## OP-153 [Bee Health]
## High plasticity for many of the Bond bee population's varroa, colony development, foraging, and virus traits, in relation to year, season and varroa treatment

Joachim R De Miranda, Nicholas Scaramella, Amélie Noël, Barbara Locke Grandér
Department of Ecology, Swedish University of Agricultural Sciences, Uppsala, Sweden

BACKGROUND:
The Bond Project is a research programme based on a small honeybee population on Gotland that has survived without varroa control for 20+ years. The Bond Project has been hugely successful and influential world-wide, by identifying numerous adaptive traits that permit this population to persist long-term with varroa.

PROBLEM:
We wanted to know how these traits would behave under normal, productive beekeeping conditions, i.e. including varroa treatment. Stable traits are suitable for breeding programmes, while variable 'plastic' traits are less suitable. Both are important for adaptation and survival.

METHODOLOGY:
The entire experiment took place on the Gotland peninsula where the Bond population survived for 20+ years. Nine Bond colonies were split evenly, with each split producing a new locally mated queen. One colony in each pair was assigned to the varroa-treated group; the other to the untreated group. Both the genetic and environmental backgrounds of the two groups are therefore essentially identical. The treated group was given a single oxalic acid treatment early December each year. The colonies were monitored over two years for survival, swarming, colony development, varroa infestation and fertility and several virus infections.

RESULTS: The oxalic acid treatment was very effective. Varroa fertility was constant at around 55%, irrespective of treatment, season or year. Swarming and survival were higher in the treated group. Bee strength (adults, open and closed brood) was variable across the season and between years, and slightly higher for the treated group. Treated colonies collected much more pollen and nectar, particularly during June. Brood rearing ceased completely by August each year, coinciding with a lack of stored pollen. DWV was lower in treated colonies, while SBV, BQCV and LSV were higher. All viruses were variable across season and between years.

PRACTICAL IMPLICATIONS:
Most of the traits were highly plastic, varying by season and year as well as treatment. The only constant trait was reduced mite fertility. The treated colonies were much more productive for similar bee strength. Their higher SBV, BQCV and LSV levels were clearly not detrimental. Finally, consider that your colony's traits may be largely plastic, rather than primarily genetic.

SLU
SCIENCE AND EDUCATION FOR SUSTAINABLE LIFE

SLU

HONEY BEE RESEARCH CENTRE

FREE-B

# Varroa-resistant bees + Treatment = ??

*(High plasticity for many of the Bond bee population's varroa, colony development, foraging, and virus traits, in relation to year, season and varroa treatment)*

**Joachim de Miranda**

Nicholas Scaramella
Amelie Noël
Barbara Locke

SLU Honey Bee Research Centre
Uppsala, Sweden

Apimondia 2025
Copenhagen, Denmark
26 September 2025

HONEY BEE
RESEARCH
CENTRE

...or...

# What is the effect of not treating (Varroa-resistant) your bees?

HONEY BEE
RESEARCH
CENTRE

# Background

## The ’Bond Project’ on Gotland

## Inspired by the movie *”Live and Let Die”…*

## …as applied to bee colonies

(©John Kefuss, with thanks!)

HONEY BEE
RESEARCH
CENTRE

# Background

## Gotland environment

HONEY BEE
RESEARCH
CENTRE

# Background

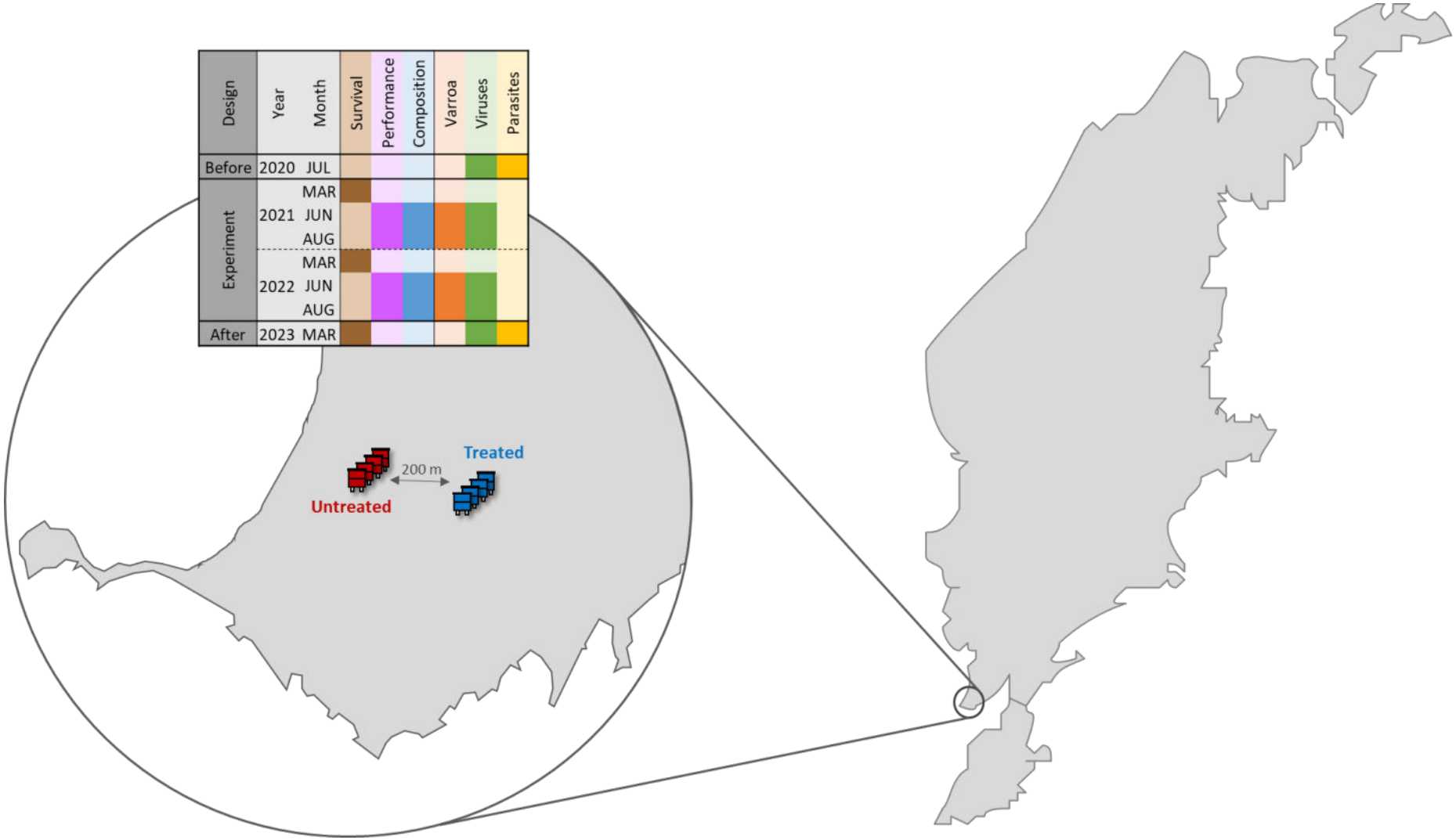
## Bond bee environment

April 2021

HONEY BEE
RESEARCH
CENTRE

# Set-up

| Design | Year | Month | Survival | Performance | Composition | Varroa | Viruses | Parasites |
|---|---|---|---|---|---|---|---|---|
| Before | 2020 | JUL | | | | | | |
| Experiment | 2021 | MAR | | | | | | |
| | | JUN | | | | | | |
| | | AUG | | | | | | |
| | 2022 | MAR | | | | | | |
| | | JUN | | | | | | |
| | | AUG | | | | | | |
| After | 2023 | MAR | | | | | | |



HONEY BEE RESEARCH CENTRE

# Rules of the Game

(…for whatever differences we do/do not find…)

## 1. Split colonies, sister queens

- NO genetic differences = no magic queens*
- NO colony differences = no magic bees*

## 2. On-site, where the Bond population survived 25+ years

- NO site differences = no magic environment**

## 3. So what is left then…?

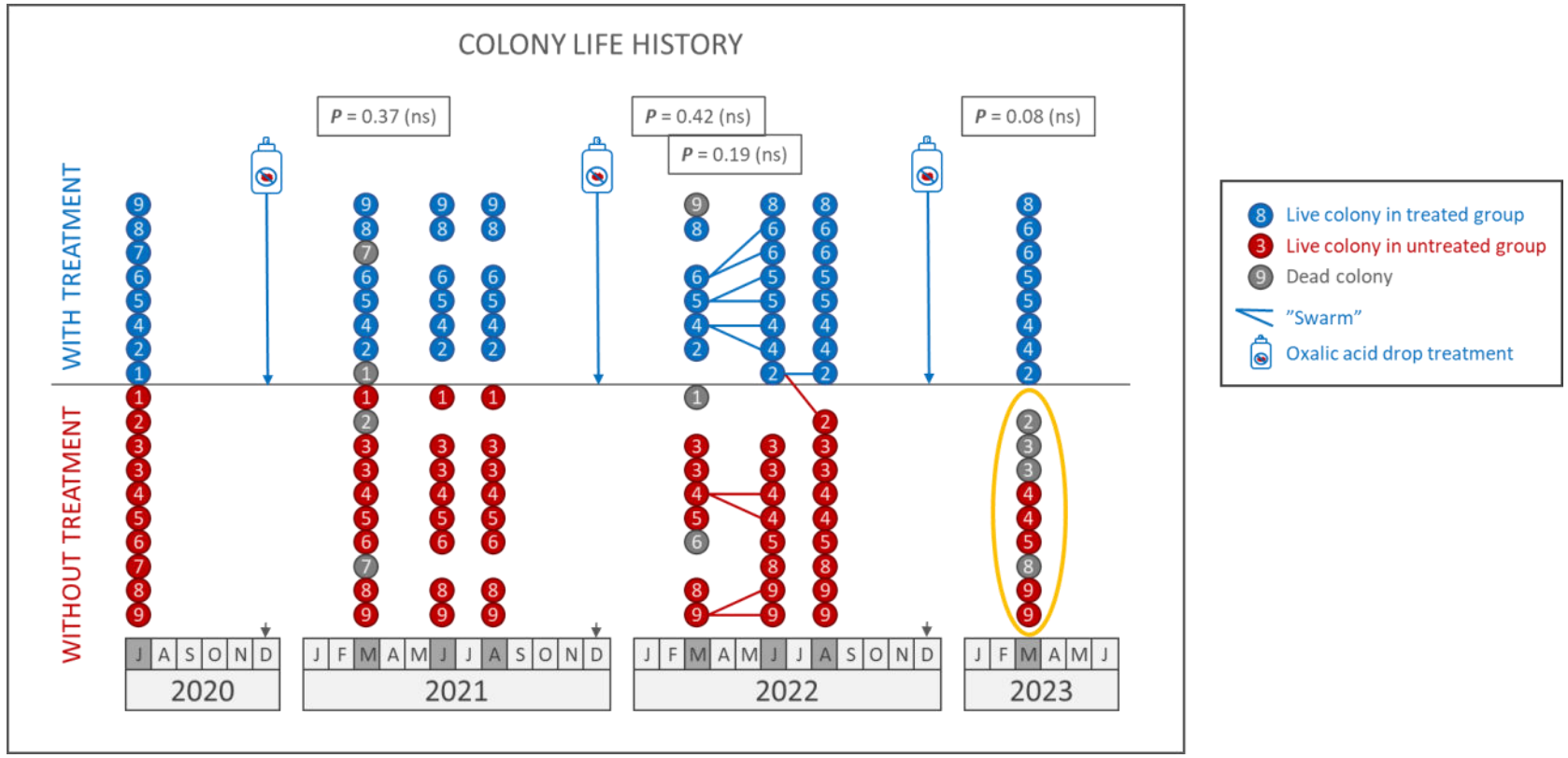
- The effect of treatment…
- …bees interacting with their environment (and treatment)
- …parasites/pathogens interacting with their hosts (and treatment)

* The bees are actually quite nice

** The environment is actually not bad

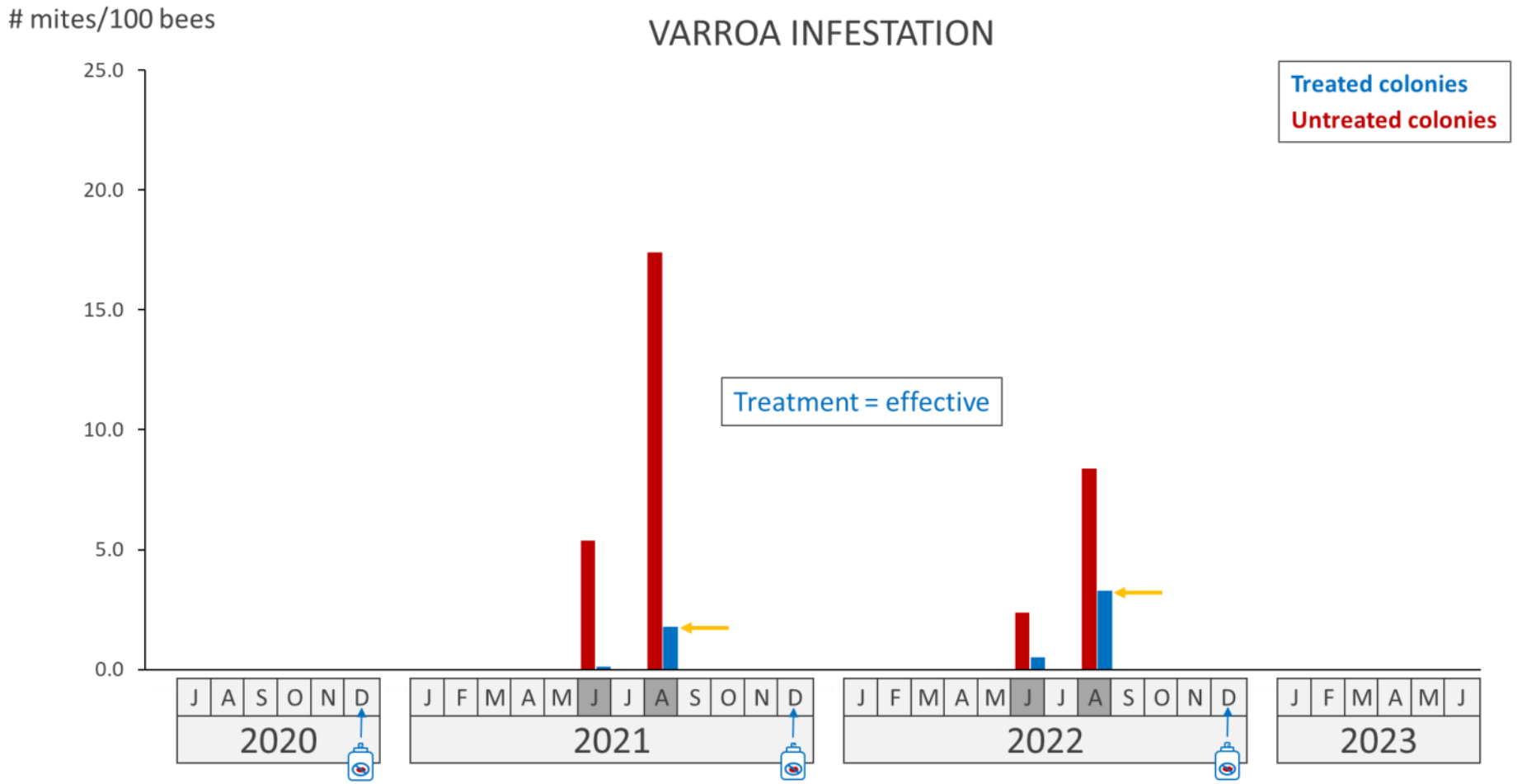
HONEY BEE
RESEARCH
CENTRE

# Survival



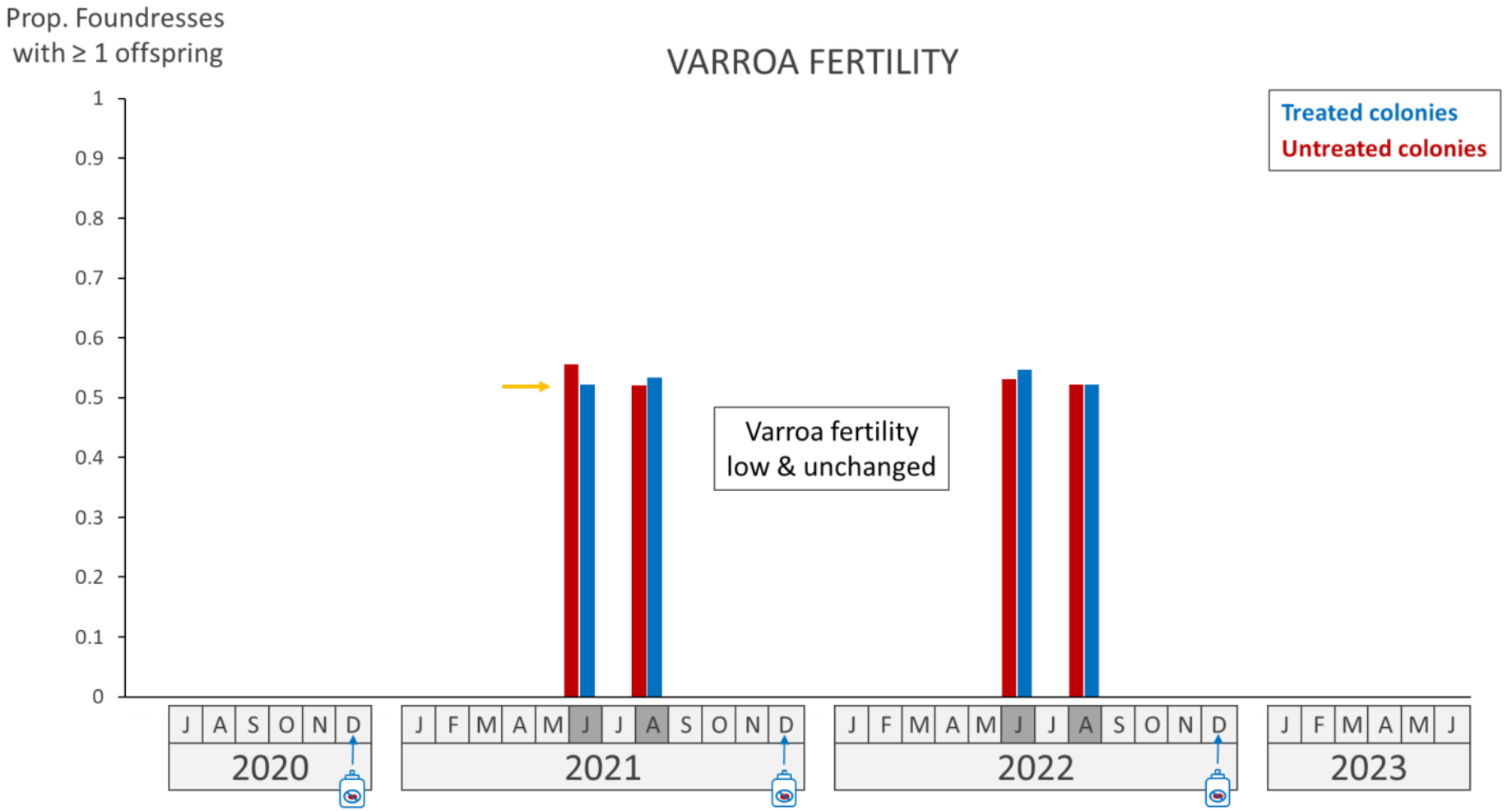
HONEY BEE
RESEARCH
CENTRE

# Varroa



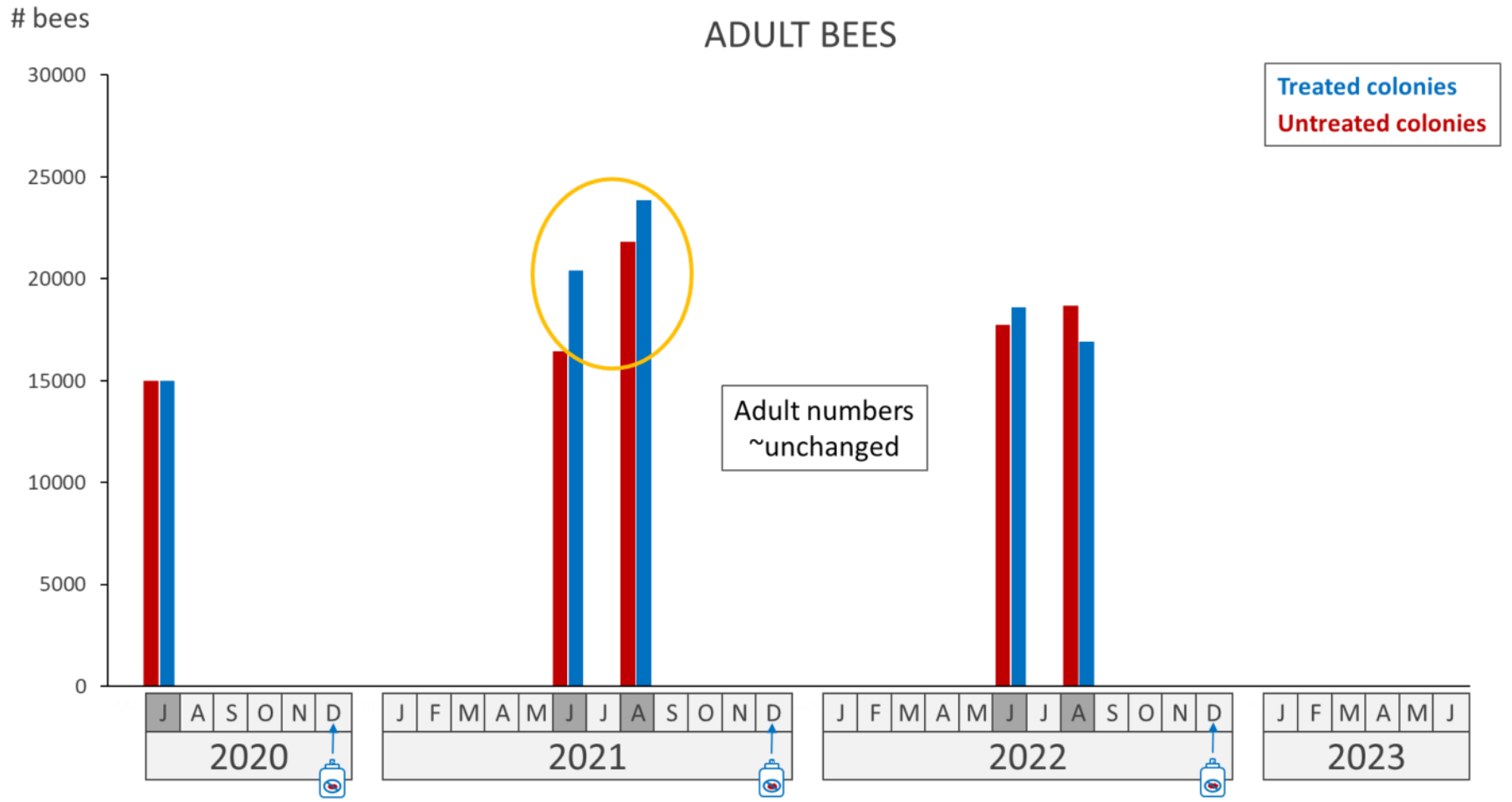
HONEY BEE
RESEARCH
CENTRE

# Varroa



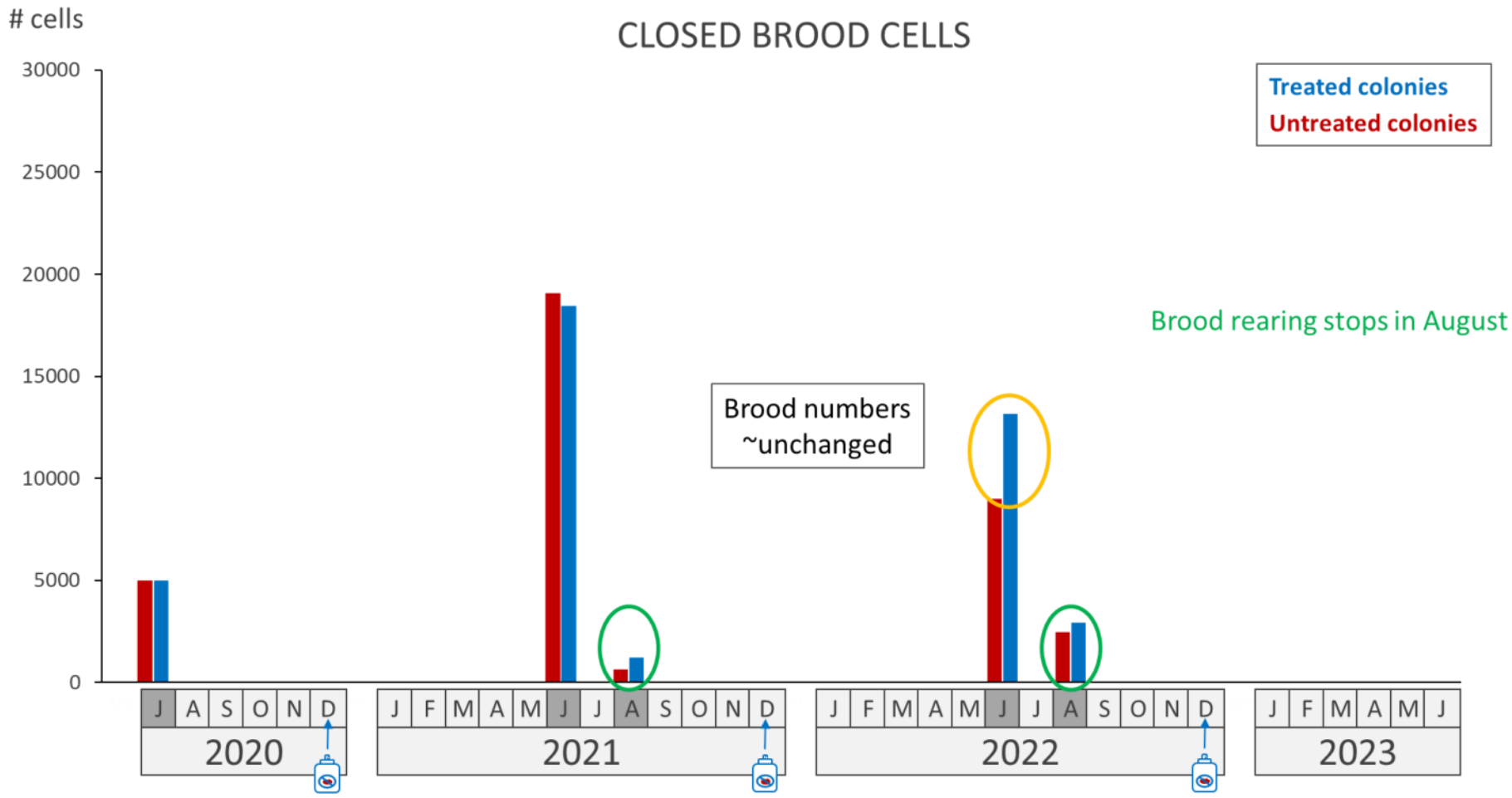
HONEY BEE
RESEARCH
CENTRE

# Bees



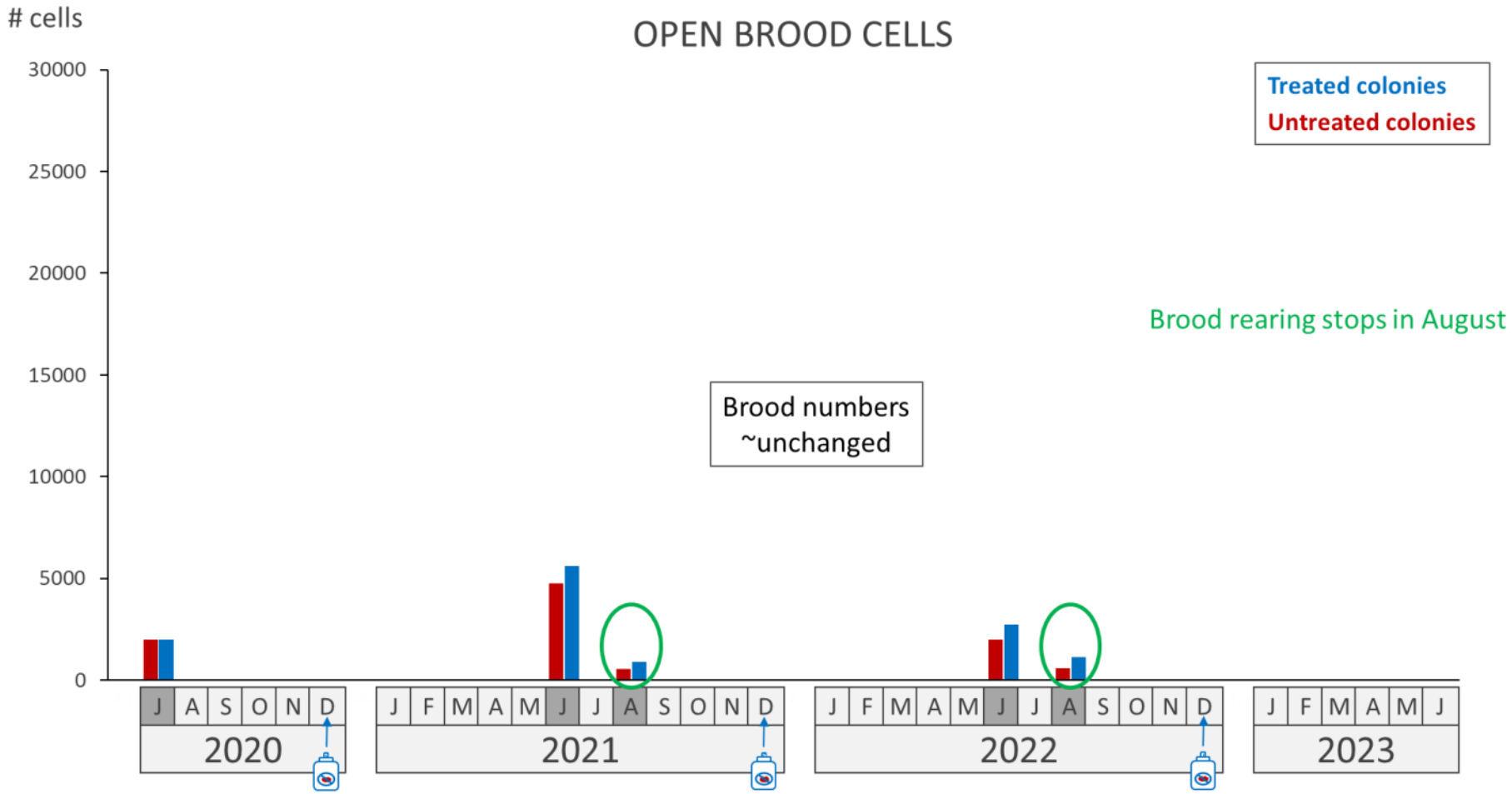
HONEY BEE
RESEARCH
CENTRE

# Bees



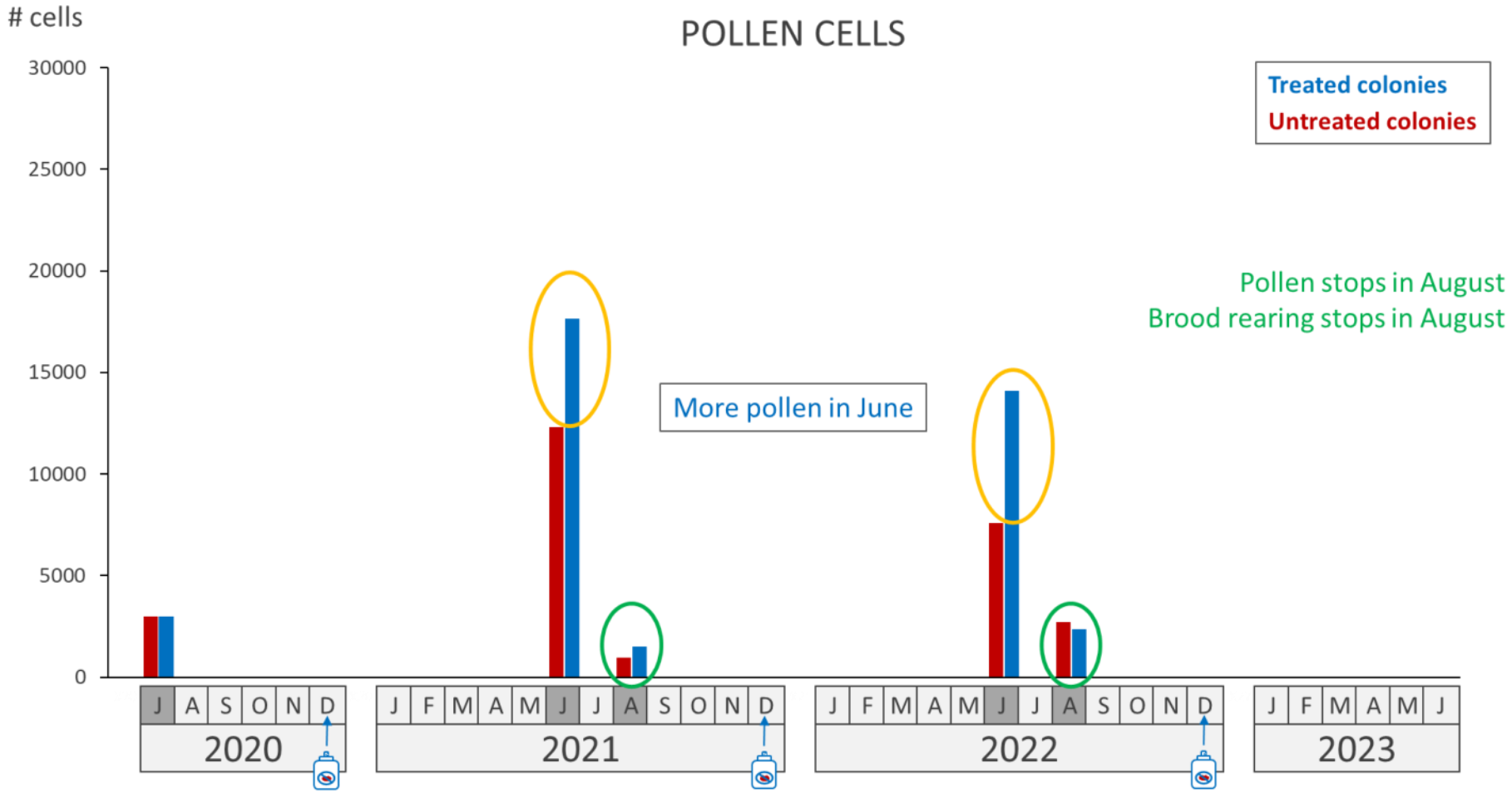
HONEY BEE
RESEARCH
CENTRE

# Bees



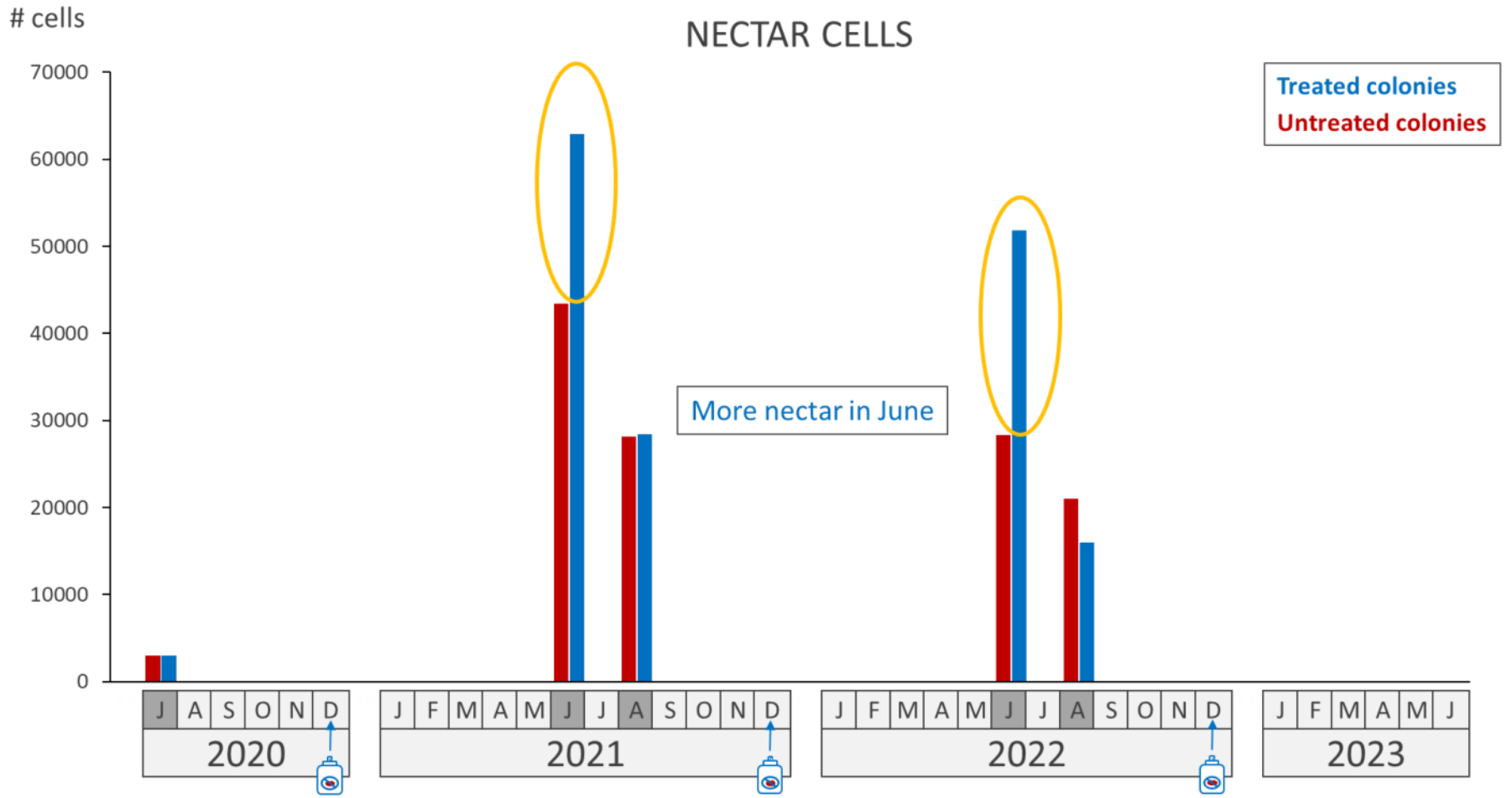
HONEY BEE
RESEARCH
CENTRE

# Productivity



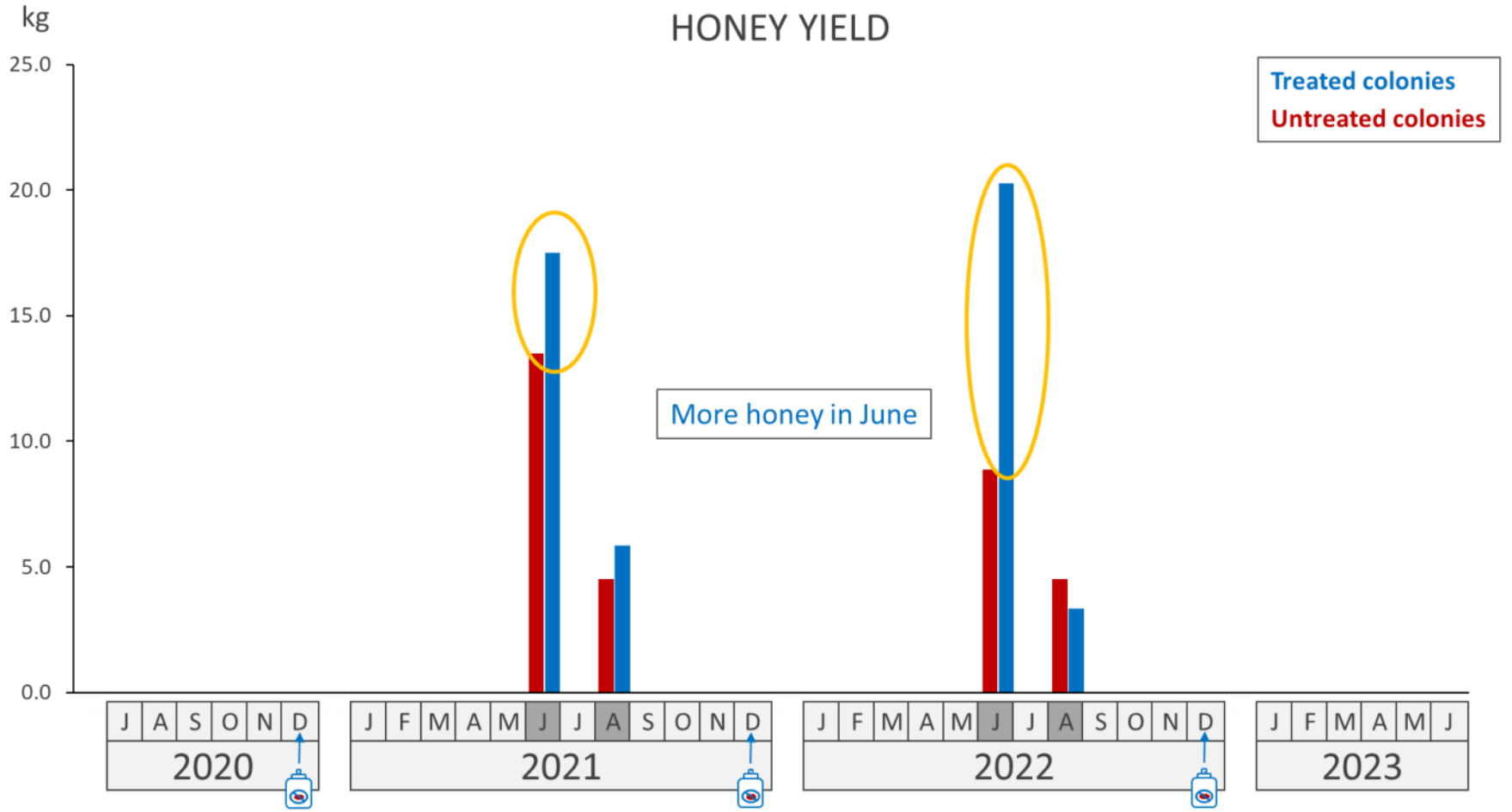
HONEY BEE
RESEARCH
CENTRE

# Productivity



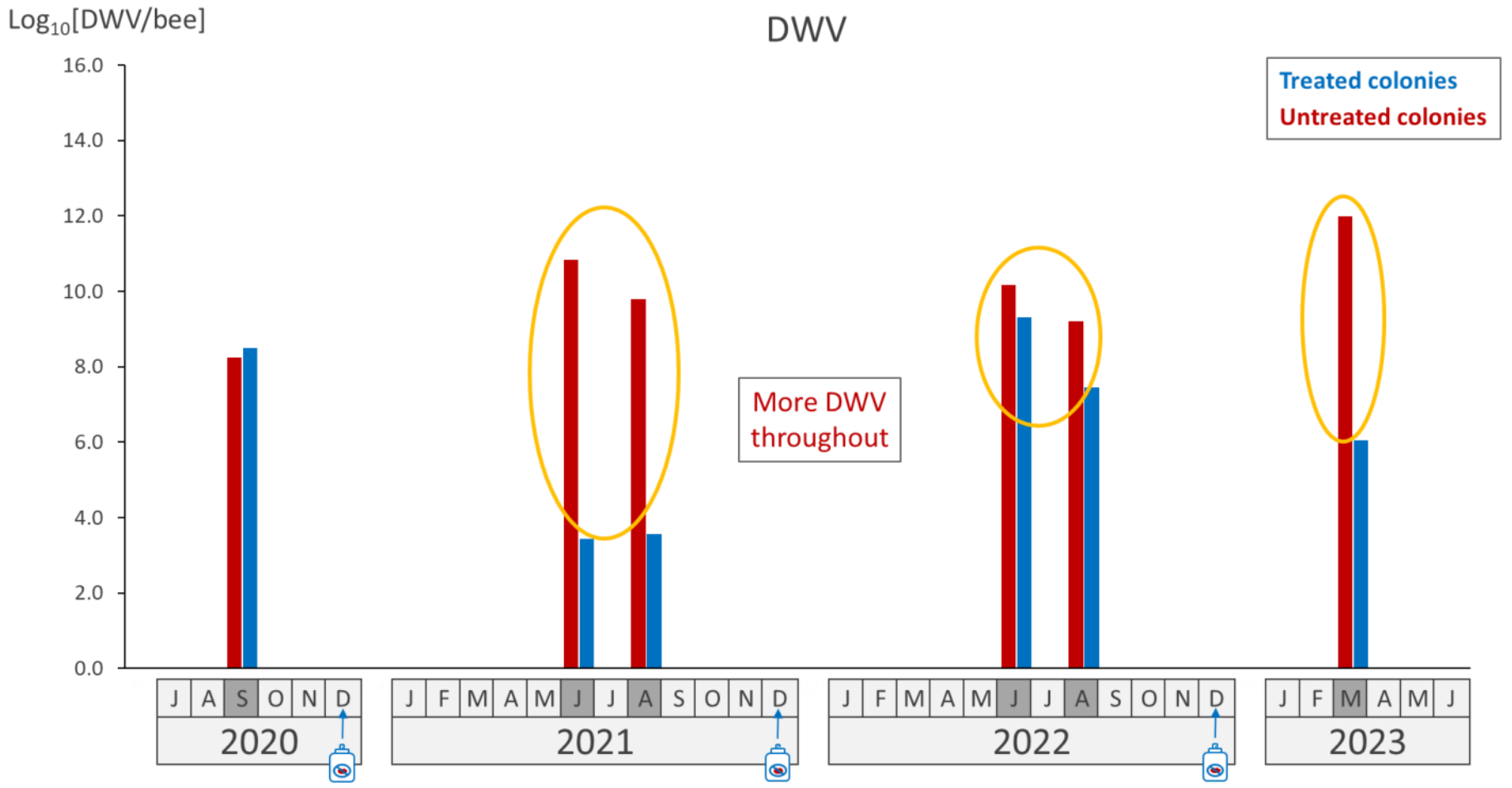
HONEY BEE RESEARCH CENTRE

# Productivity



HONEY BEE RESEARCH CENTRE

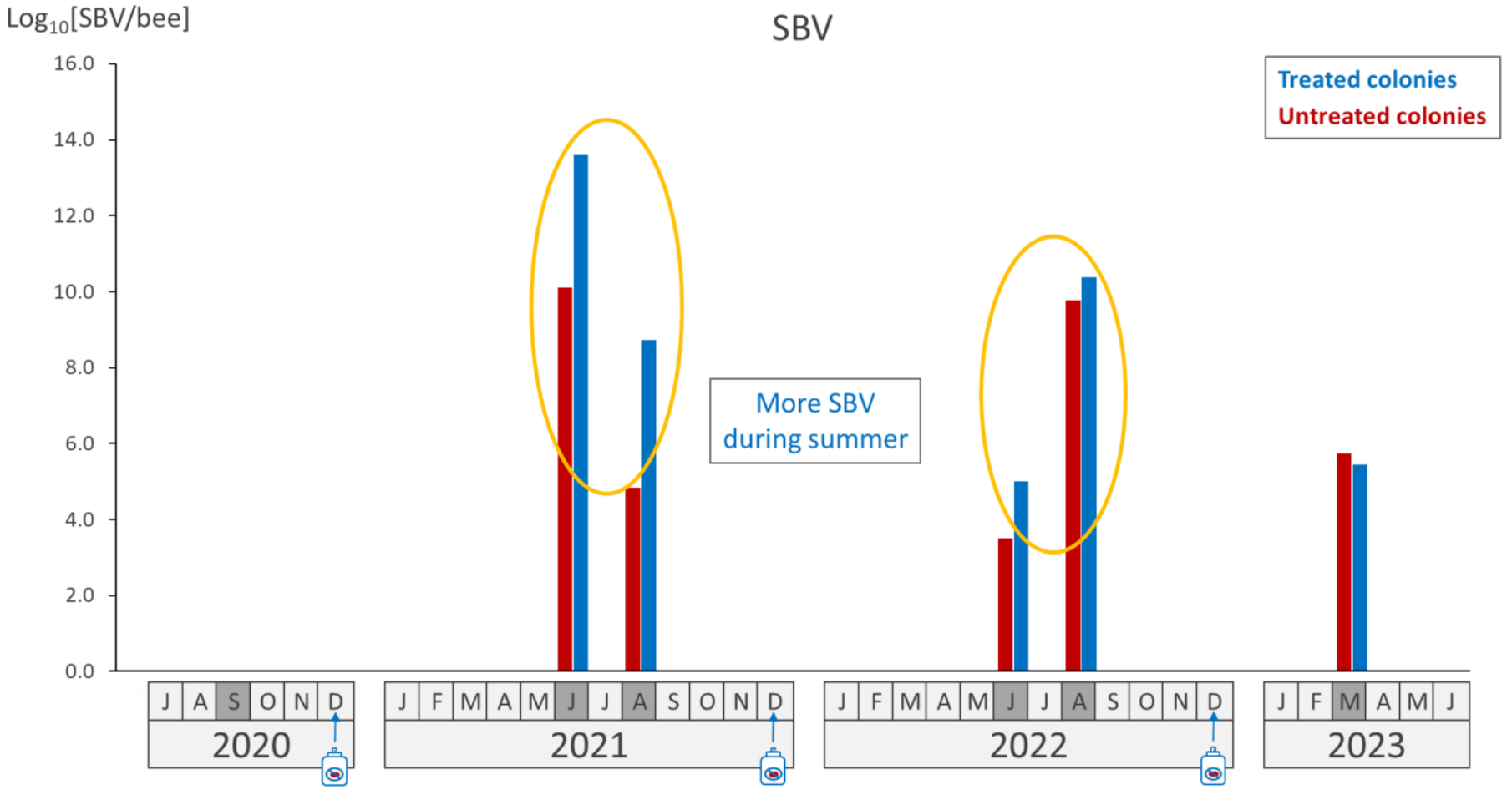
# Viruses




We see this consistently…

HONEY BEE
RESEARCH
CENTRE

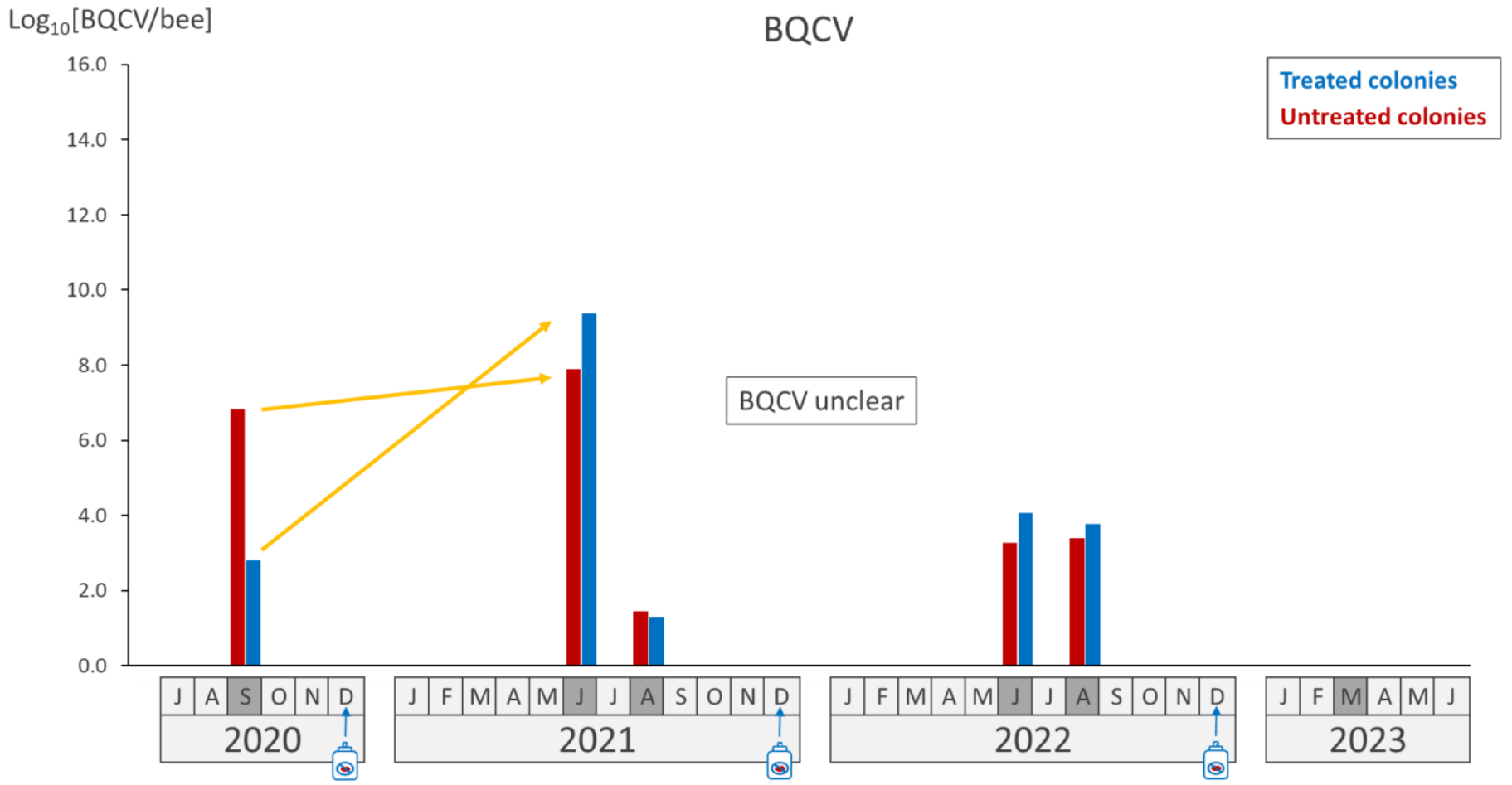
# Viruses




We see this consistently…

HONEY BEE RESEARCH CENTRE

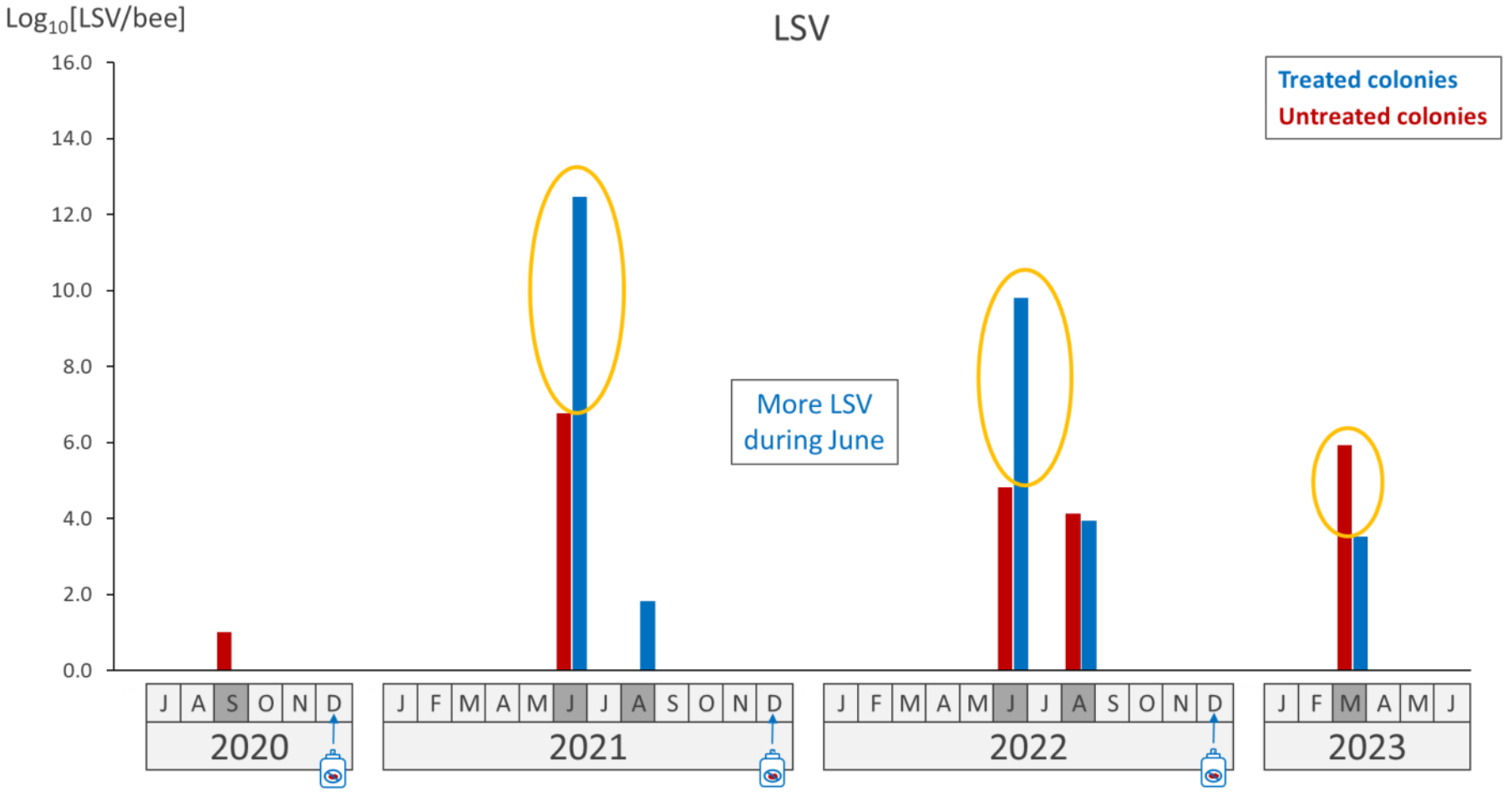
# Viruses




BQCV has different interests…

HONEY BEE RESEARCH CENTRE

# Viruses




We see this consistently…

HONEY BEE RESEARCH CENTRE

# Summary

1. Treatment is effective...
   - No effect on mite fertility*
   - Little effect on bee numbers**
   - Strong effect on bee productivity (honey, nectar, pollen)***

2. …with contrasting effects on viruses:
   - DWV levels: linked to varroa & lower productivity
     - ✓ (we know why and how)
   - SBV & LSV levels: linked to treatment & higher productivity
     - ✓ (no idea why or how)

3. Environment on Näsudden:
   - Dry, mild general climate, excellent microclimate
   - Short brood (…mite…) rearing season, limited by pollen (May-Aug)
   - Long, unbroken broodless period (Sep-Apr)

4. Genetic systems, adaptation & plasticity:
   - Genetic: historical (not here; see Rules…)#
   - Epigenetic: GxE, bees (genomes) exploiting environment over time##
   - Metagenetic: bugs (genomes) helping bees (genomes) exploit environment###
   - Transcriptomic: bee genomes responding to environmental cues####

* Adapted low, which helps…
** May have missed some foragers
*** Not more bees, but better bees

# Looooong term, fixed, inherited (queen)
## Medium term, plastic, inherited (queen)
### Short term, plastic, semi-inherited (bees)
#### Very short term, plastic, transient

HONEY BEE RESEARCH CENTRE

# Conclusions

Good bees

&

Appropriate environment

&

Observant beekeeping

=

Happy outcomes

HONEY BEE
RESEARCH
CENTRE

FORMAS

Jordbruksverket

biodiversa+
European Biodiversity Partnership

HONEY BEE
RESEARCH
CENTRE

FORMAS

biodiversa+
European Biodiversity Partnership

Jordbruksverket

HONEY BEE
RESEARCH
CENTRE