Weed surveillance using environmental DNA collected from honeybee (*Apis mellifera*) hives

What are the plant density and distance limitations?

Erin Hill, Liz Milla, Francisco Encinas-Viso, Ben Gooden, Mariana Hopper, Harry Eyck, Peter Jones, John Roberts

Honeybees actively and passively collect DNA from the environment

Using hive eDNA samples to find weeds is a new application of this technology

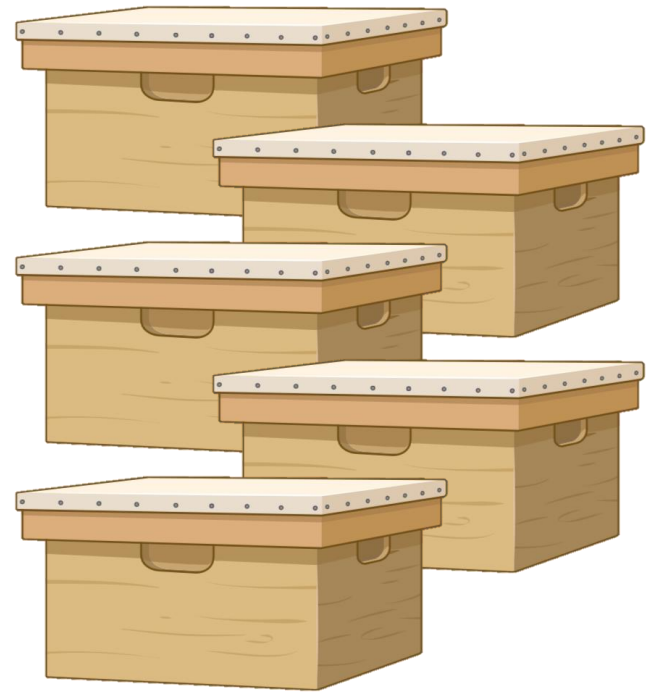
What does a positive weed detection mean?

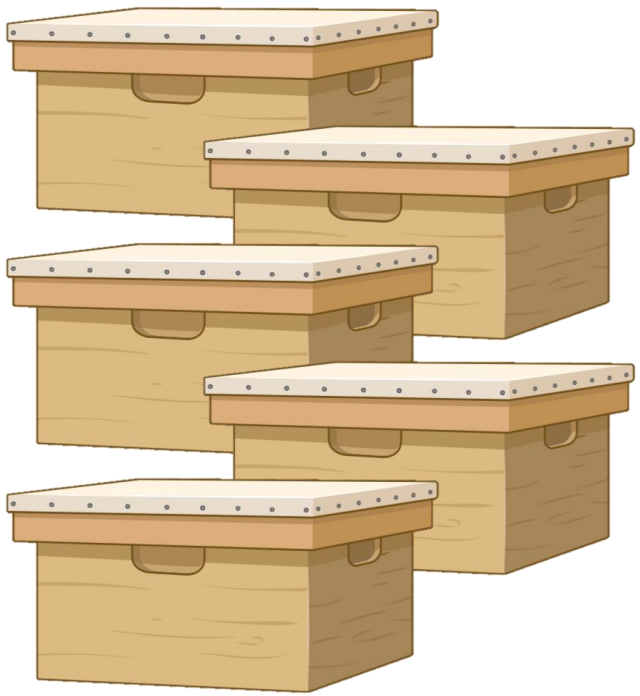
Can we detect rare weeds?

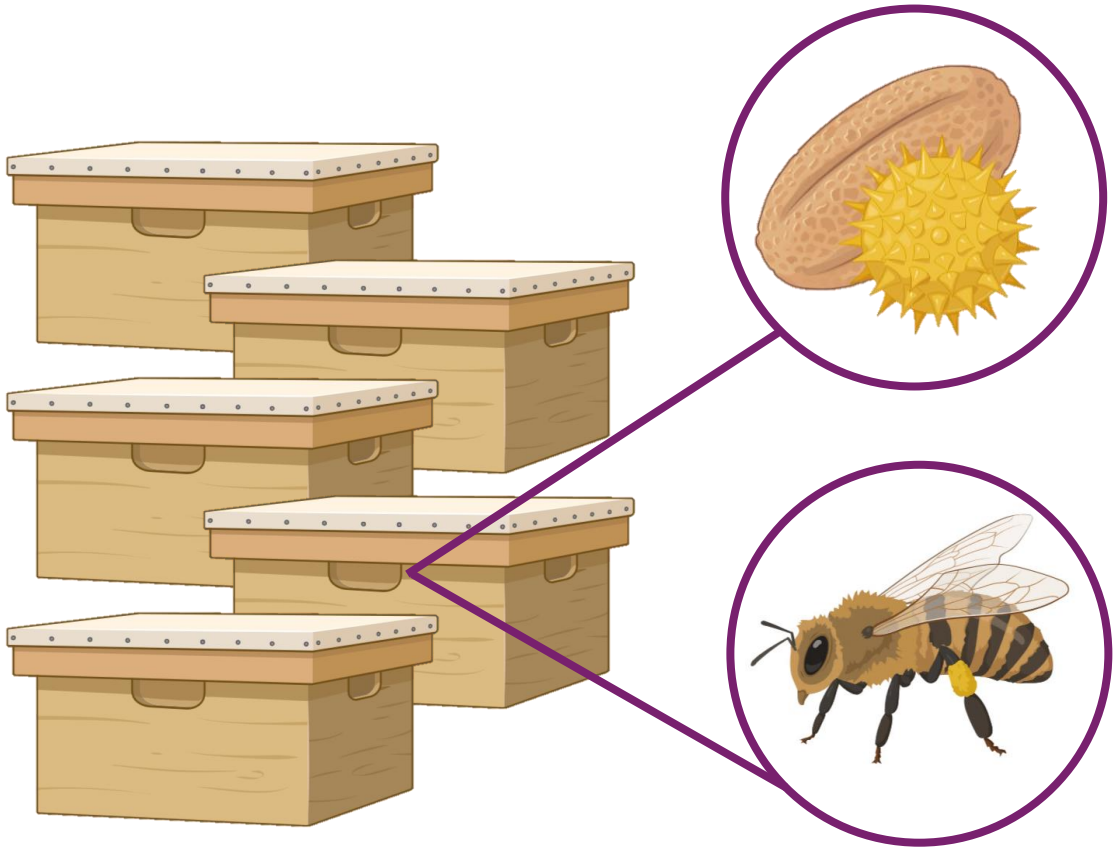
Can we detect weeds that are far away?

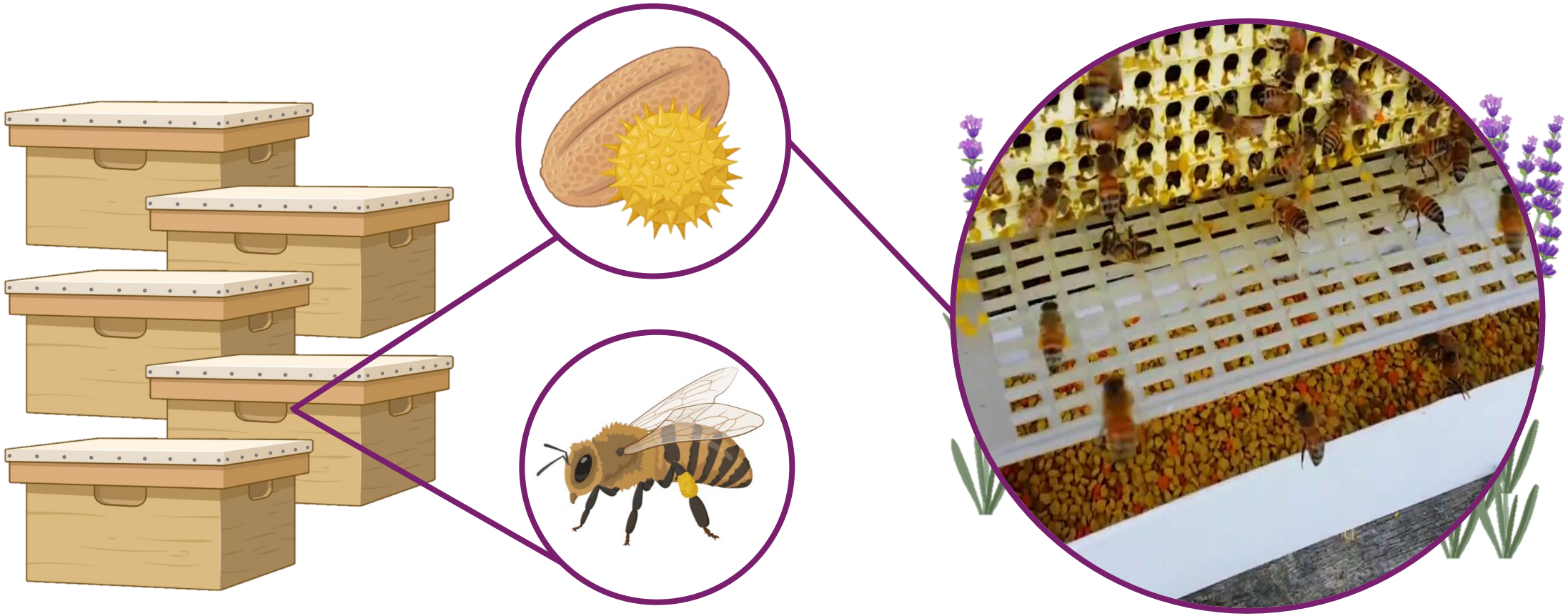
Part 1: Manipulate density and distance of novel plants over several weeks

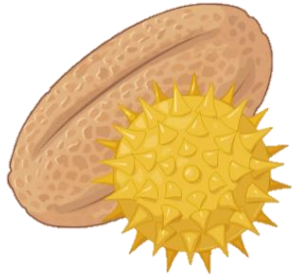
Part 2: Floral surveys to find rare/distant plants already in the environment

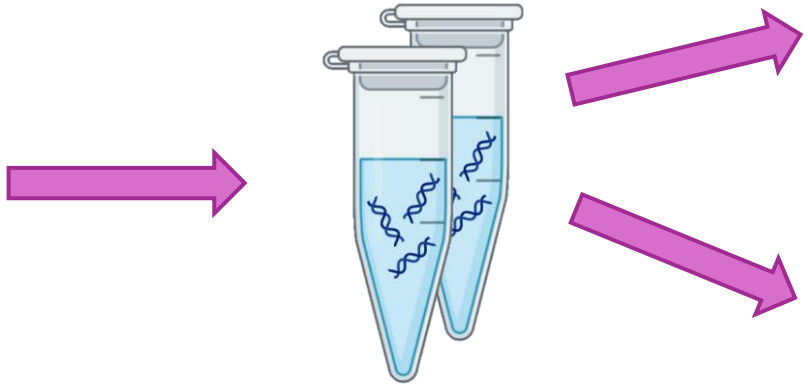




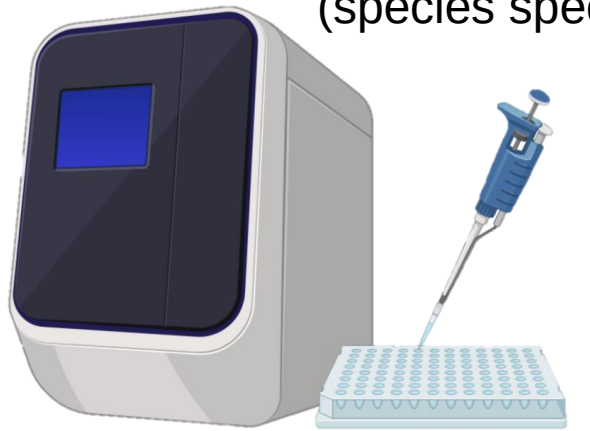








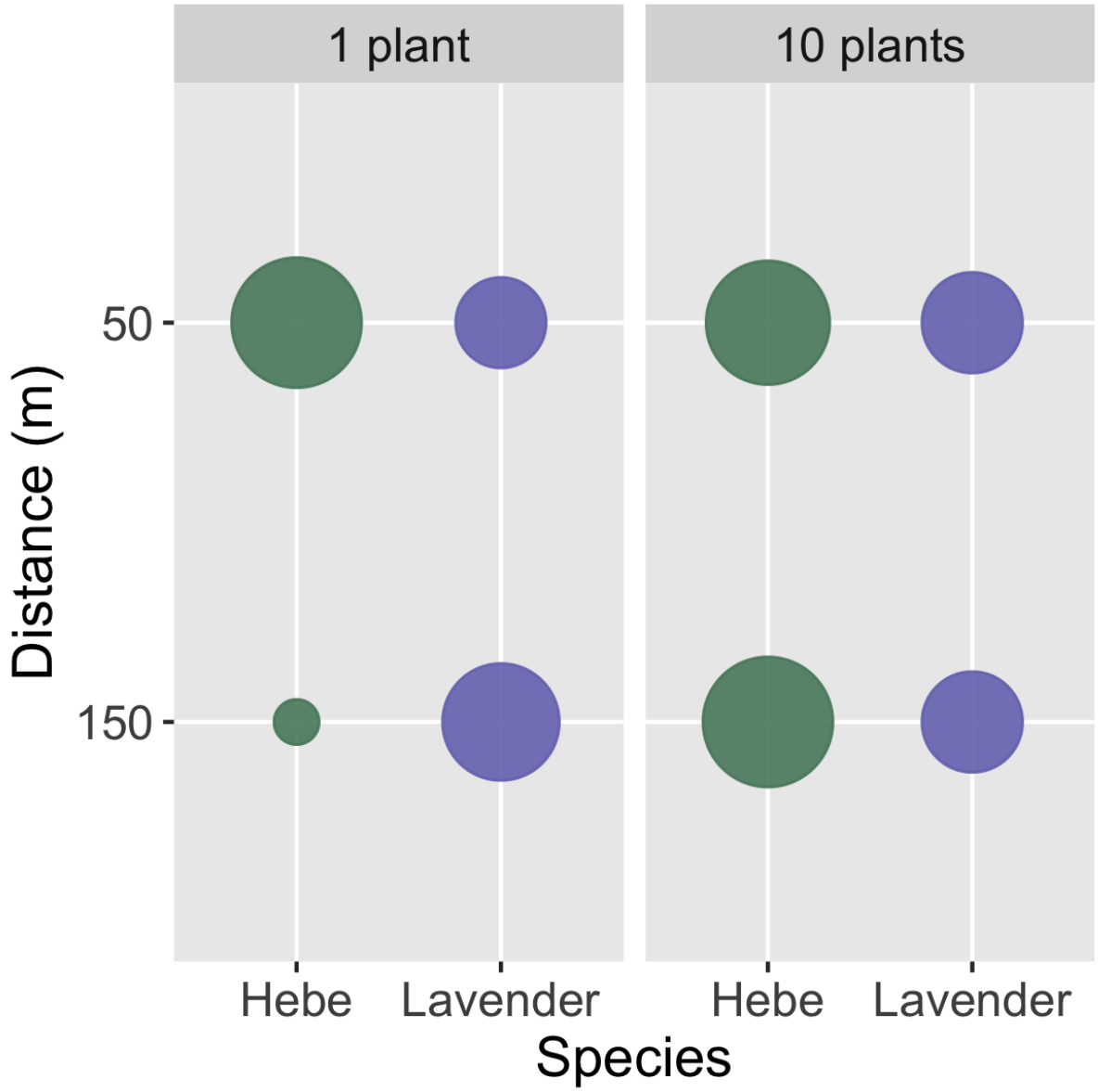
qPCR
(species specific)



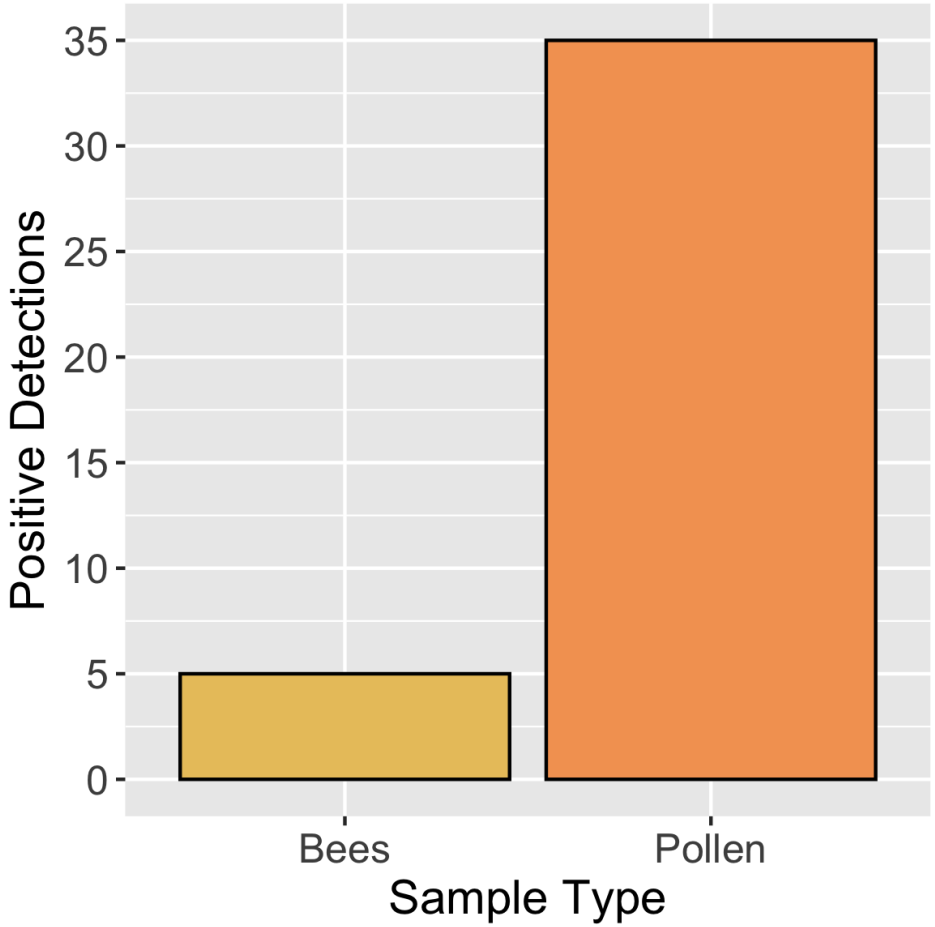
Metabarcoding
(multi-species)

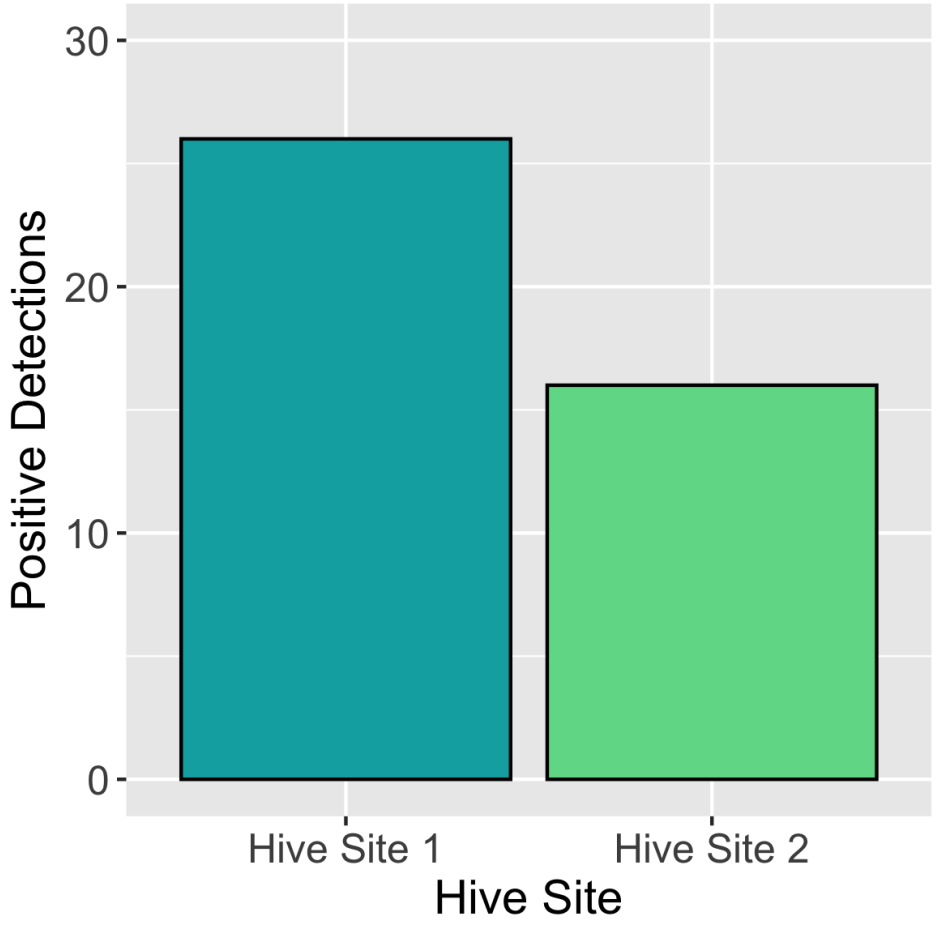
We were able to detect a single plant 150 m away within 24 hours…

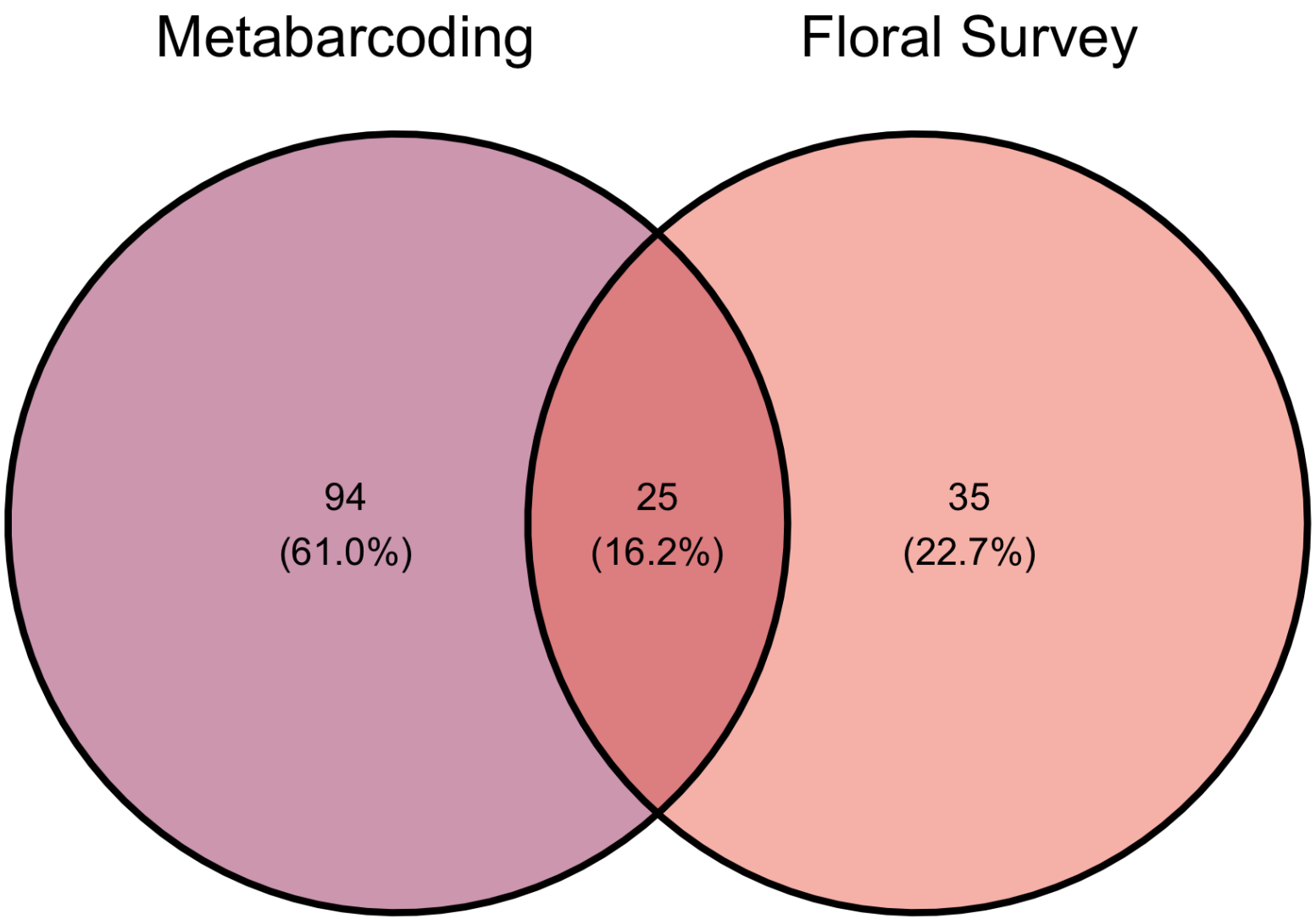
…but no plants were detected at distances >150 m

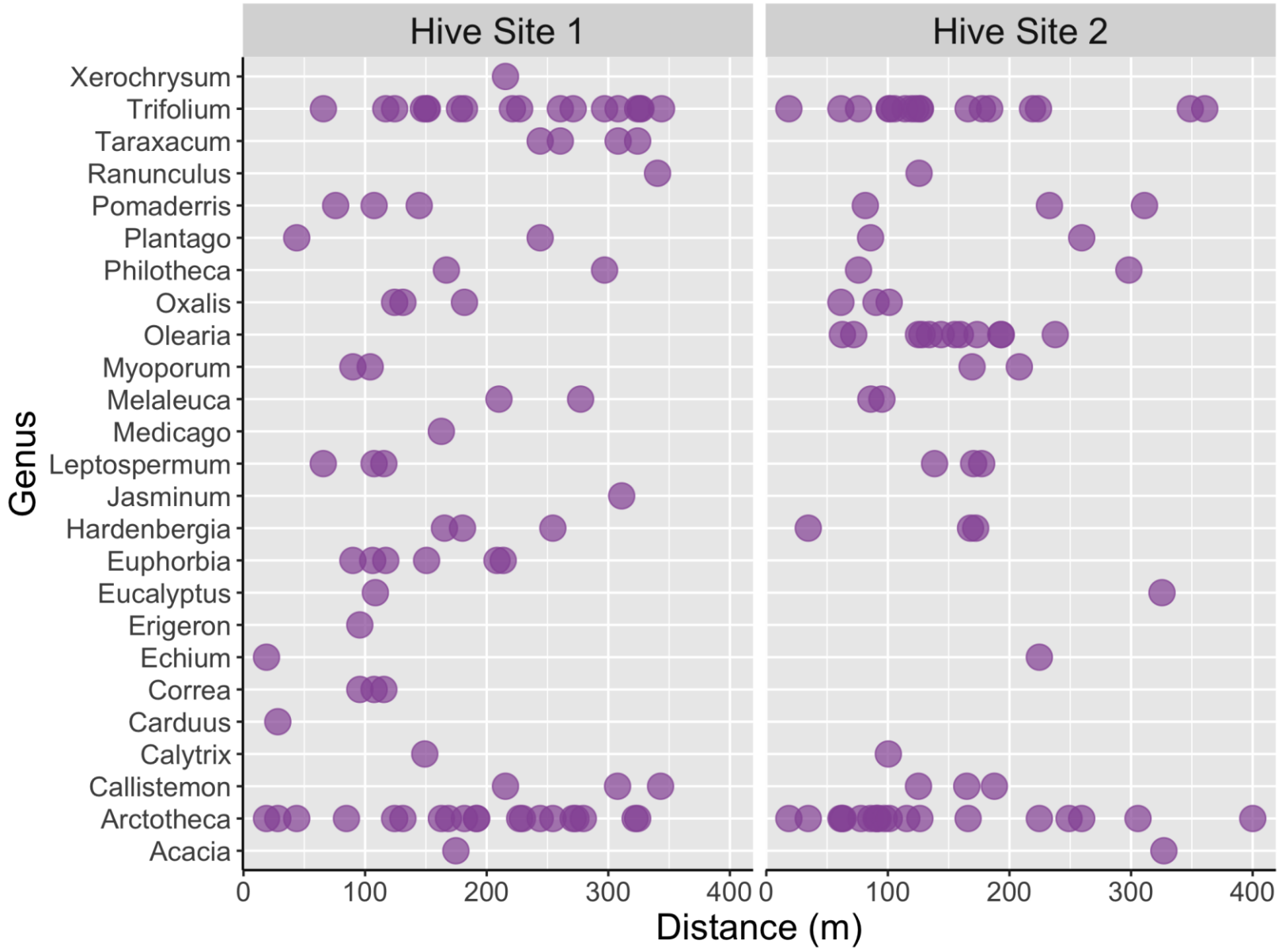


Positive qPCR detections were significantly affected by hive site and sample type



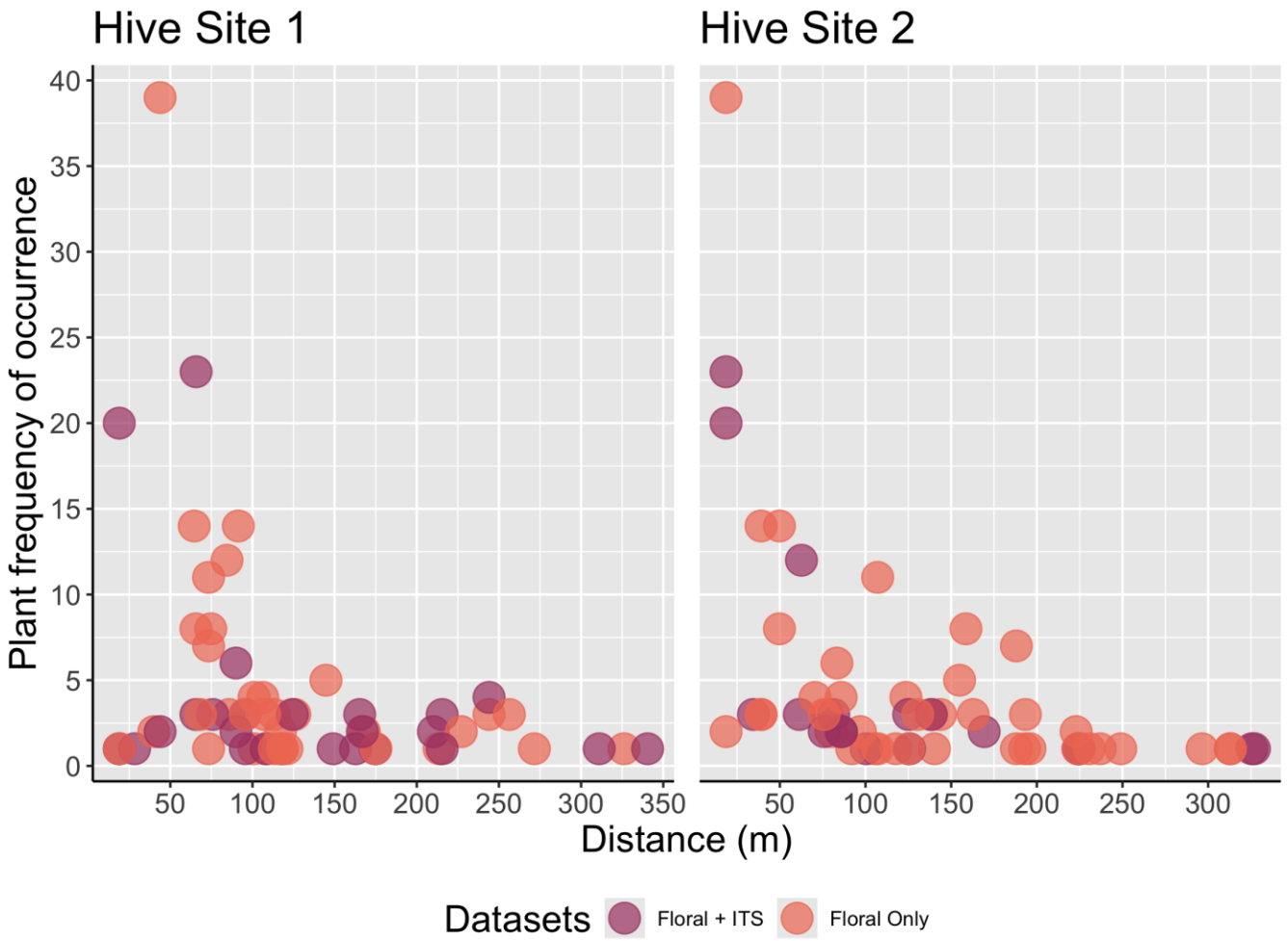



Metabarcoding
Floral Survey
94
(61.0%)
25
(16.2%)
35
(22.7%)

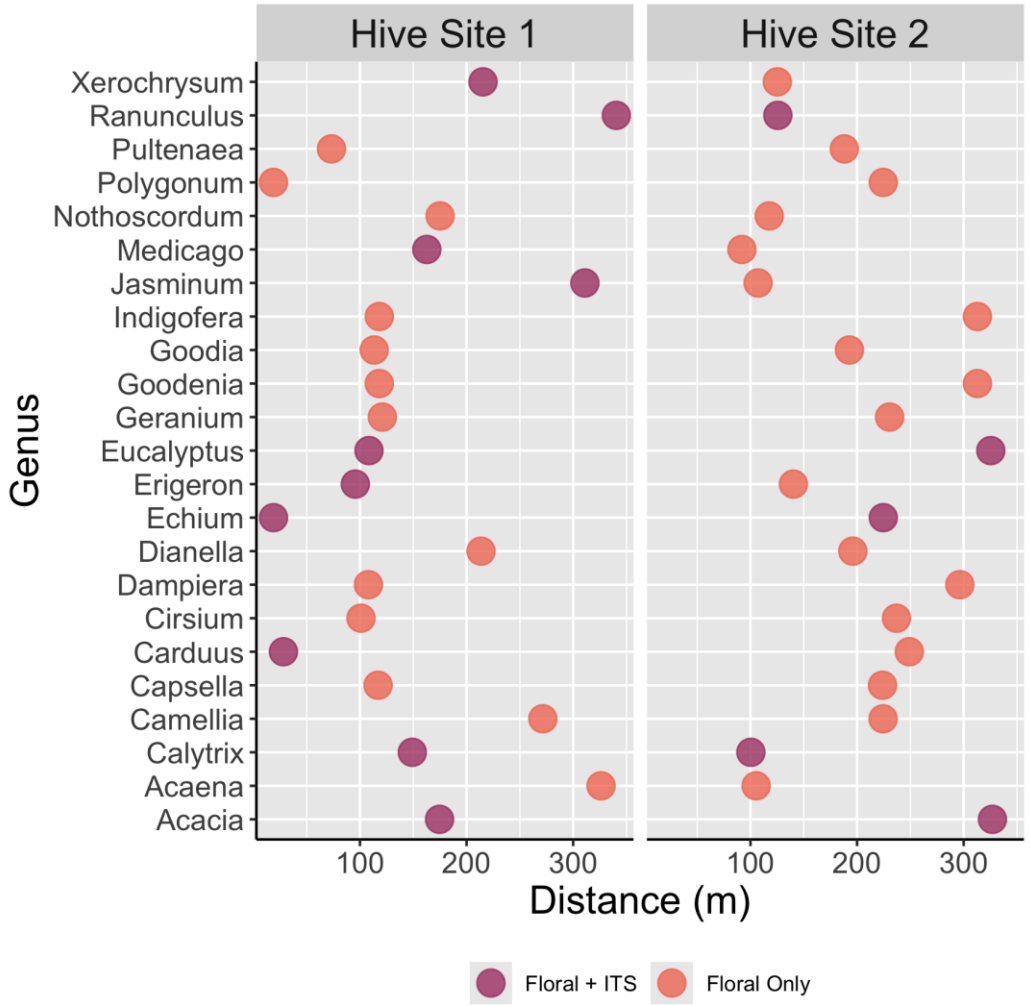


Max distance: 340.49 m

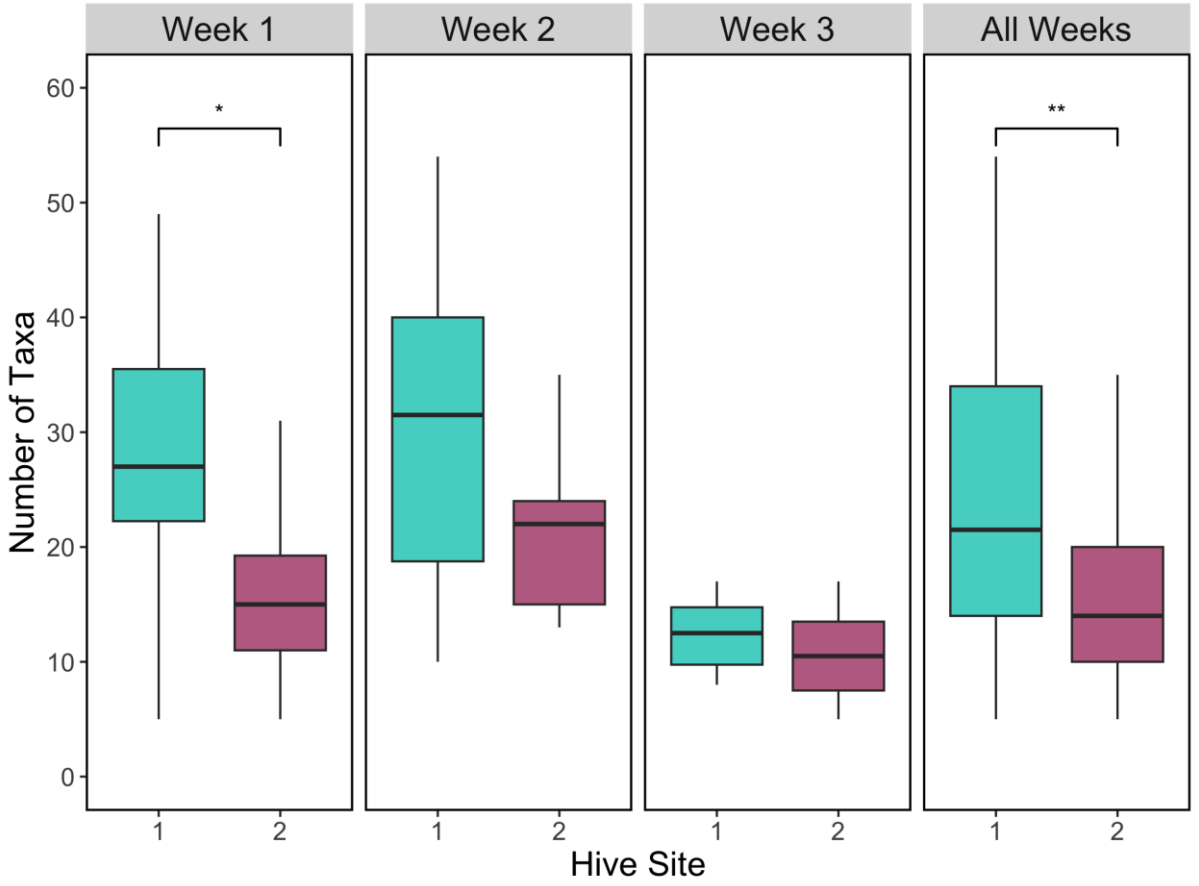
Metabarcoding detections cover the same range as the floral surveys



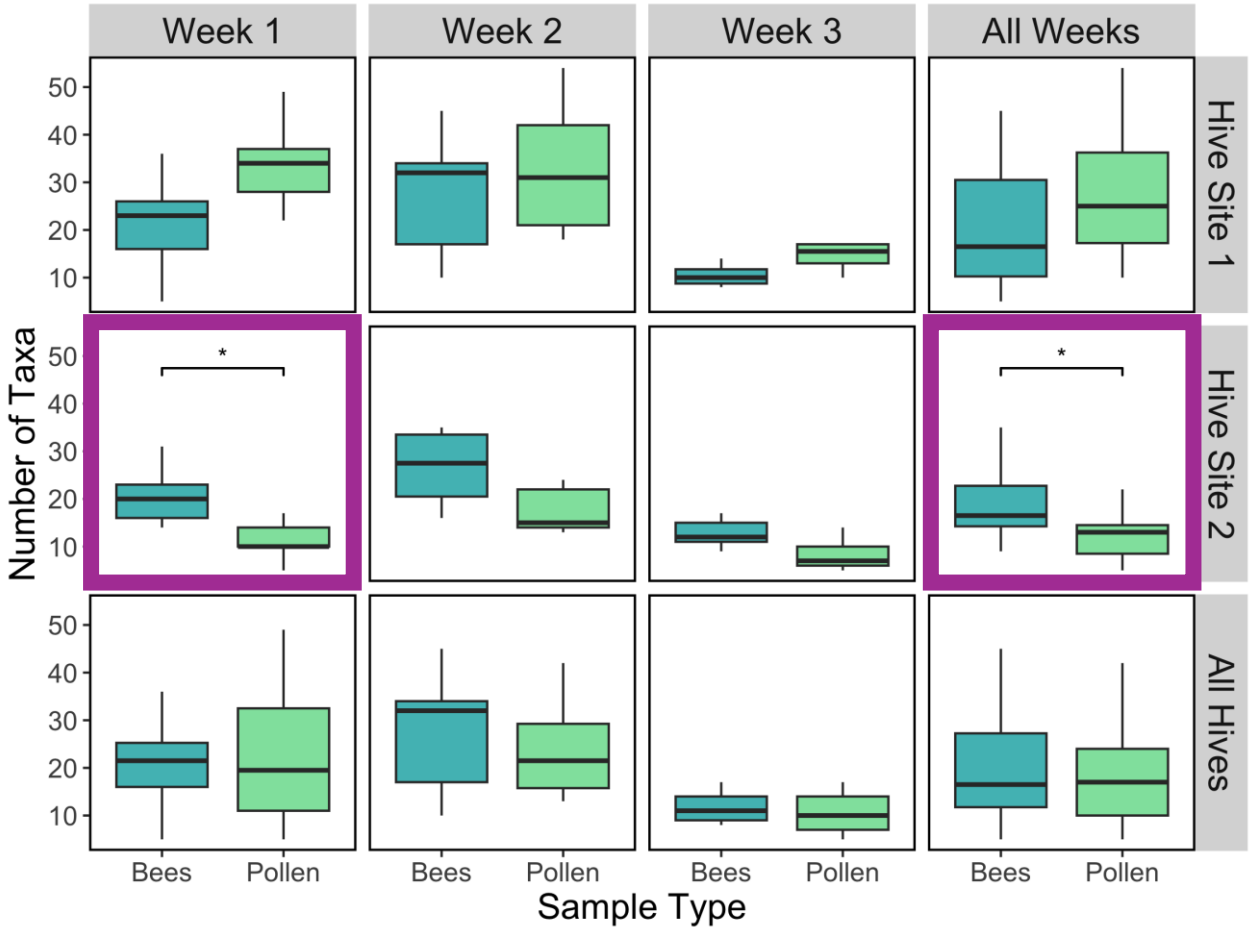
Low density plants could be detected via metabarcoding



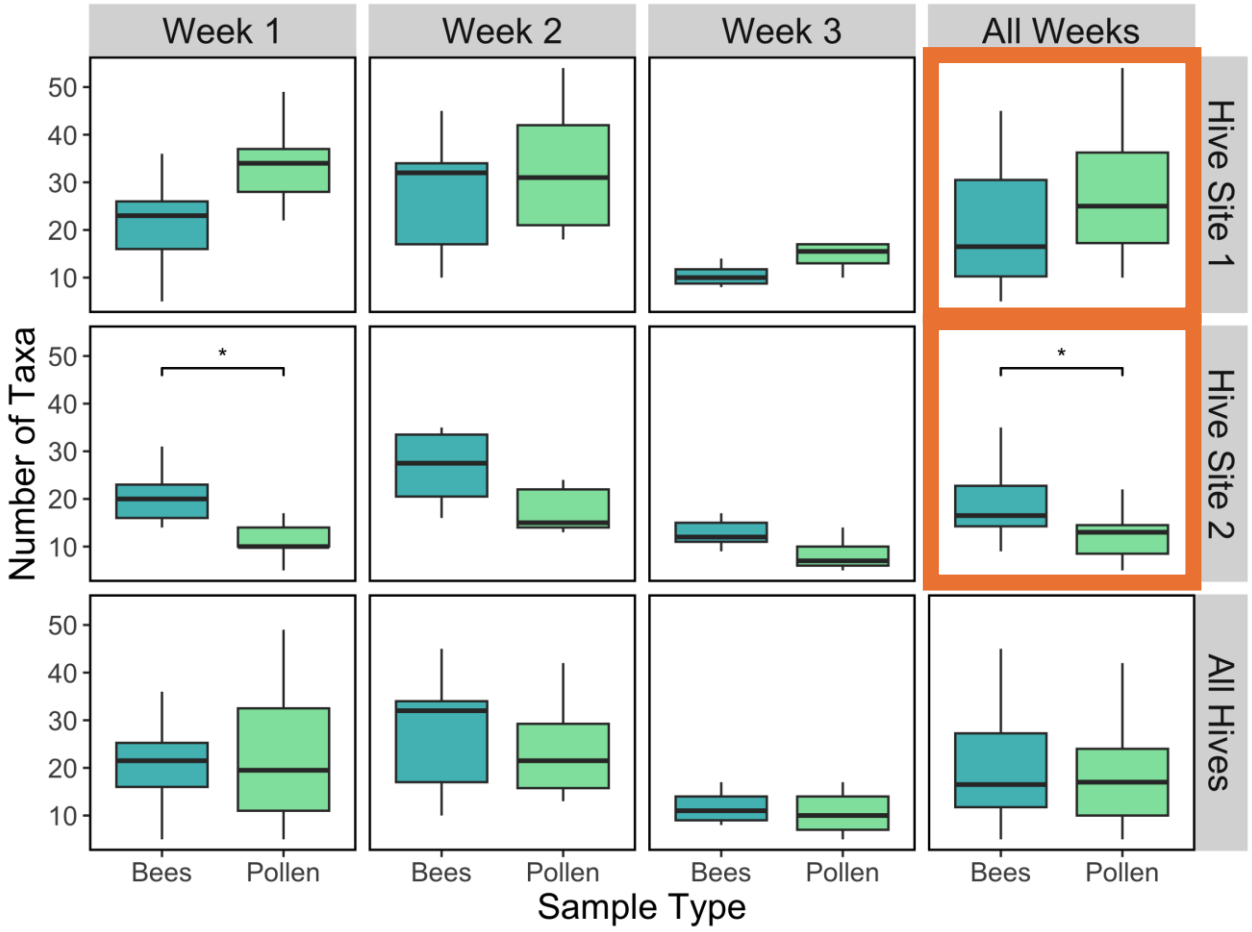
Significant differences in plant detection due to hive site



Significant differences in plant detection due to sample type



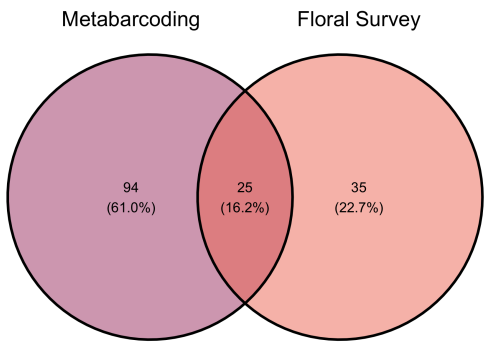
Significant differences in plant detection due to sample type



What does a positive weed detection mean?

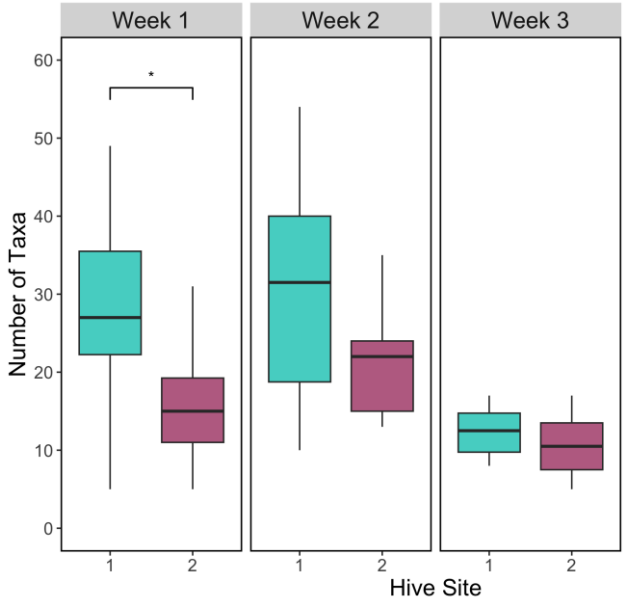
Can we detect rare weeds? ✓

Can we detect weeds that are far away? ✓



What's up with hive site 2?

- Newly established hives for this project

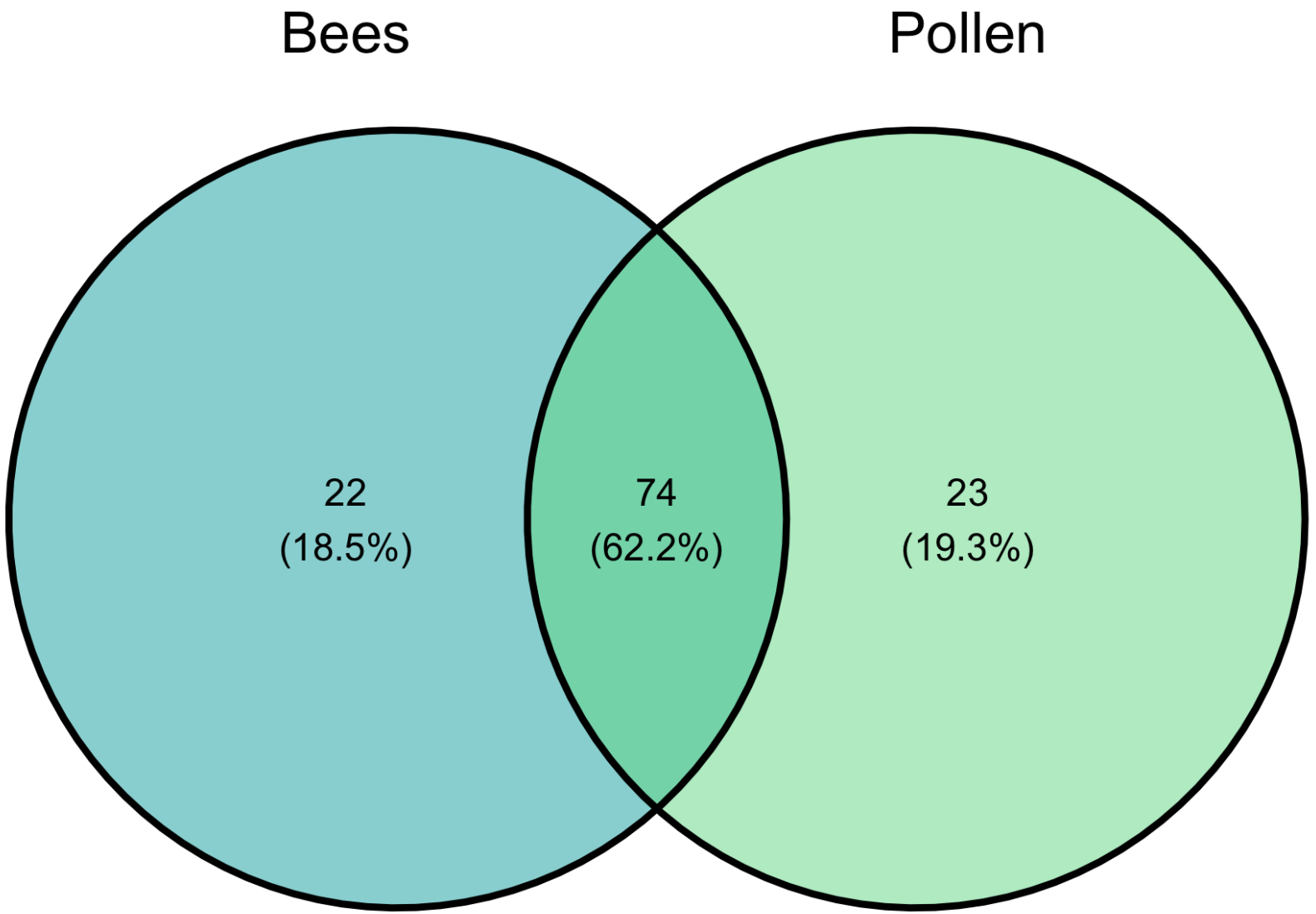


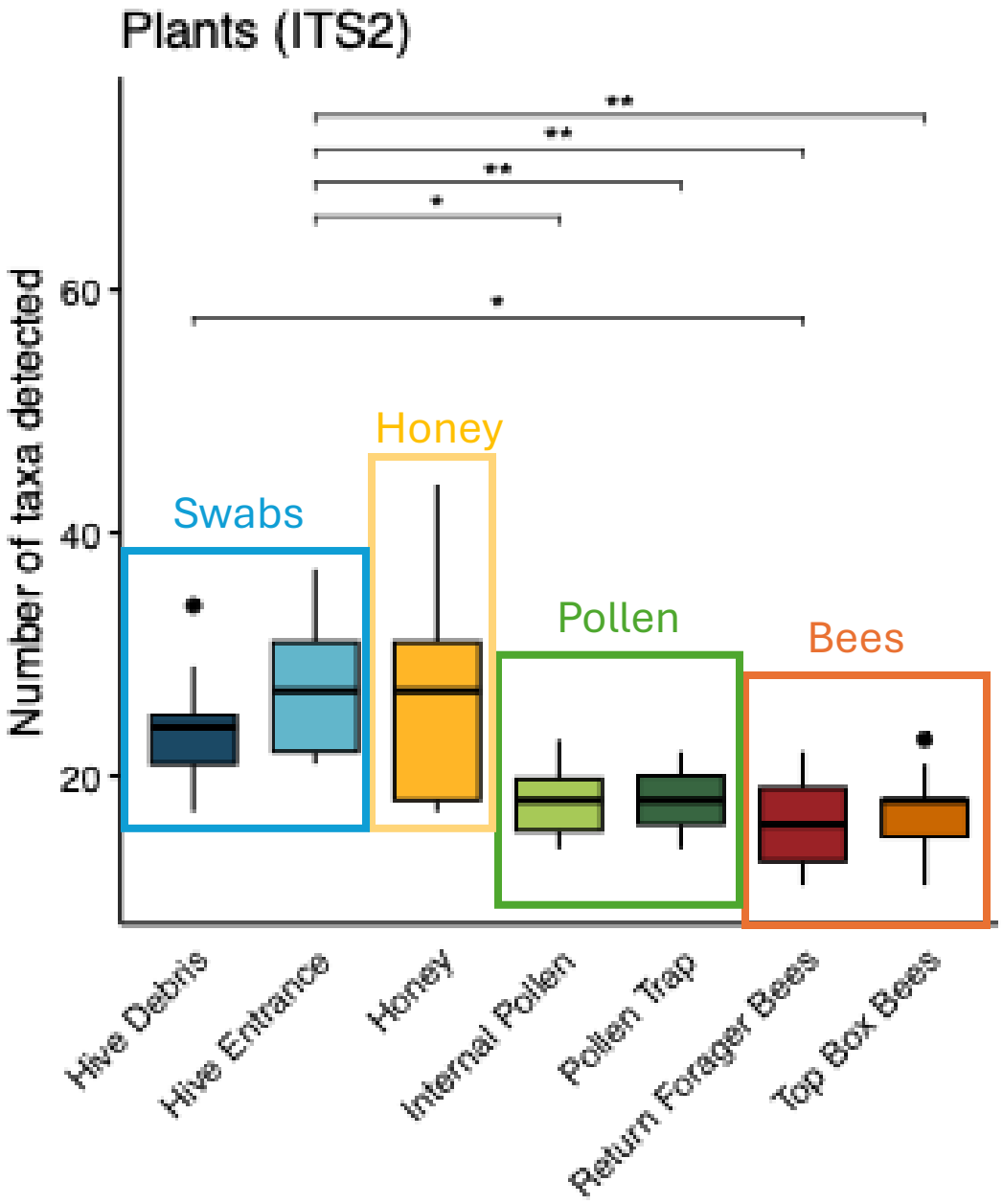
What’s up with hive site 2?

- Newly established hives for this project
- Hive productivity not static over time

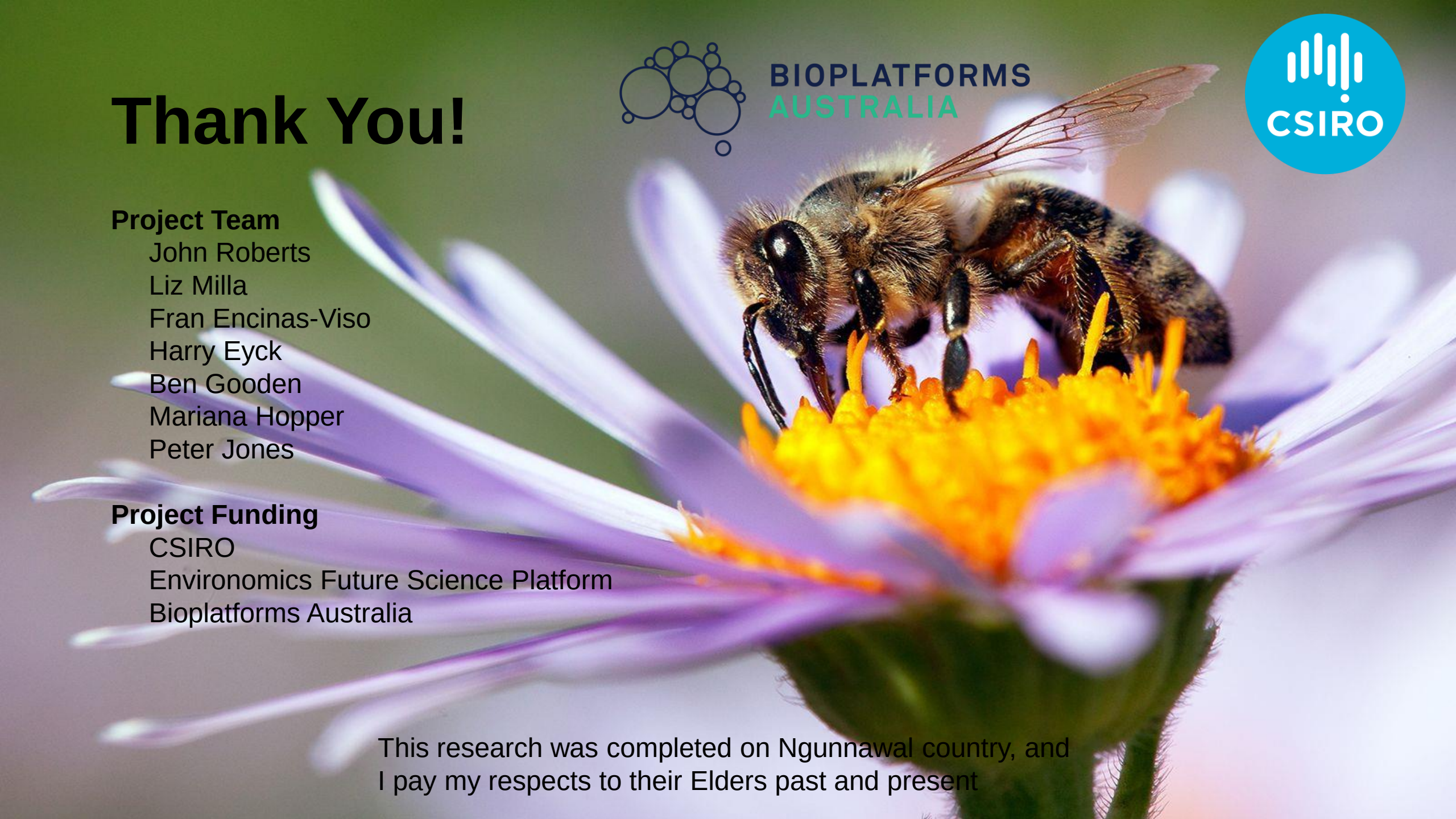
But what samples should I use?

	Pollen	Bees
qPCR	O	X
Metabarcoding	?	?


Bees
Pollen
22
(18.5%)
74
(62.2%)
23
(19.3%)


Plants (ITS2)
Number of taxa detected
60
40
20
**
**
**
*
*
Swabs
Honey
Pollen
Bees
Hive Debris
Hive Entrance
Honey
Internal Pollen
Pollen Trap
Return Forager Bees
Top Box Bees

Thank You!



Project Team

John Roberts
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Harry Eyck
Ben Gooden
Mariana Hopper
Peter Jones

Project Funding

CSIRO
Environomics Future Science Platform
Bioplatforms Australia

This research was completed on Ngunnawal country, and
I pay my respects to their Elders past and present