OP-083 [Bee Biology]
Generating a comprehensive metagenome-assembled genome (MAG) catalogue of the honey bee gut

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A holistic approach to bee health is required to address global challenges. A key component of bee health is the bee's gut microbiota, which plays an essential role in digestion, defense against pathogens and regulation of the immune system, making it a key area of research to improve the sustainability of beekeeping. A balanced and healthy microbiota can enable honey bees to respond more efficiently to pathogen infections or disturbances such as exposure to agricultural pesticides. Despite recent significant advances in gut microbiome studies, a comprehensive study of honey bee gut bacterial, archaeal, and viral genomes across multiple biogeographical regions and honey bee subspecies remains unavailable.

Therefore, within the European BeeGuards project, we will leverage the consortium's large scale field study across 12 European countries to generate the first comprehensive integrated honey bee gut metagenome catalogue (MAG) (iBeeMC). To this end, we are deep sequencing >90 worker bee guts sampled across Europe capturing the bacterial strain diversity of diverse honey bees genotypes and climates. Additionally, by measuring DWV-A and B loads, we will obtain further knowledge on the abundance and distribution of this virus across Europe. Importantly, the iBeeMC and viral loads will be used to study the effect of management on the microbiome of honey bees.

Further, we will implement a hologenomic framework to honeybee research by generating hologenomic sequence data (bee genomes and transcriptomes, gut metagenomes and metatranscriptomes) from field and controlled laboratory experiments that will be linked to phenotypic colony observations such as colony development patterns, pathogen loads, and colony performance and survival, as well as environmental data collected from in-hive digital tools. From a microbial ecology perspective, we aim to identify microbial profiles associated with resilience (enrichment or depletion of certain microbial variants and/or functions).

By understanding the interactions between bees, their microbiomes, and their environment, BeeGuards will provide valuable insights for informed decision-making in resilient beekeeping.

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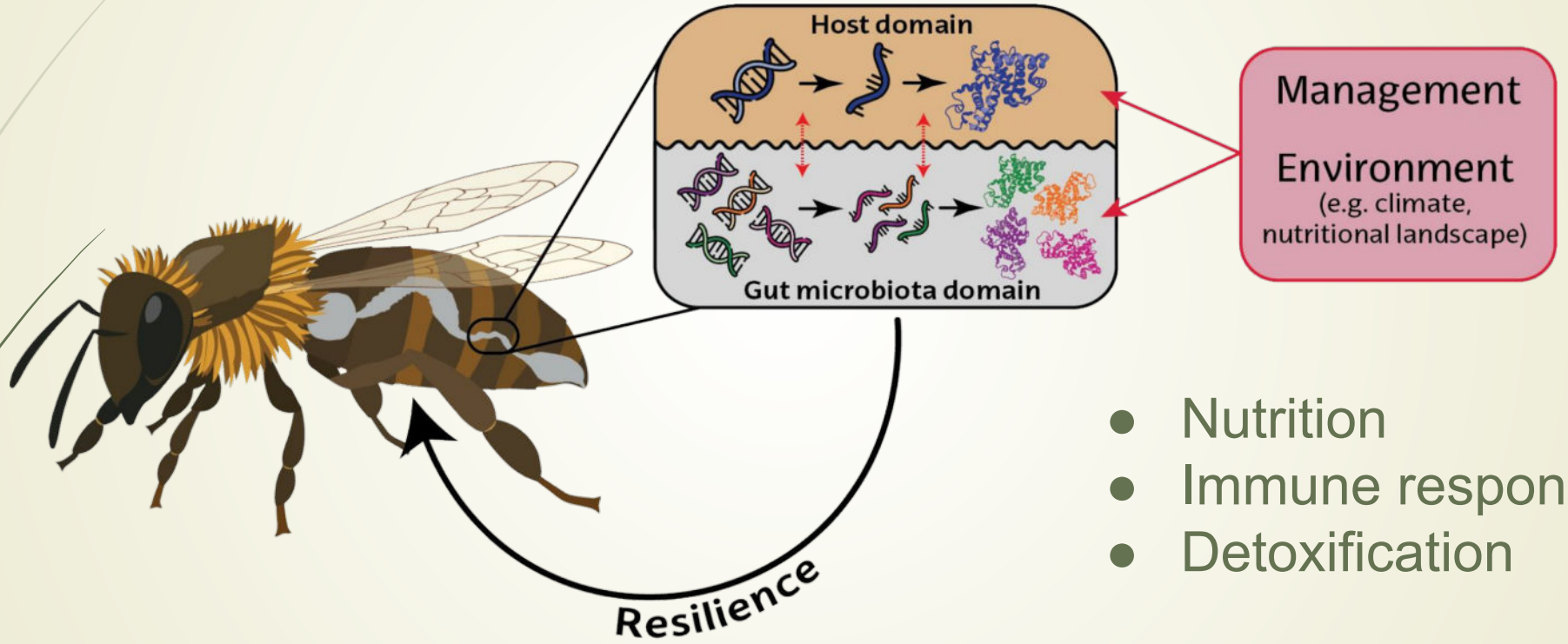
Apimondia 2025

A gentle push

Microbiome and Resilience

Holobiont: Bee + Microbiota



- Nutrition
- Immune response
- Detoxification

How Microbes Help Bees Adapt to Climate Change and Pests?

Aim: Understand Better the Microbiome

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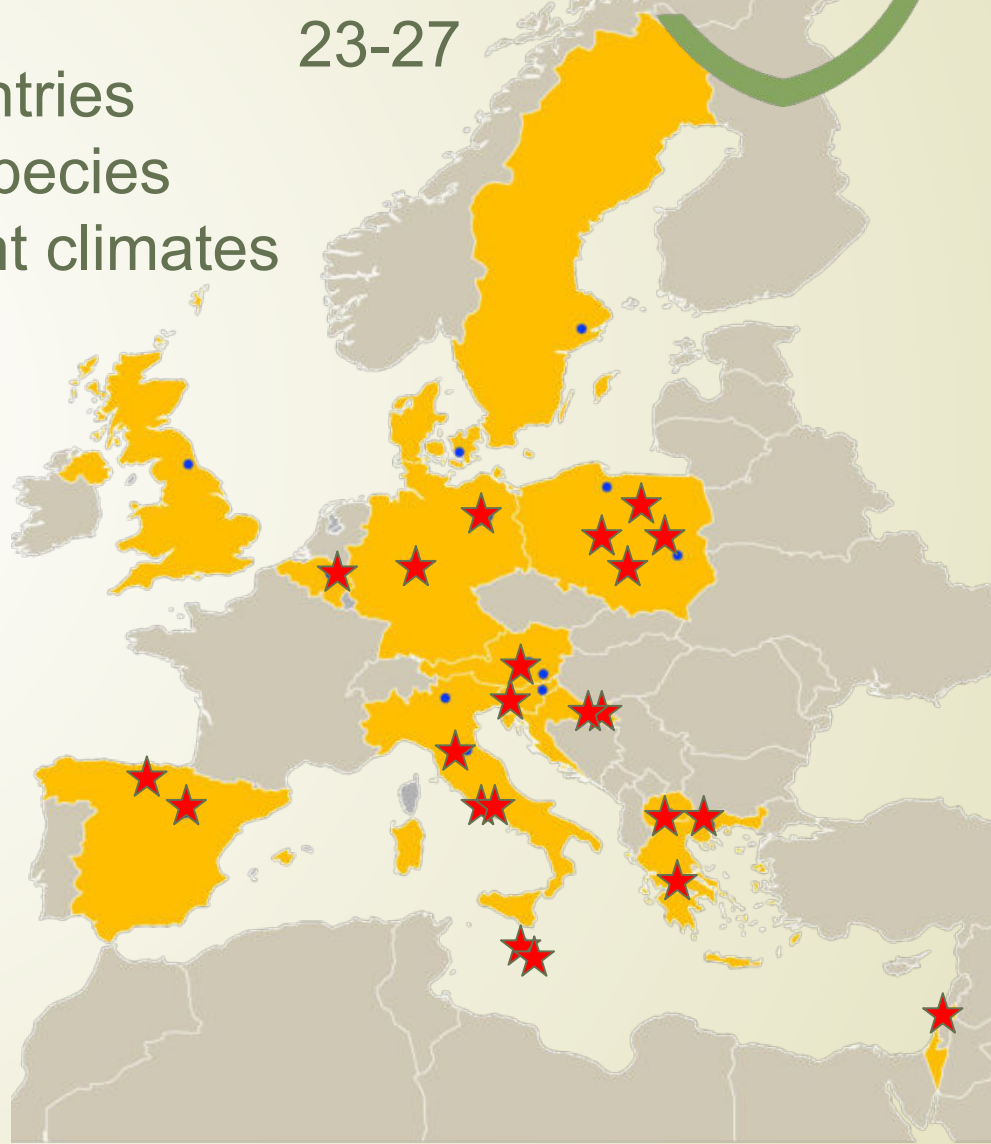
23-27

Create ***iBeeMC***: an exhaustive honey bee gut bacterial reference across Europe

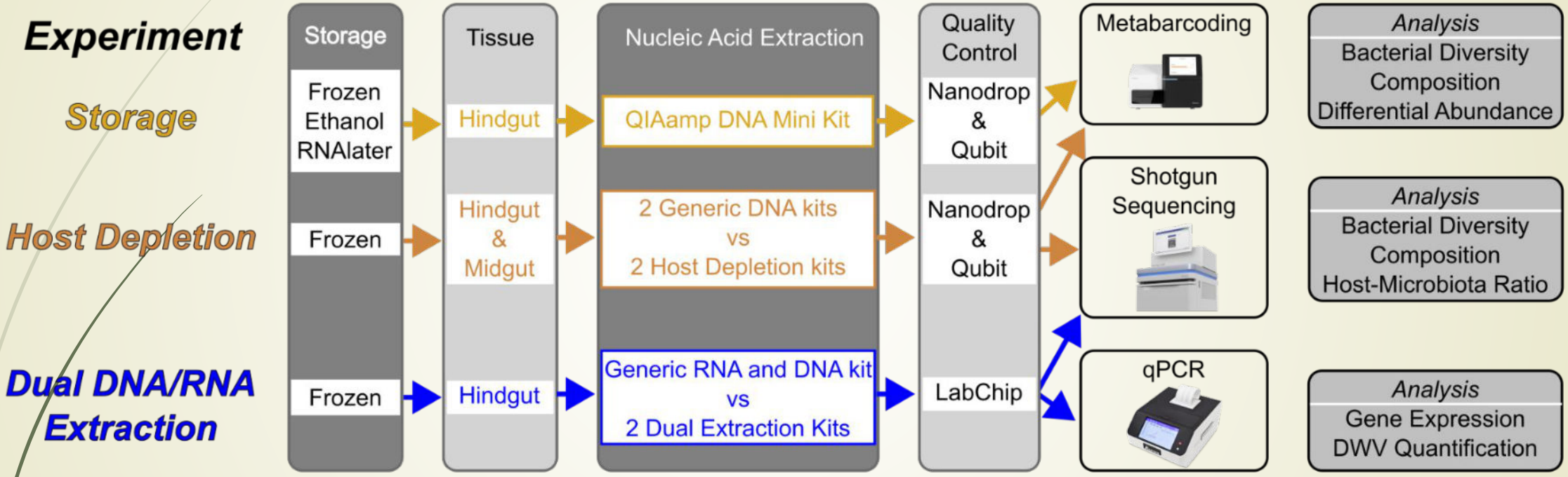
What for?

- Bacterial Diversity and Functions
- Strains and pangenomics
- Links to health and resilience
- Base for future studies

- 12 countries
- 6 Subspecies
- Different climates
- 2 years



Standard Laboratory Protocol

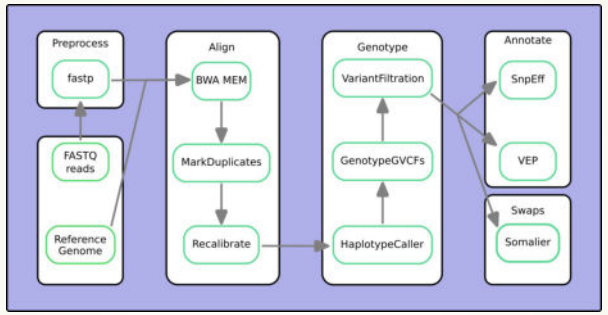


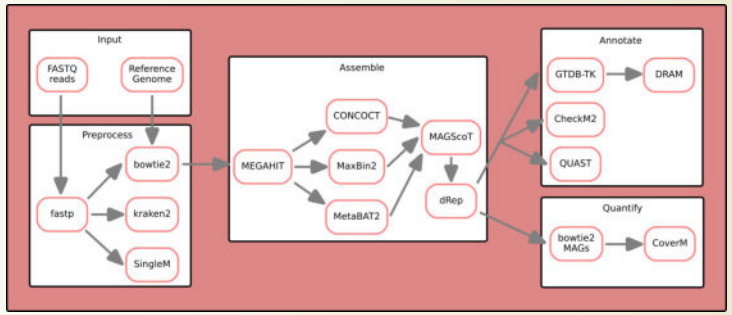
Gorrochategui and Marcos *et al*. In Prep

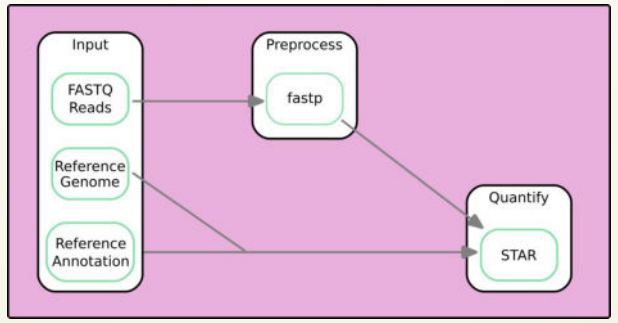
Standard Bioinformatic Protocols

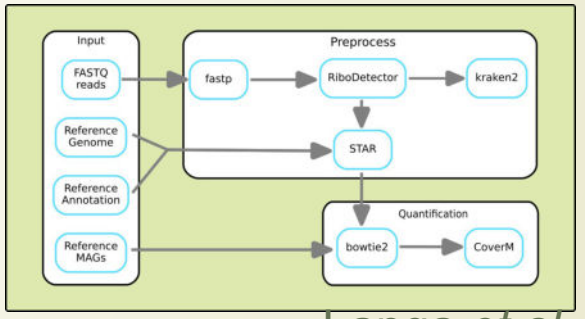
github.com/3d-omics/{pipeline}

	Host	Microbiota
Genomics	hg_genotype	mg_assembly
Transcriptomics	ht_quant	mt_quant









Langa *et al*. Some day

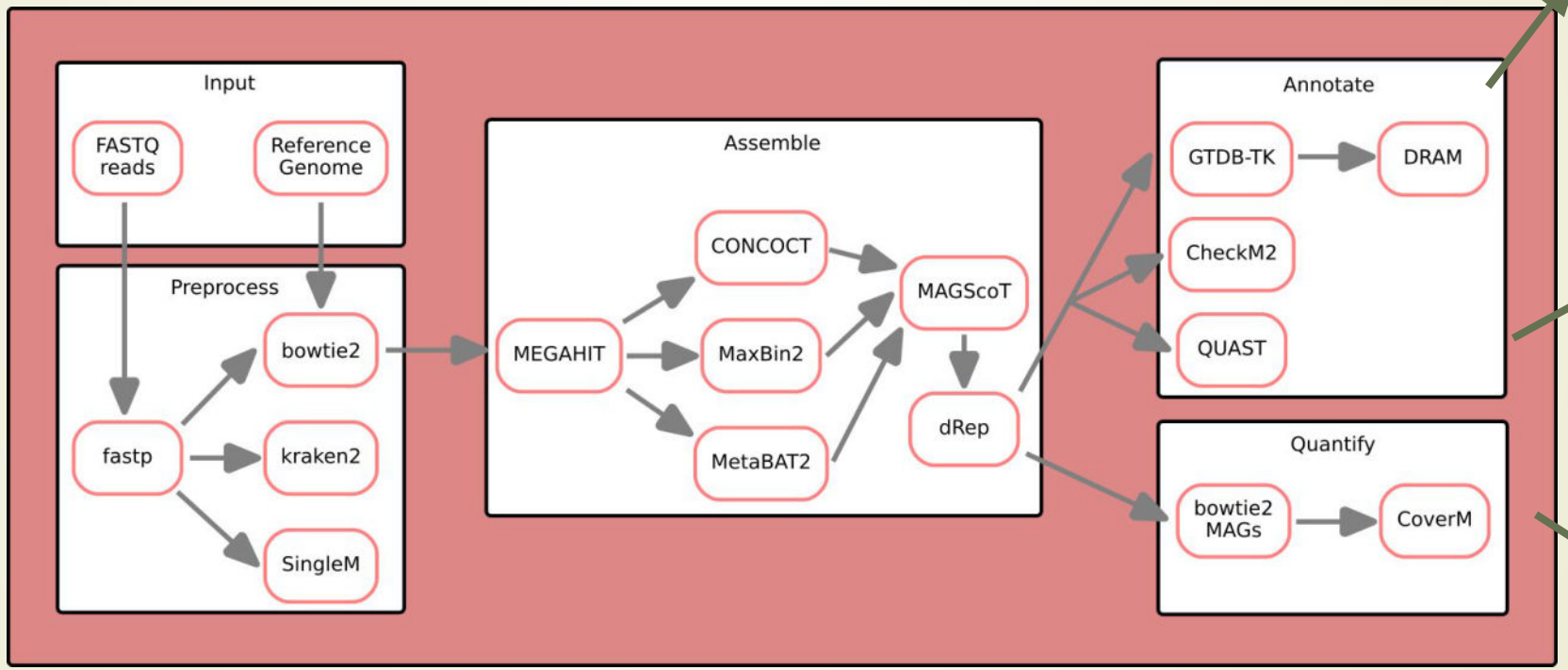
EHU

3D'omics

CEH CENTER FOR EVOLUTIONARY HOLOGENOMICS

Standard Bioinformatic Protocols: mg_assembly

github.com/3d-omics/mg_assembly



Genomes

Genes

Phylogeny

EnsemblMetazoa

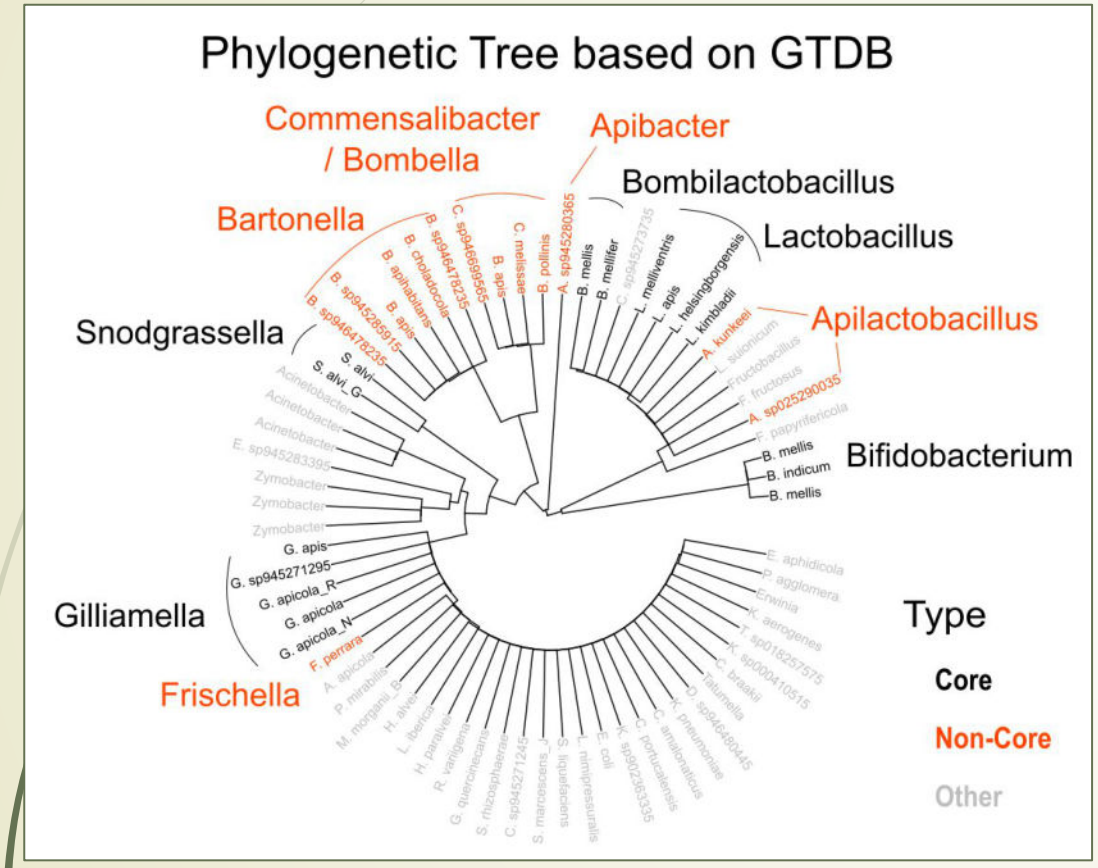
Apis mellifera (Honey bee, DH4)
Amel_HAv3.1

EHU

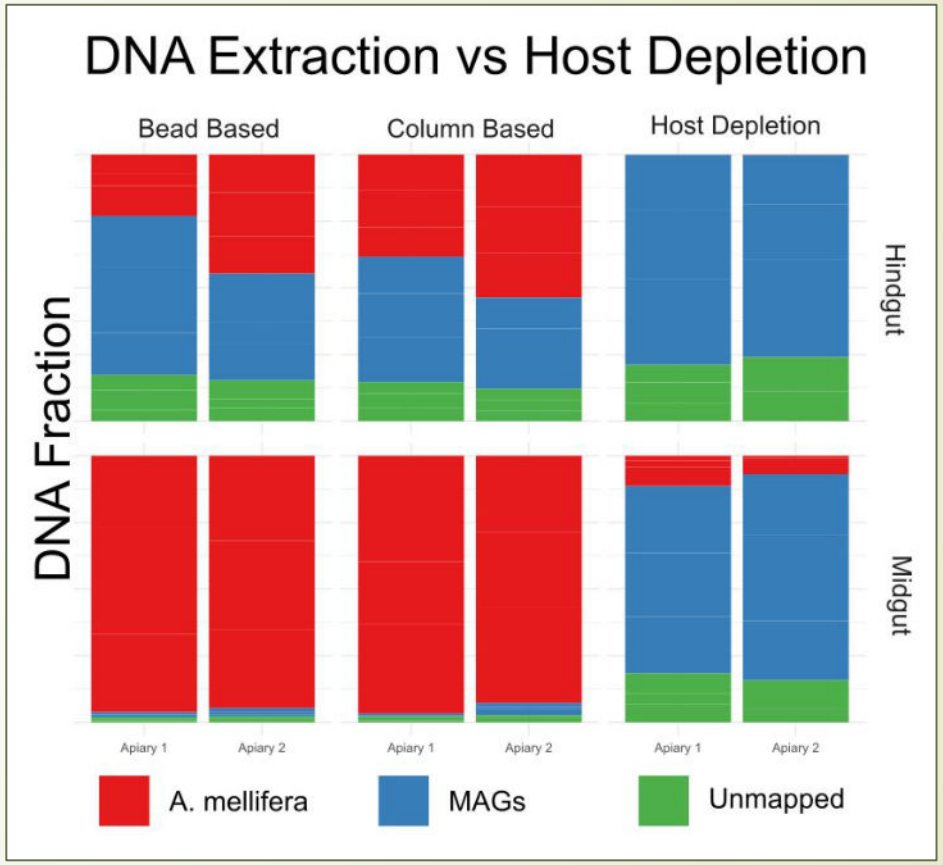
3D'omics

CEH CENTER FOR EVOLUTIONARY HOLOGENOMICS

Host Depletion

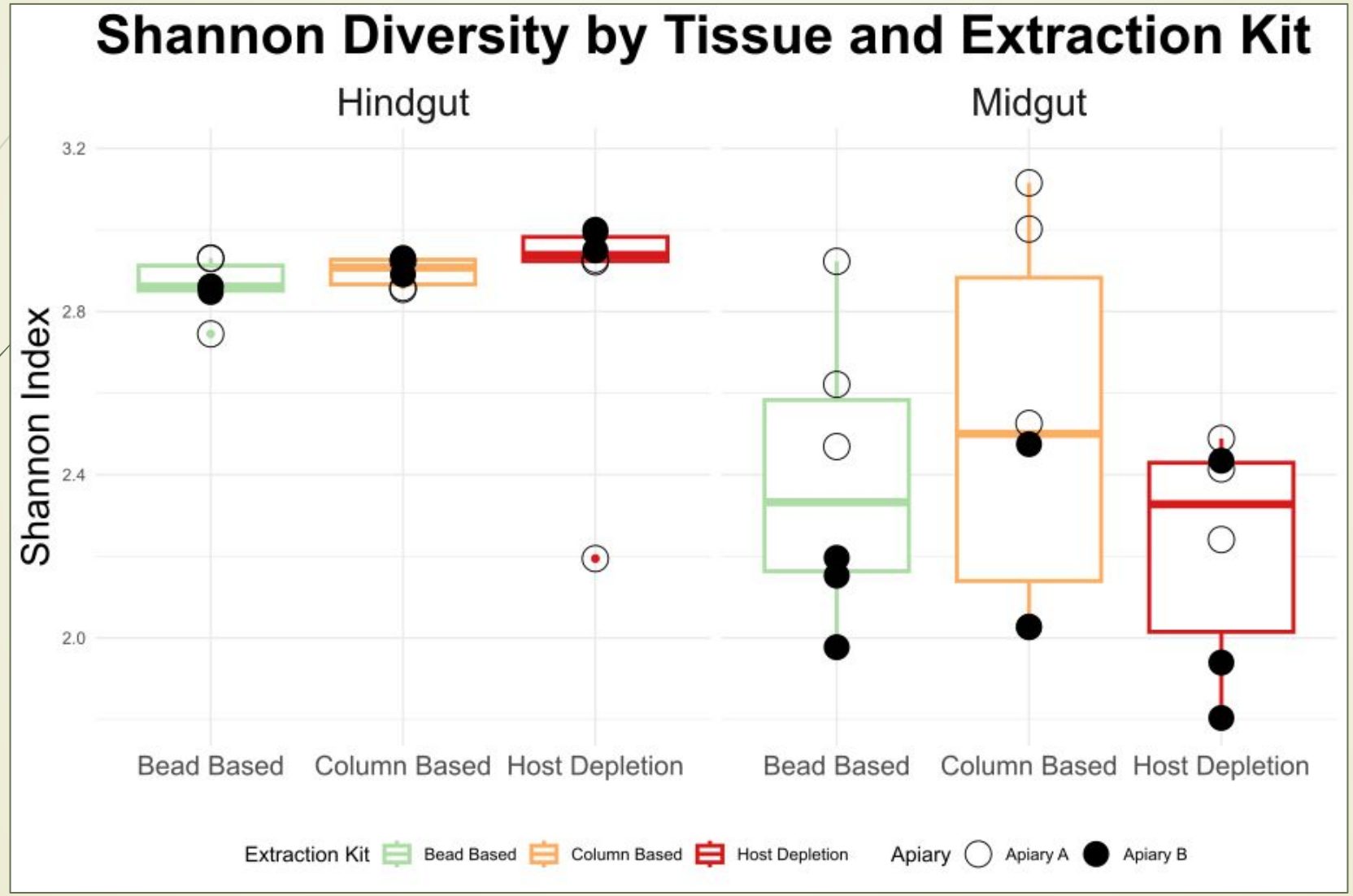


69 MAGs



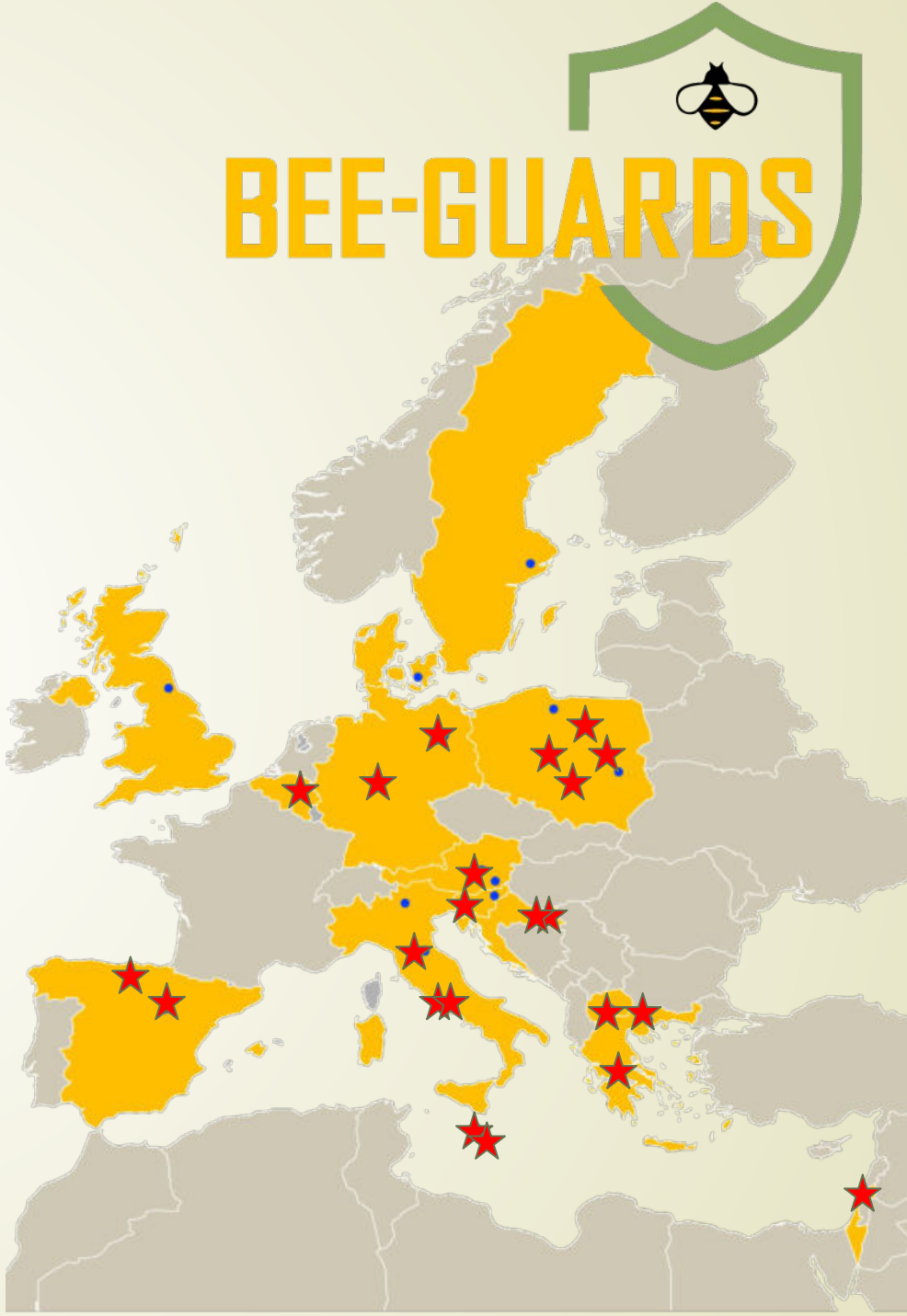
Depletion Success

Host Depletion: No Significant Differences



To Date

- 540 Dissected Guts
- 90 Samples
- Next Week: NovaSeq S2
- October: assembly



Uses of the iBeeMC

Europe Phase 2
2026

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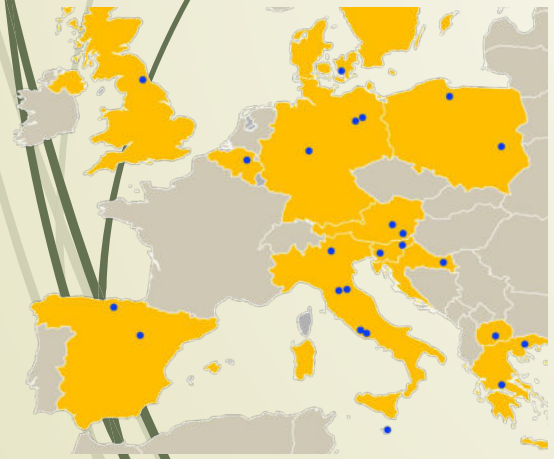
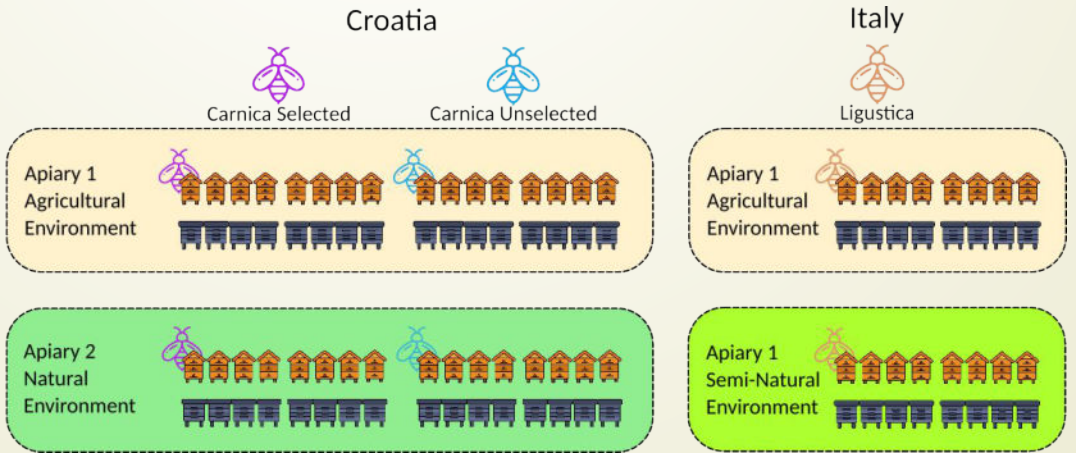


Field Experiment
2024 - 2026

Sveučilište Josipa Jurja Strossmayera u Osijeku
Fakultet agrobiotehničkih znanosti Osijek



Lab Experiment
2026 - 2027

Wrapping Up

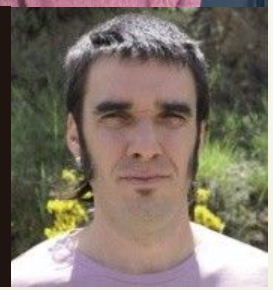
- iBeeMC
- Optimizations:
  - in the lab
  - the computer
- Three levels:
  - Europe
  - Field
  - Lab

Acknowledgements

Applied Genomics & Bioinformatics

EUSKO JAURLARITZA
GOBIERNO VASCO

EHU
Euskal Herriko Unibertsitatea
Universidad del País Vasco



Sveučilište Josipa Jurja Strossmayera u Osijeku
Fakultet agrobiotehničkih znanosti Osijek

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Thank you!

Questions?

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Funded by
the European Union

More BEE-GUARDS!

BEE-GUARDS – an EU project for resilient beekeeping	Cecilia Costa	Hall A1	Wed 14:30	EU Projects
Predicting the impact of Varroa under climate change: An individual based modelling approach	Hollie Pufal	Hall A2	Fri 09:45	Bee Health
Alien species - European beekeeping under "siege"	Cecilia Costa	Hall A1	Fri 11:00	Animal Welfare
Status Report on BeeGuards Innovative Breeding Strategies	Raffaele Dall'olio	Hall A2	Sat 12:30	Bee Biology

And +10 posters
And a booth

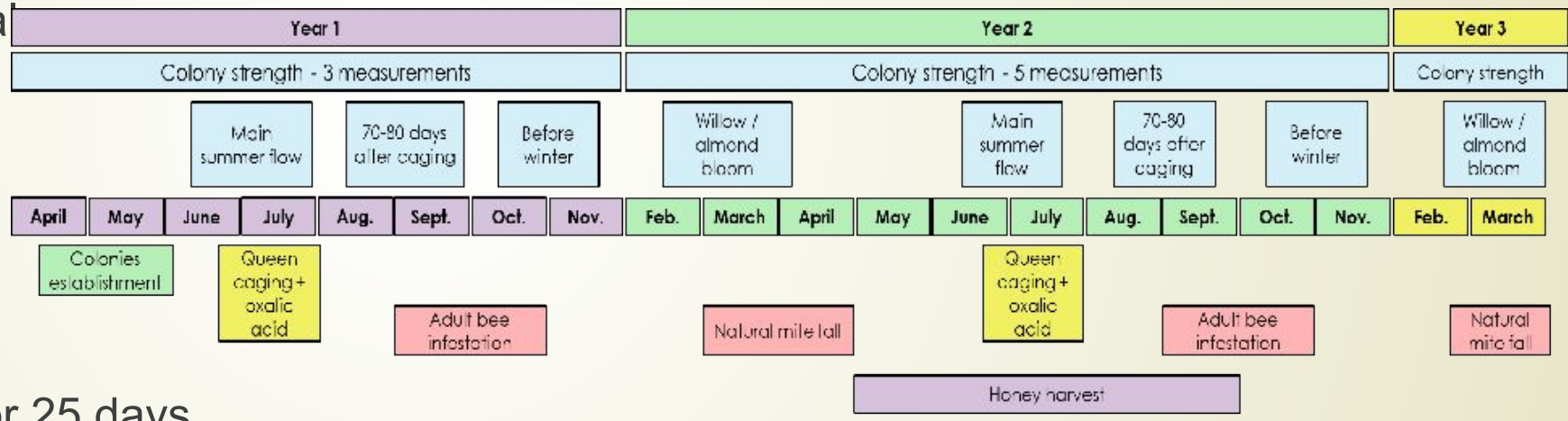
An Innovative Treatment

Conventional

- Regular drone brood removal
- Summer treatment: the usual
- Winter treatment: the usual

Innovative

- No drone brood removal
- Summer: Queen caging for 25 days followed by OA
- Winter: if 3-4% adult infestation, OA

WHY?

Let the hive learn / adapt to varroa while the project lasts