Activity four: Hive health surveillance system

Hive health is complex but crucial

Healthy hives improve our **food security**, **biodiversity**, and even **individual wellbeing**

Honeybees have experienced declines in many parts of the world
Contributing factors include:

Nutrition
Agricultural Chemicals
Hive management
Climate
Pests and Diseases

Factors interact with each other:
Hives that experience stress from one factor may be less tolerant of pest and disease incursions

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Protecting our pollinators

Rapidly responding to pests and diseases in individual bee hives

Monitoring system

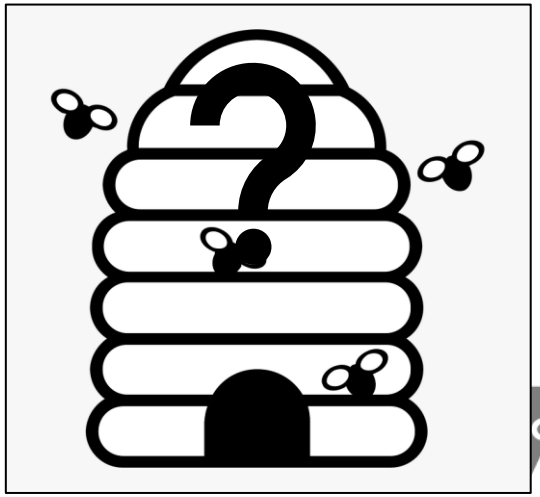
Exotic pests
Established pests
Other measures of hive health
e.g., Beneficial microbes

eDNA High throughput Sequencing

Traceability

Tracking individual hives
User friendly
Links to other data platforms
e.g., Orchard traceability system or BeeMAX

Hive tracking devices



The '*buzz*' on eDNA metabarcoding

Environmental DNA

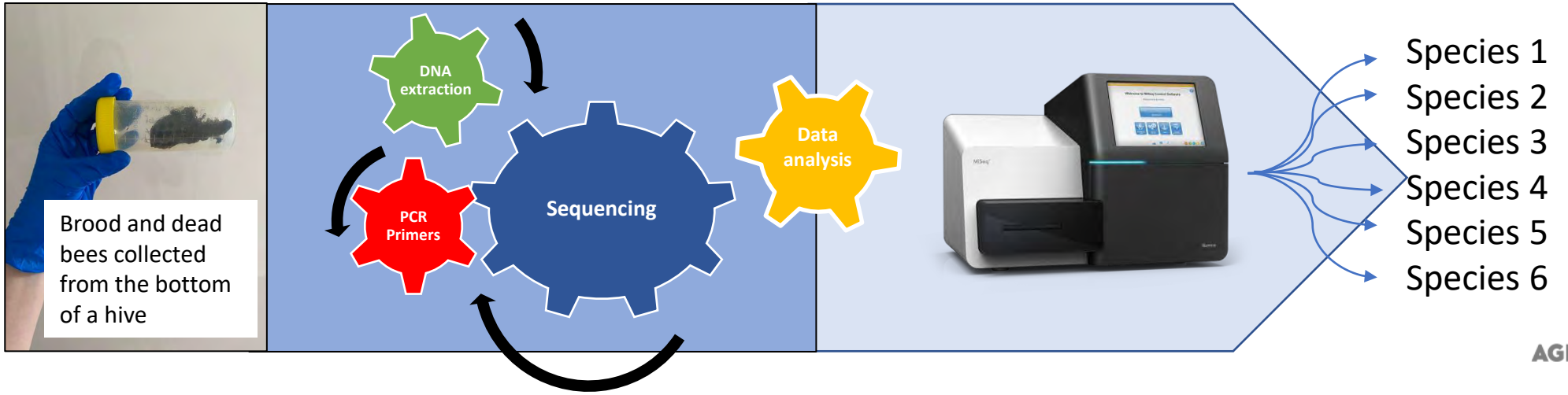
- When species interact with their environment they leave behind traces of DNA

e.g., faeces, shed skin or exoskeletons, mucus, hair, or body parts

- Can be found in soil, water, or even the air

Metabarcoding

- Species identification using sections of DNA (animal, plant, bacteria, or fungi)



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How eDNA metabarcoding might monitor hives

Exotic pests and diseases

- eDNA was used to first detect North American bullfrogs in French ponds

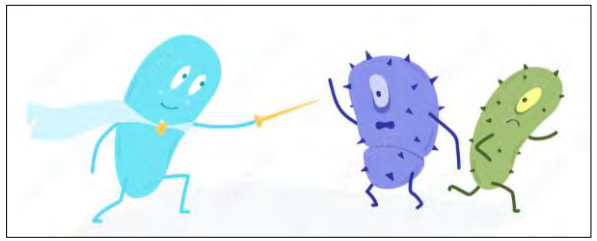
- eDNA trials on ethanol- washes for Varroa mite in NZ (Francesco Martoni)

Established pests and diseases

- Provide beekeepers with information on the health of their hives

- What symptoms should they watch out for if a pest or disease is detected?

Beneficial microbes in bee guts or the hive

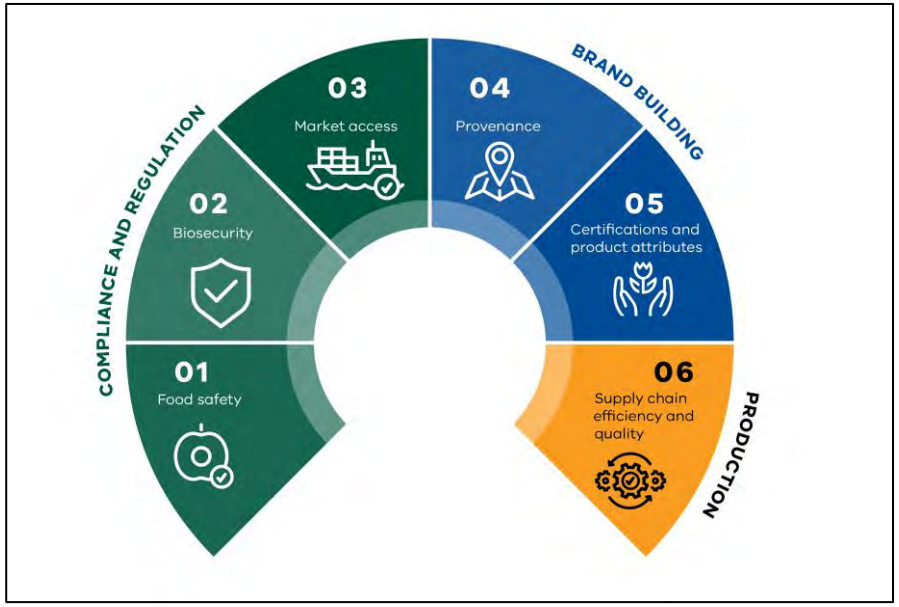


- Beneficial microbes might improve nutrition, help defend against pathogens and/or help detox pesticides (Motta et al., 2022)

- Research is linking bee gut bacteria to bee health (Raymann & Moran, 2018)

Traceability matters

Track hive movement, contact trace exotic incursions, and/or identify poisoning events



Hives used for pollination visit different farms during the season

- Exposes hives to different environments including pests and diseases
- Exposes hives from different apiaries to one another
- Exposes hives to agricultural chemicals

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What have we done so far?

Selected four hives
Two trackers in each hive
- GPS
- Temperature
- Humidity

DJPR Smart Farm -> Irymple farm

Collecting samples for eDNA metabarcoding every two weeks
- Debris from the bottom of the hive
- Insects
- Brood
- Dead bees
- Wax

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Next steps

Trial different trackers

- Trackers tested so far are not user-friendly and have short lifespans

Continue sampling hives and speaking with apiarists

Linking data to on-farm data platforms

- Orchard traceability system

Processing hive samples for eDNA metabarcoding

- Insects
- Fungi
- Bacteria

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Things to think about

Minimise hive disturbance

- Sampling and tracking devices

Apiarist privacy

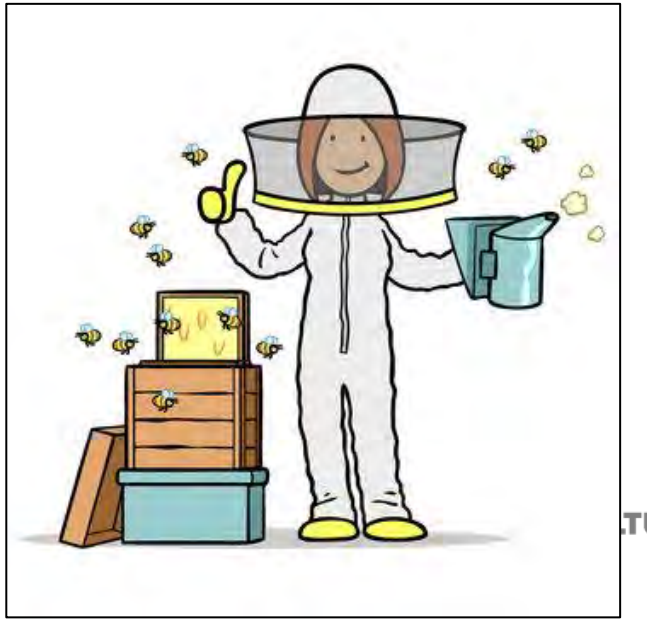
- Protected and feel safe using any end products

Monitoring needs to be user-friendly and benefit apiarists

- Provide information on hive health

How do we define a hive?

- Apiarists may swap frames/components between hives
- Bees can enter the wrong hive

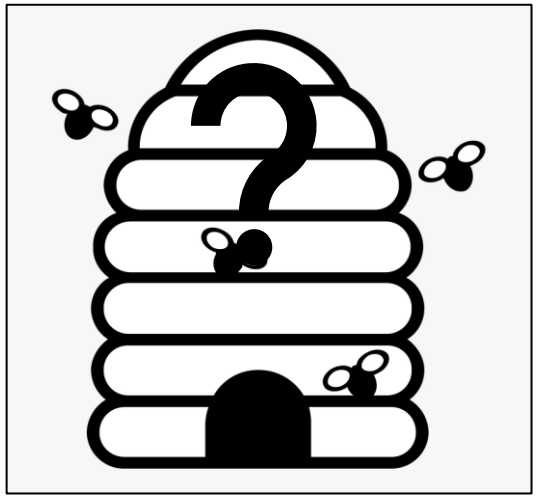


Summary

Hive health is complex but crucial

Monitoring
- eDNA and metabarcoding

Traceability
- Tracking devices
- On-farm data platforms



Currently tracking and monitoring four hives

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