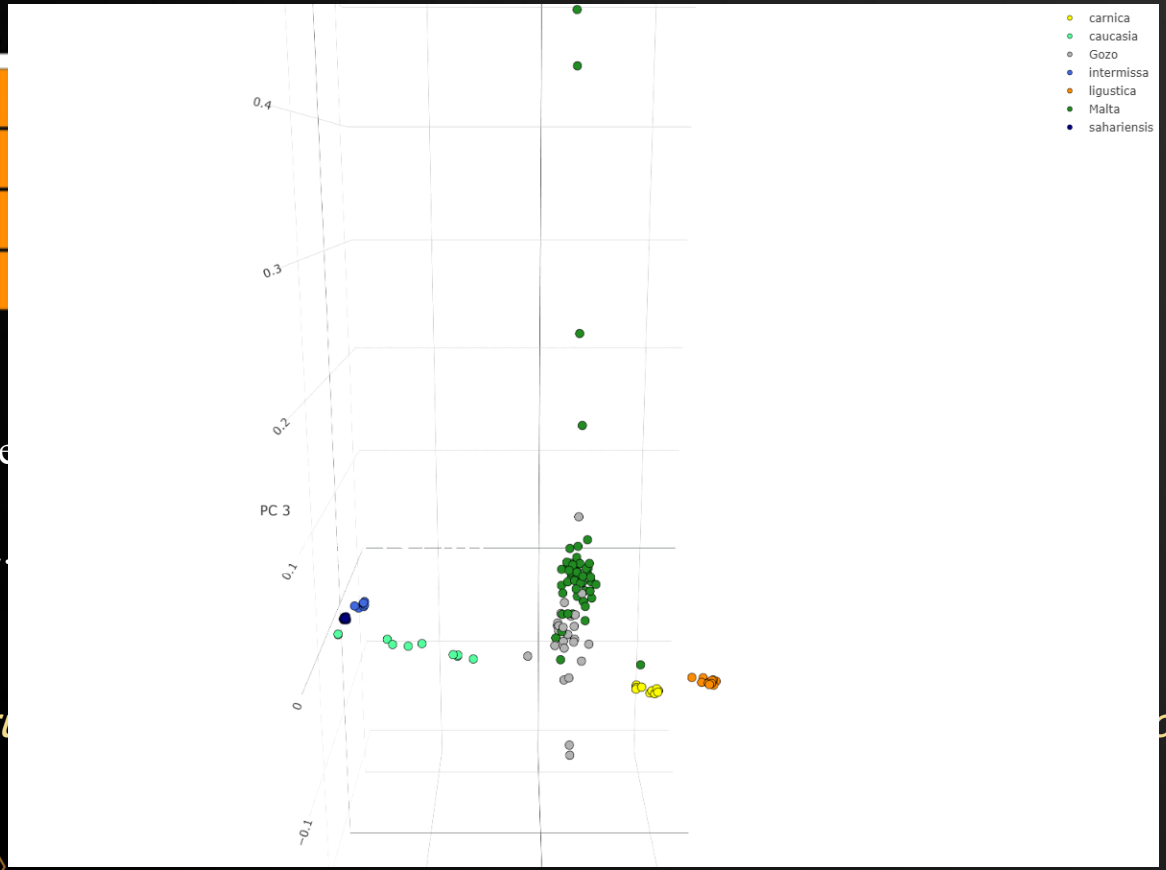
Best K=2

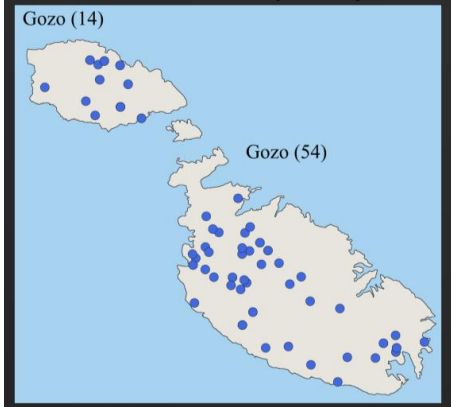
Q-value threshold of ≤ 0.1

# *A. m. ruttneri*

ligustica

- Me
- 22




*A. m. ru* *caucasia* (N=10) *+ A. m.*

Best K=2

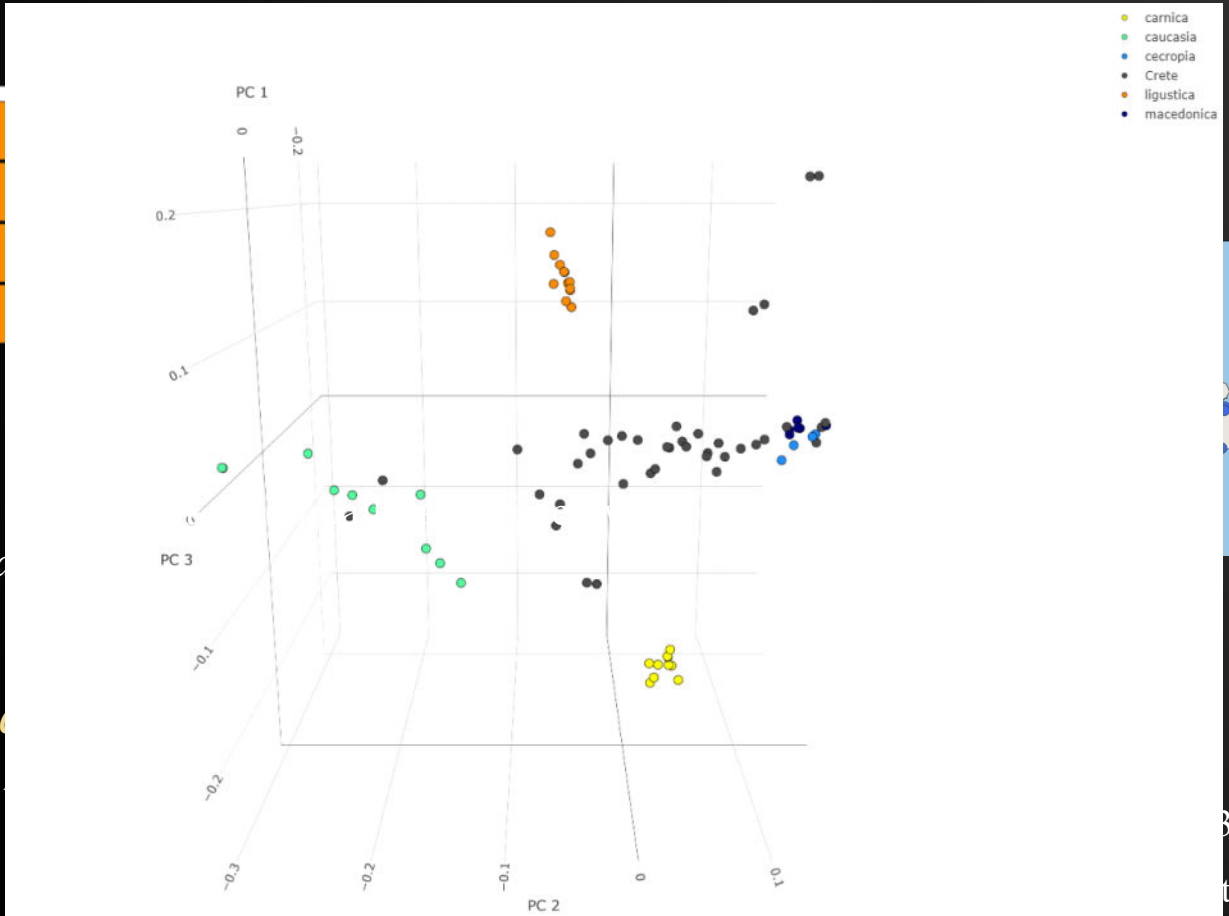
Q-value threshold of ≤ 0.1

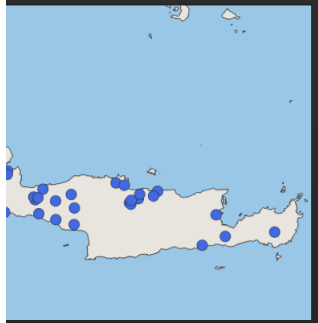
# *A. m. adamii*

ligustica

No clear
*A. m. ado*

*A. m. a*
(N=10) +

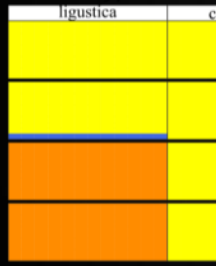


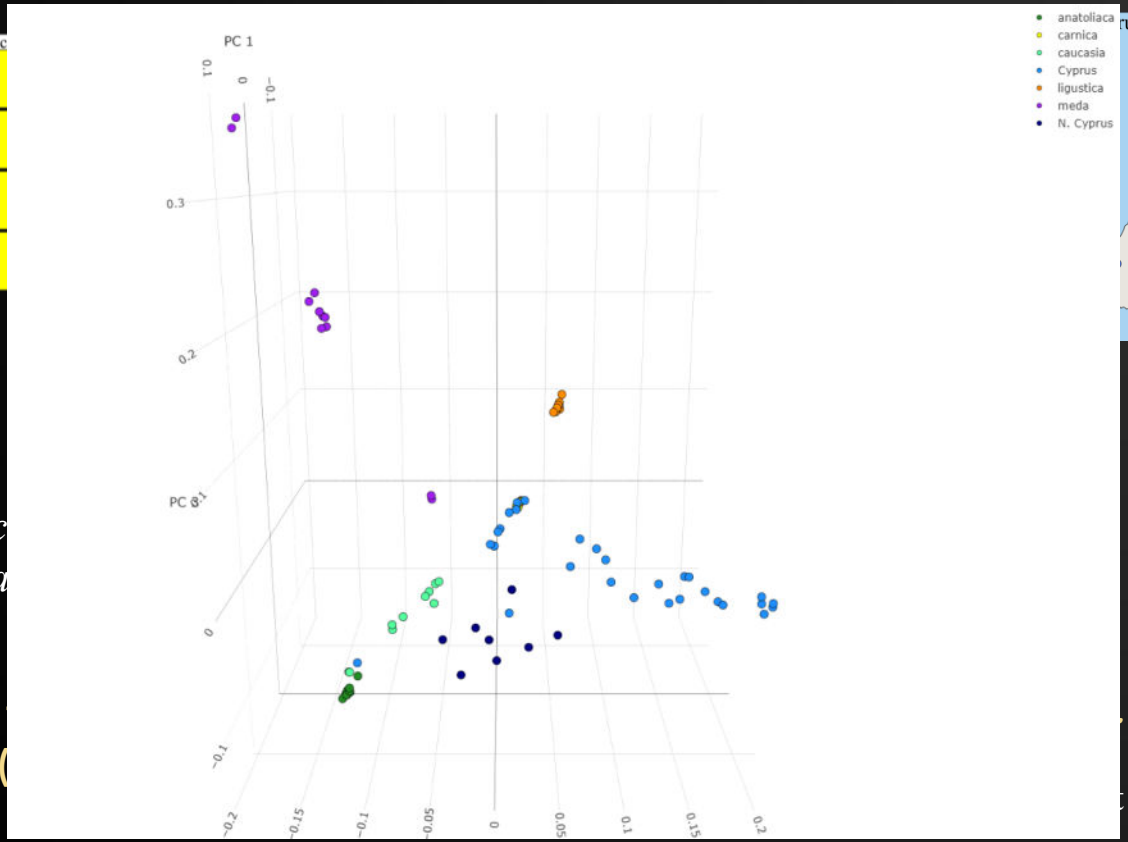



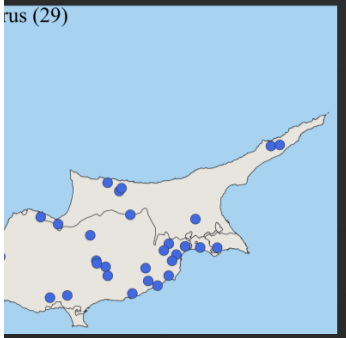
3

threshold of ≤ 0.1

# *A. m. cypria*




Dominant
markedly:

- *A. m. c*
- *A. m. a*

*A. m. cypria* *caucasia*

K=2

Q-value threshold of ≤ 0.10

# Conclusion

## *Apis mellifera siciliana*

*Showed the highest median purity*
*Success of long-term conservation efforts*

## *Apis mellifera adami*

A further confirmation of its extinction

## *Apis mellifera ruttneri*

Some genetic integrity remains
It is heavily impacted by introgression

## *Apis mellifera cypria*

Genetic structure differs across the administrative border
Genetically pure individuals are found only in the South
Dominant introgression varies:
*A. m. carnic*a in the South
*A. m. anatoliaca* in the North

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MEDI BEES

# Thank you

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