

ABACUSBIO LIMITED
Bridging Science & Business



FutureBees NZ

MBIE genetic improvement
project update

Apiculture NZ 2019



UNIVERSITY
of
OTAGO

Te Whare Wānanga o Otāgo
NEW ZEALAND

The aim of FutureBees

*“To develop and apply tools to **integrate modern genomic selection into honeybee breeding**, enabling New Zealand beekeepers to **rapidly improve honeybee performance.**”*



Why genomic selective breeding?

- Selective breeding can bring gains in productivity and efficiency.
- Better Stocks produce better outcomes
- Genomic techniques can improve speed and accuracy of selection
- This has been demonstrated in many other industries.



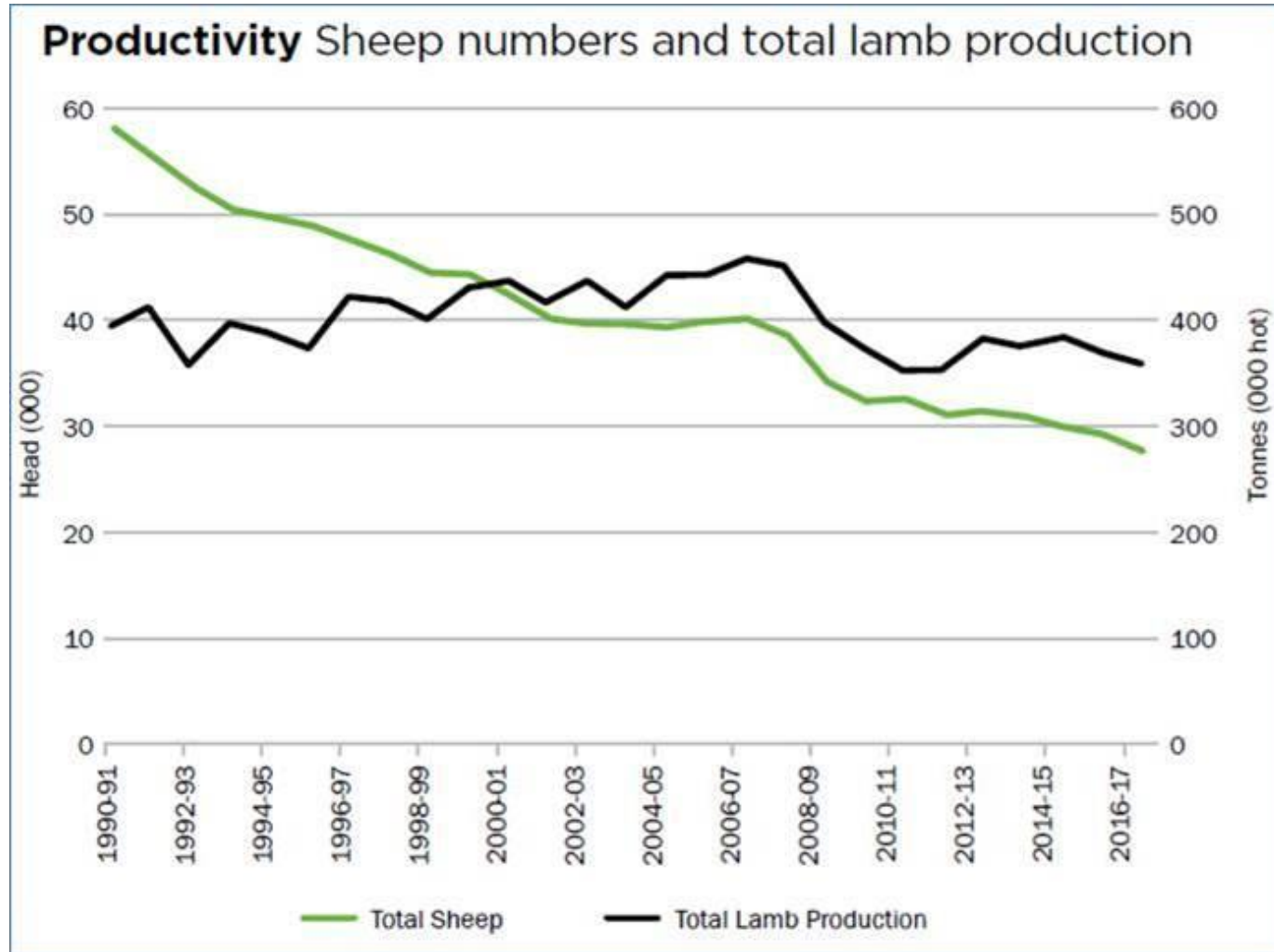
The New Zealand Sheep industry

	1989/90	2014/15	Change
Adult ewes mated	39 mn	19 mn	-51%
Lambs tailed per ewe mated	100%	130%	+30%
Ewe live weight (kg)	52 kg	64 kg	+20%
Lamb carcass weight	14.3 kg	18.6 kg	+30%
Carcass sold per breeding female	12.5 kg	23.9 kg	+91%

Increase in meat sold per ewe	90%
Increase in feed eaten per ewe	43%



Why genomic selective breeding?



<https://futurebeesnz.wordpress.com/>



Why Bee Breeding is not quite like sheep breeding!



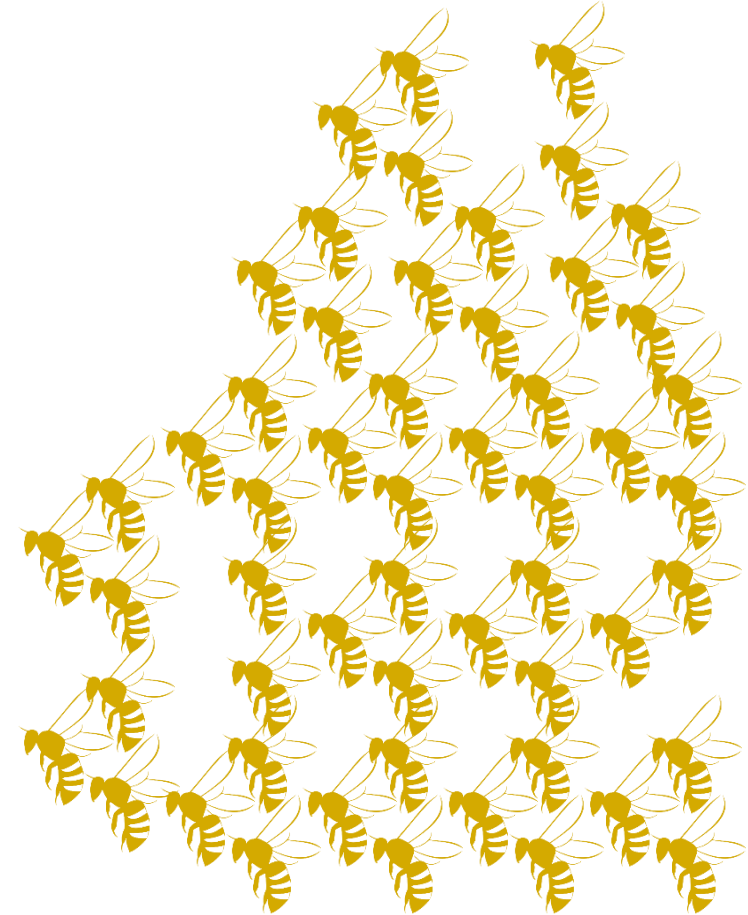
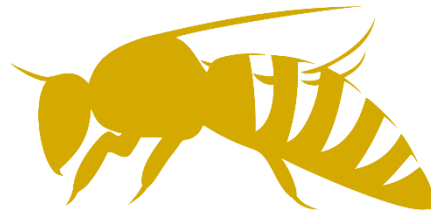
1. Inbreeding bees is a terrible idea (much worse than sheep)



Challenges in bee breeding: Haplodiploidy



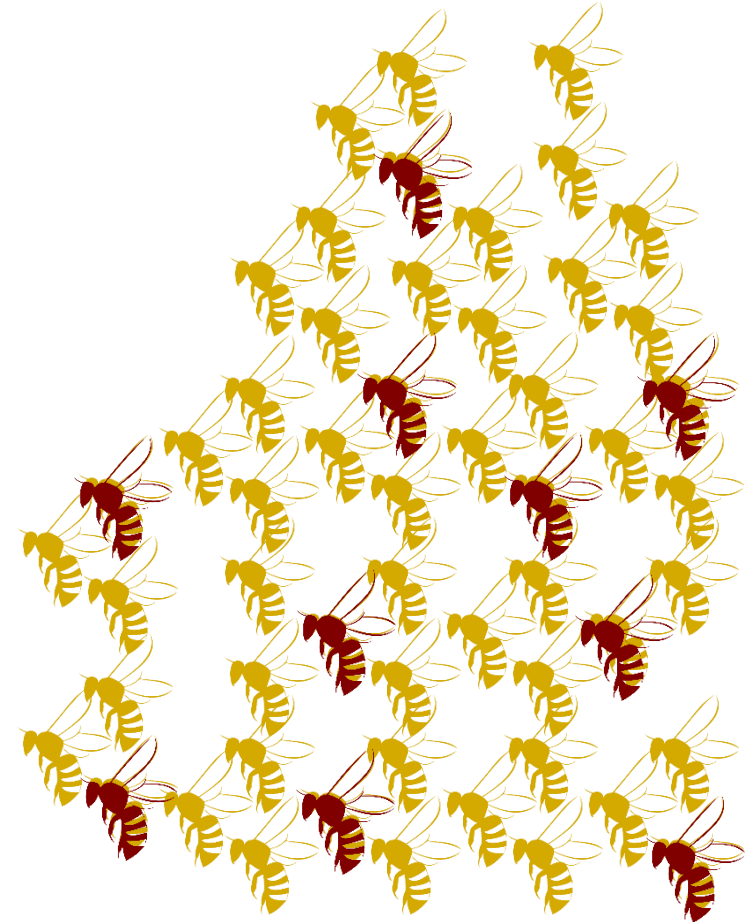
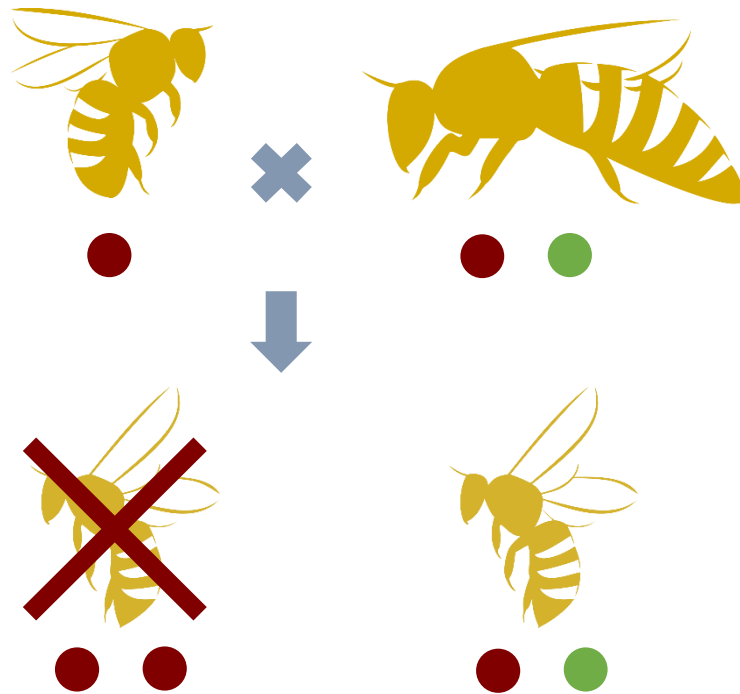
- 🐝 haplo-diploid system of sex determination
 - 🐝 based on the gene *csd*
(*complimentary sex determiner*)



Challenges in bee breeding: Haplodiploidy



 haplo-diploid system of sex determination



Our Solution: Three new genetics tests for *csd* alleles

Why Bee Breeding is not quite like sheep breeding!

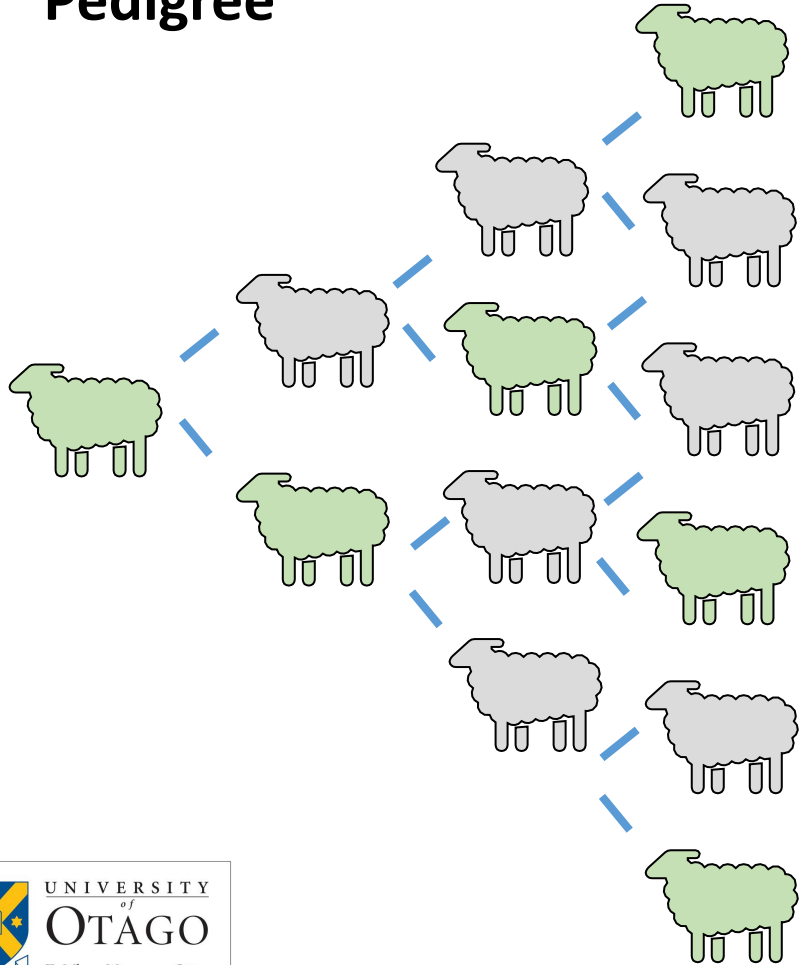


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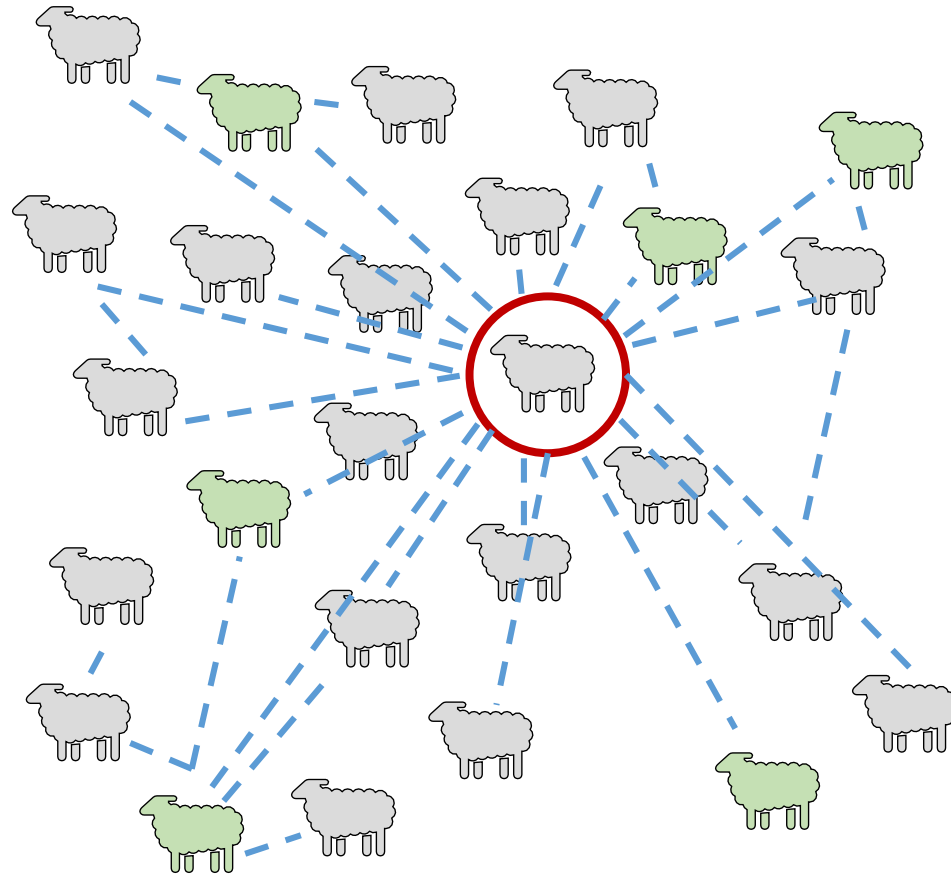
 2. Bee biology (not just haplodiploidy) is challenging

How to achieve accurate selection?

Pedigree

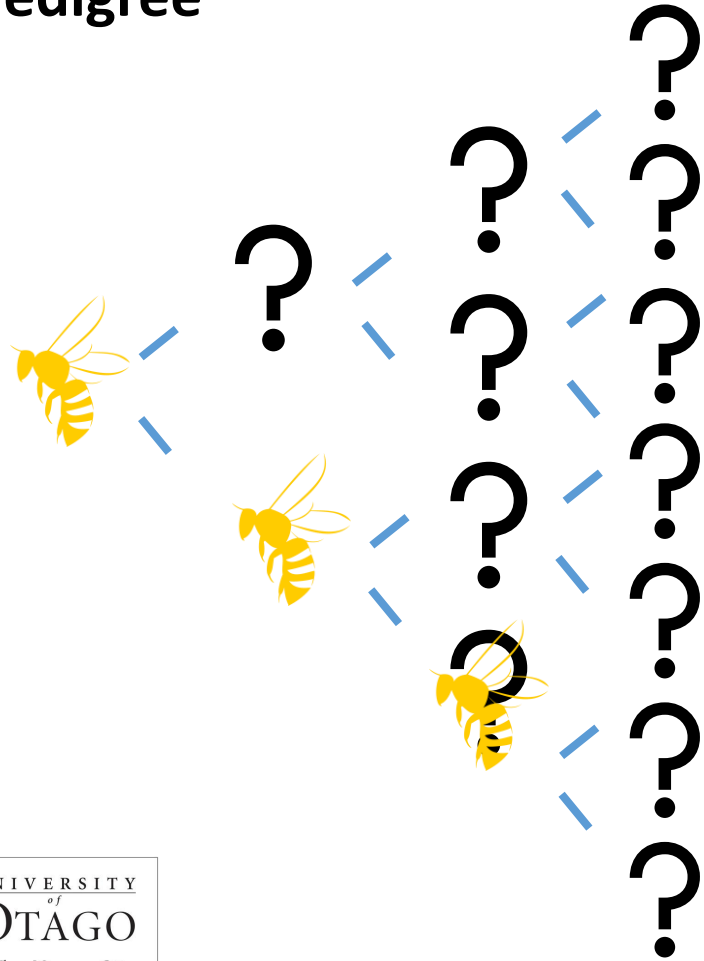


GRM

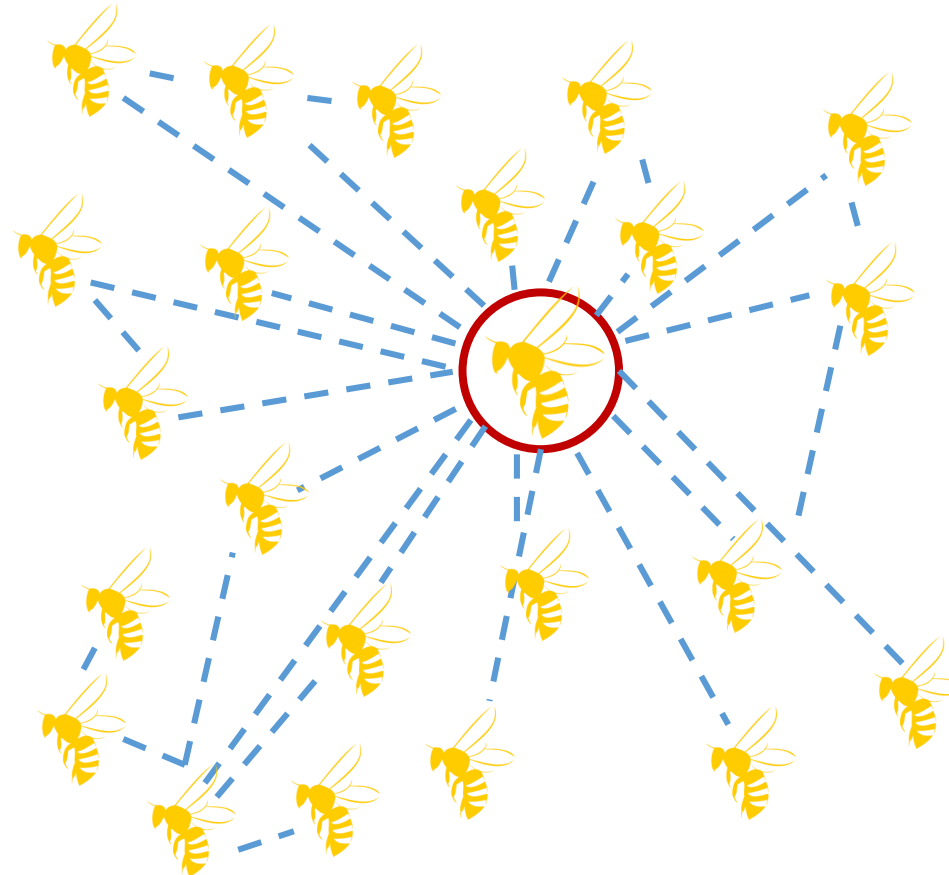


How to achieve accurate selection?

Pedigree




GRM



Our Solution: using whole genome sequencing of individual bees

Why Bee Breeding is not quite like sheep breeding!



1. Inbreeding bees is a terrible idea (much worse than sheep)
2. Bee biology (not just haplodiploidy) is challenging
3.  Bees are very sensitive to the environment.



Genes and the environment

- The phenotype of an organism is defined by the interactions of its genes, and the environment.
- Phenotype (P) = Genotype (G) + Environment (E)
- If the influence of the environment is high, it makes it hard to determine the influence of genes and then to change that by selection.

Our Solution: New ways of assessing nutrition and pathogen load

<https://futurebeesnz.wordpress.com/>

Why Bee Breeding is not quite like sheep breeding!



1. Inbreeding bees is a terrible idea (much worse than sheep)
2. Bee biology (not just haplodiploidy) is challenging
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4. Phenotyping bees is hard

Phenotyping and new traits



Our Solution: Trialing various types of automated phenotyping

<https://futurebeesnz.wordpress.com/>



Not picking genes

- One common misunderstanding of what we do is that we are finding genes FOR traits.
- While this is academically interesting it's a bad idea in selective breeding
 1. Most traits we care about are polygenic
 2. Selecting an organism for one trait leads to bees that can't do other important things

Selection involves Trade-offs

We aim to select for bees that are the most economically valuable to you.

That's why we are asking YOU what you want in a bee, and what you might trade-off to achieve that

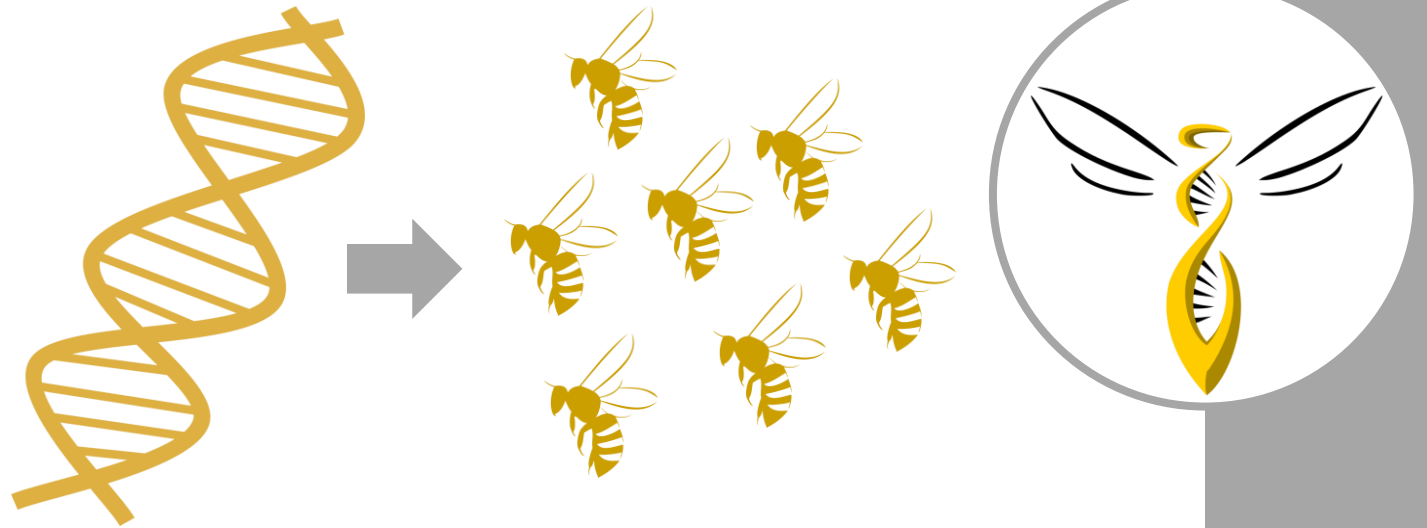


FutureBees project steps

1. Define the genetic merit of candidates for breeding based on:



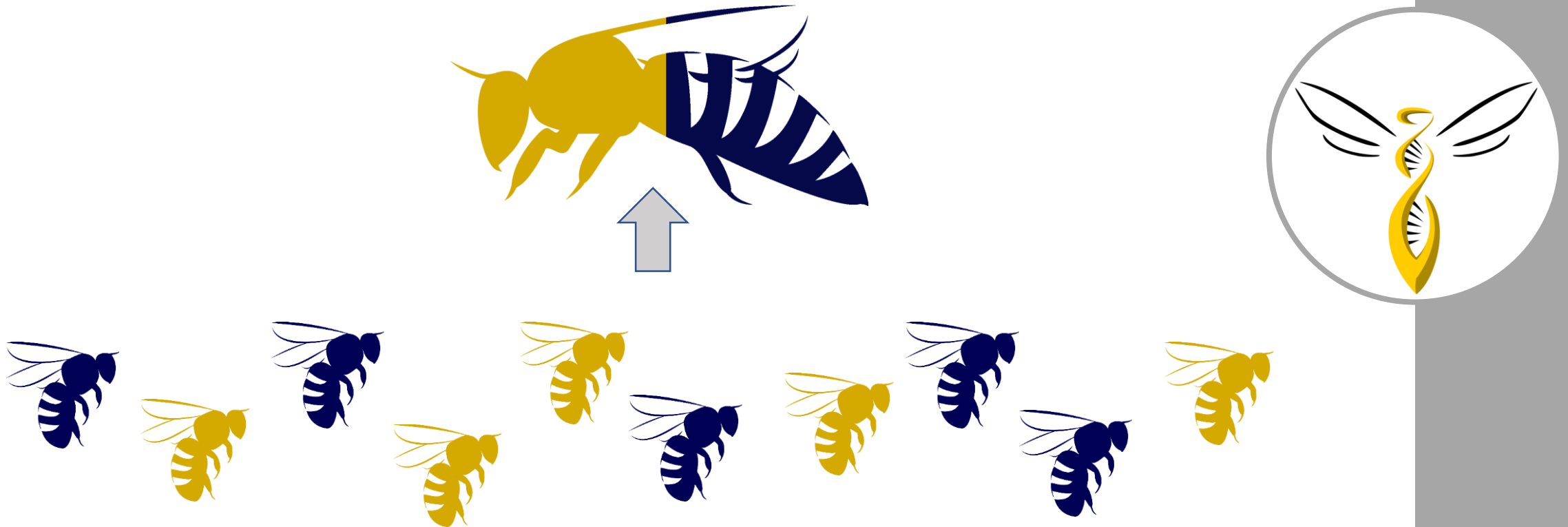
performance



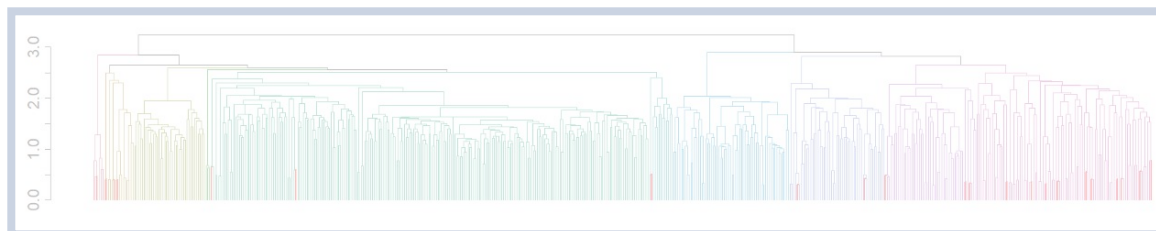
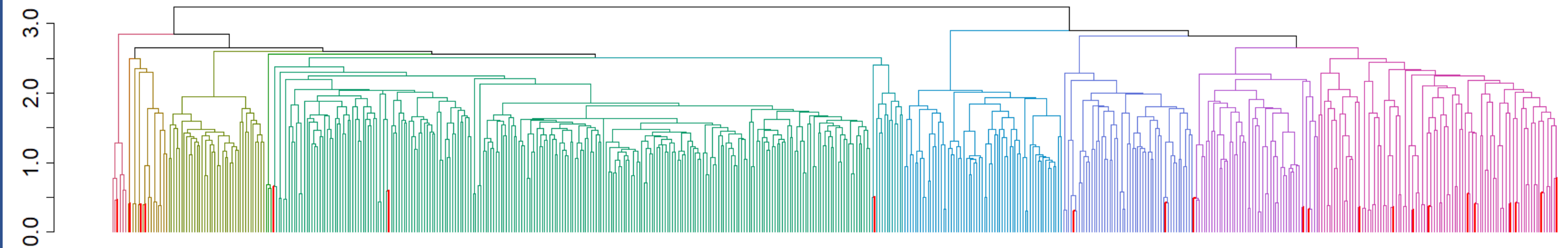
genetic relationships

What has been done so far?

Genetic diversity



What ha



FutureBees project steps

2. Select & breed the best candidates



elite queen breeder



genetics consultants



What is a breeding objective?

The breeding objective defines the
goal of a breeding program.

It defines the **ideal individual**
that we are trying to achieve.



The basic honeybee breeding objective



honey yield



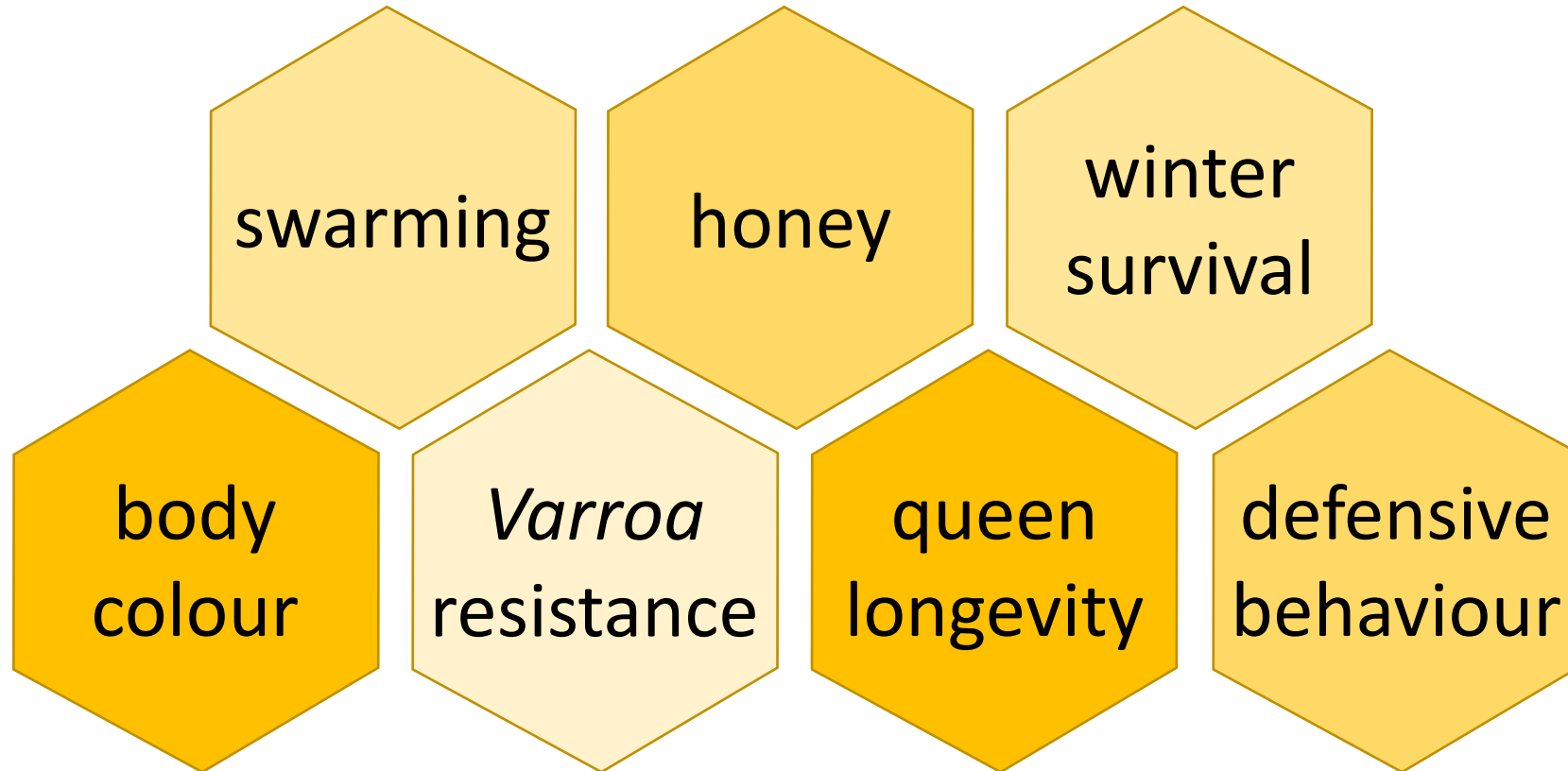
gentleness



winter survival



What are you looking for in a queen?



The breeding goal survey

Visit **futurebeesnz.wordpress.com** and

*tell us what **you** want improved in New Zealand bees!*



FutureBees project steps

3. Test improved genetics in commercial conditions



4. Develop new traits (e.g. pollination, disease resistance)



What do we want to leave you with?

- An accessible and affordable way to determine the quality of **your** bees to support **your** decision making
- A system to help **you** access the bees **you** need to improve **your** stock (something supported by levy payments in equivalent industries)
- A national bee stock that is more efficient and robust which allows **you** to do more with less





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www.futurebeesnz.wordpress.com