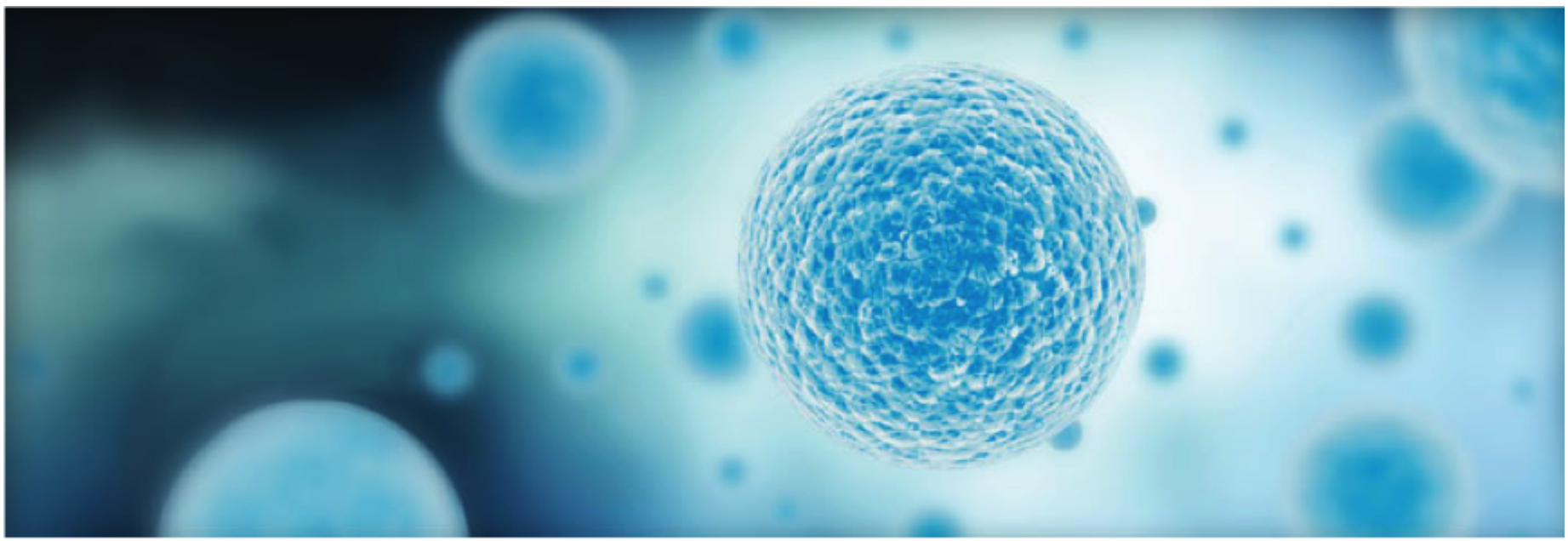
ReasearchTalk

Samantha A. Alger

5/1/2017

The role of plants in bee virus transmission

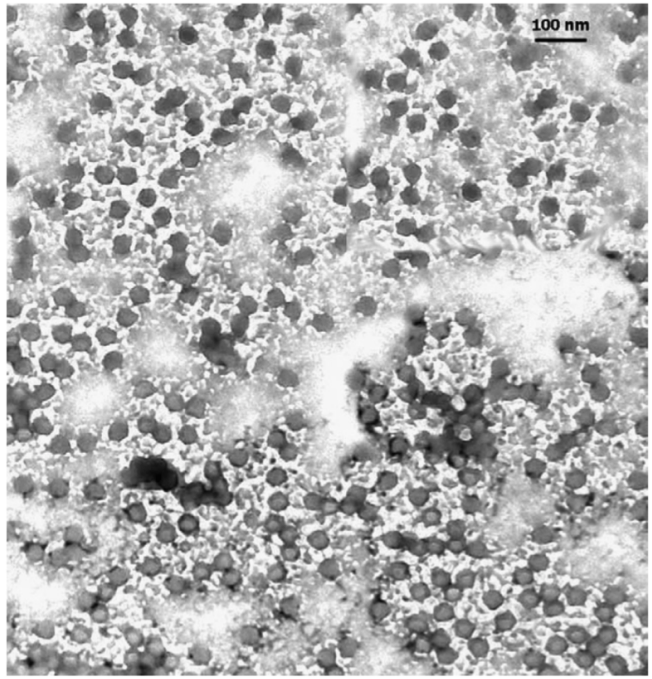
Samantha Alger



It's Official!
Rusty Patched Bumble Bee • Bombus affinis
First bee in the continental U.S. to be listed
under the Endangered Species Act
Xerces Society

RNA Viruses

Deformed Wing Virus (DWV)
Black Queen Cell Virus (BQCV)
Israeli Acute Paralysis Virus (IAPV)



Transmission Routes

Research Questions

Part I.

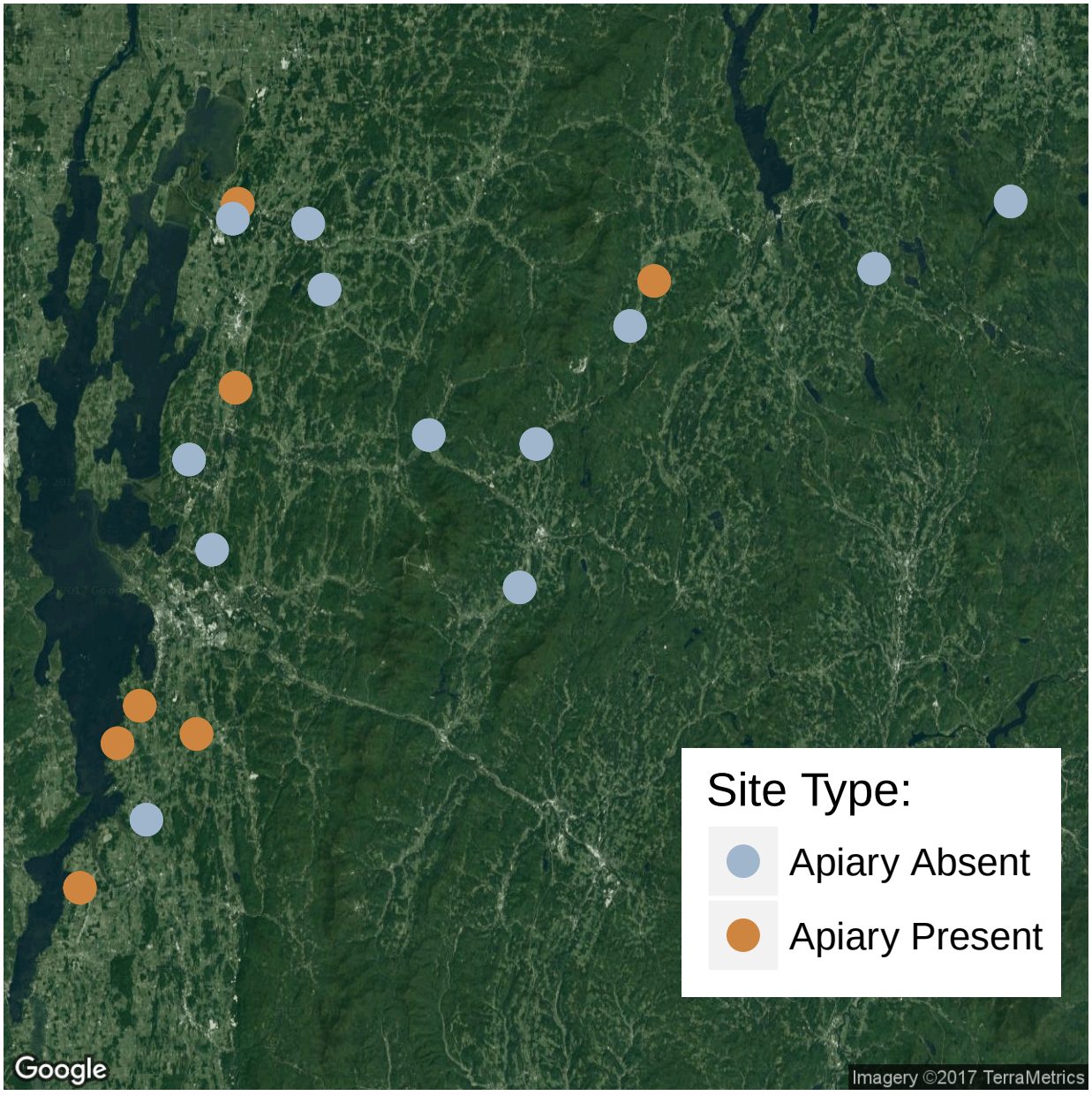
What is the prevalence of RNA viruses in bumble bees?

Is there evidence for disease spillover from managed honey bees?

Part II.

Can flowers act as bridges in disease transmission?

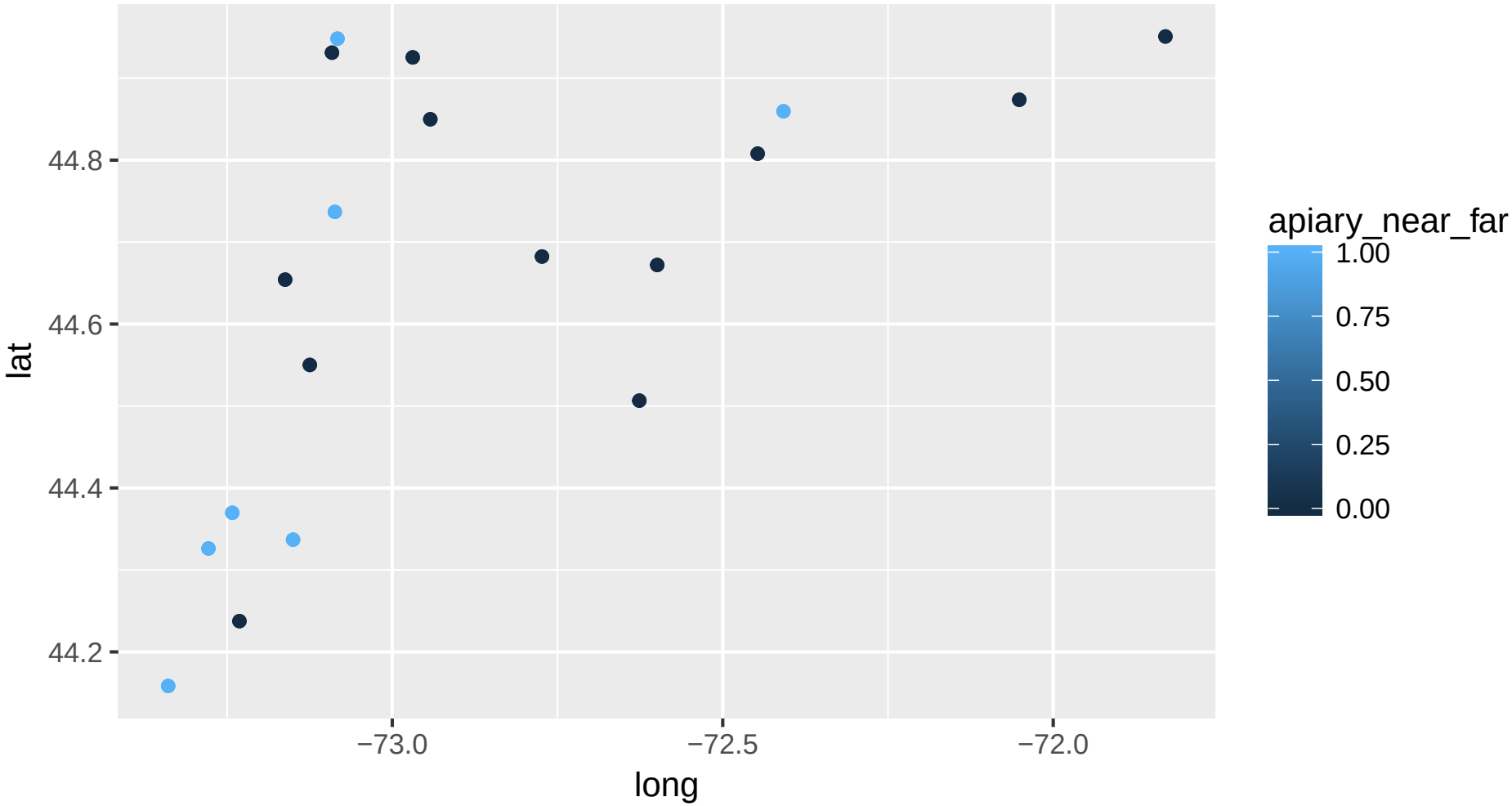
Part I: Survey



Code for Map

```
1
2
3
4  library(ggmap)
5
6  # make preliminary plot to check it out
7  # color according to apiary near/far:
8  ggplot(spatDat, aes(x = long, y = lat, group = apiary_near_far)) +
9    geom_point(aes(colour = apiary_near_far))
10
11
```

Code for Map


44.8
44.6
44.4
44.2
lat
−73.0
−72.5
−72.0
long
apiary_near_far
1.00
0.75
0.50
0.25
0.00

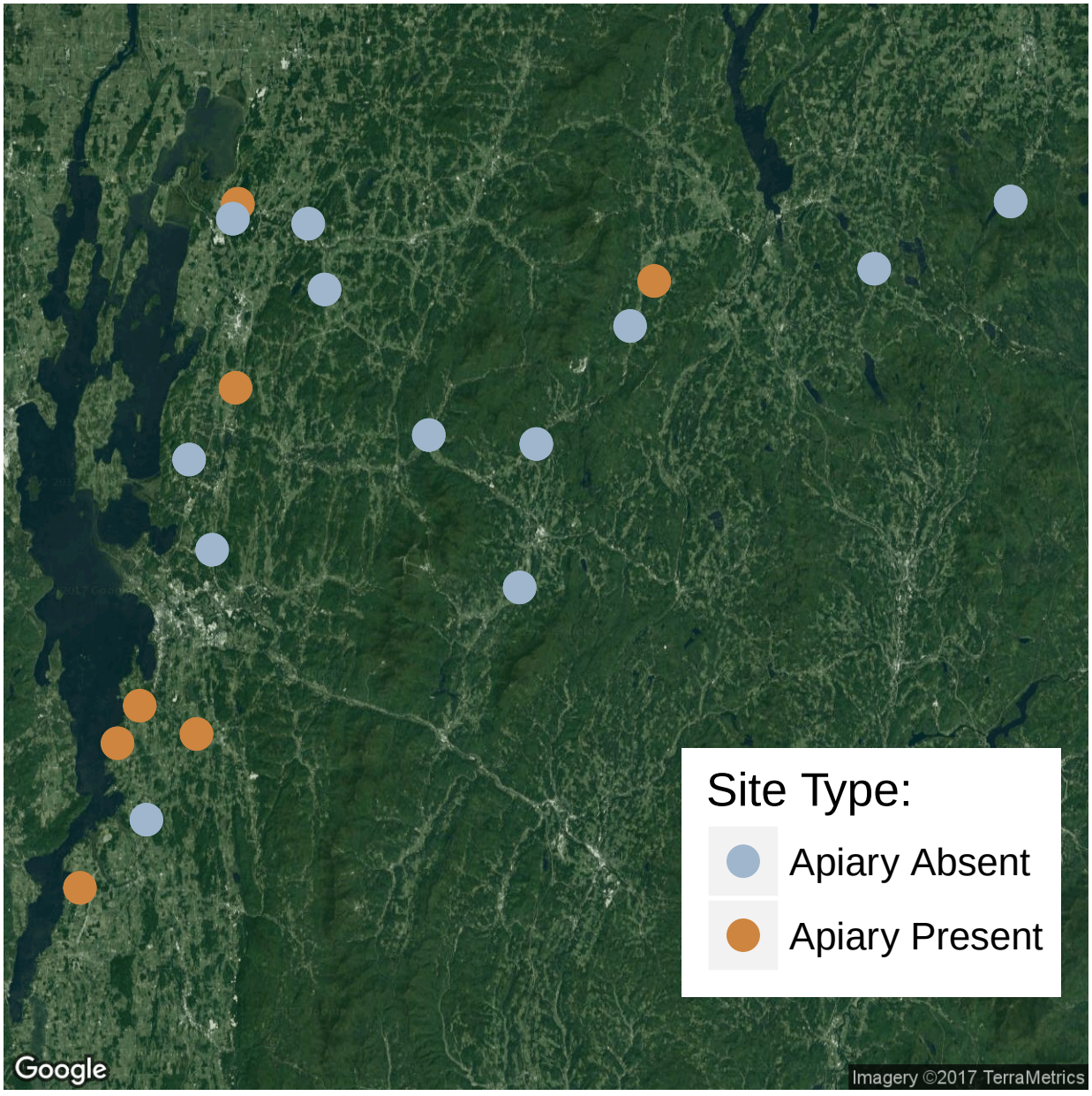
Code for Map

```
14
15  #Now we need a map to overlay these points:
16
17  # Use the dataframe lat and long to make the bounding box
18  # adding or subtracting 0.5 for aesthetics:
19  bbox <- c(min(spatDat$long) - 0.1,
20            min(spatDat$lat) - 0.1,
21            max(spatDat$long) + 0.1,
22            max(spatDat$lat) + 0.1
23  )
24
25  # get the base map
26  vt <- get_map(location = bbox, source = "google", maptype = "satellite")
27
```

Code for Map

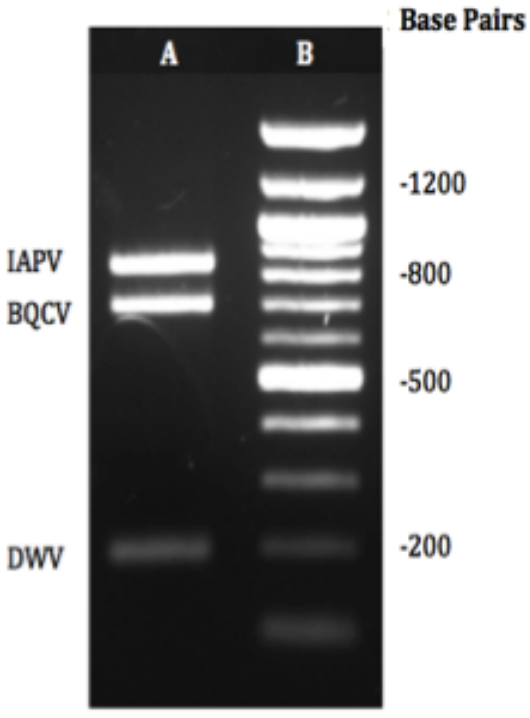
```
#set colors for the map points:
colors <- c("slategray3", "tan3")
# use ggmap to plot the points on the vt basemap
ggmap(vt) +
  geom_point(data = spatDat,aes(x = long,
                                y = lat,
                                color = (spatDat$apiary)),
             size=3) +
  theme( # theme removing grids etc.
    legend.position=c(.8, .2),
    panel.grid.major = element_blank (), # remove major grid
    panel.grid.minor = element_blank (), # remove minor grid
    axis.text = element_blank (),
    axis.title = element_blank (),
    axis.ticks = element_blank ()
  ) + scale_color_manual(values=colors, name="Site Type:", labels=c("Apiary Absent",
"Apiary Present"))
```

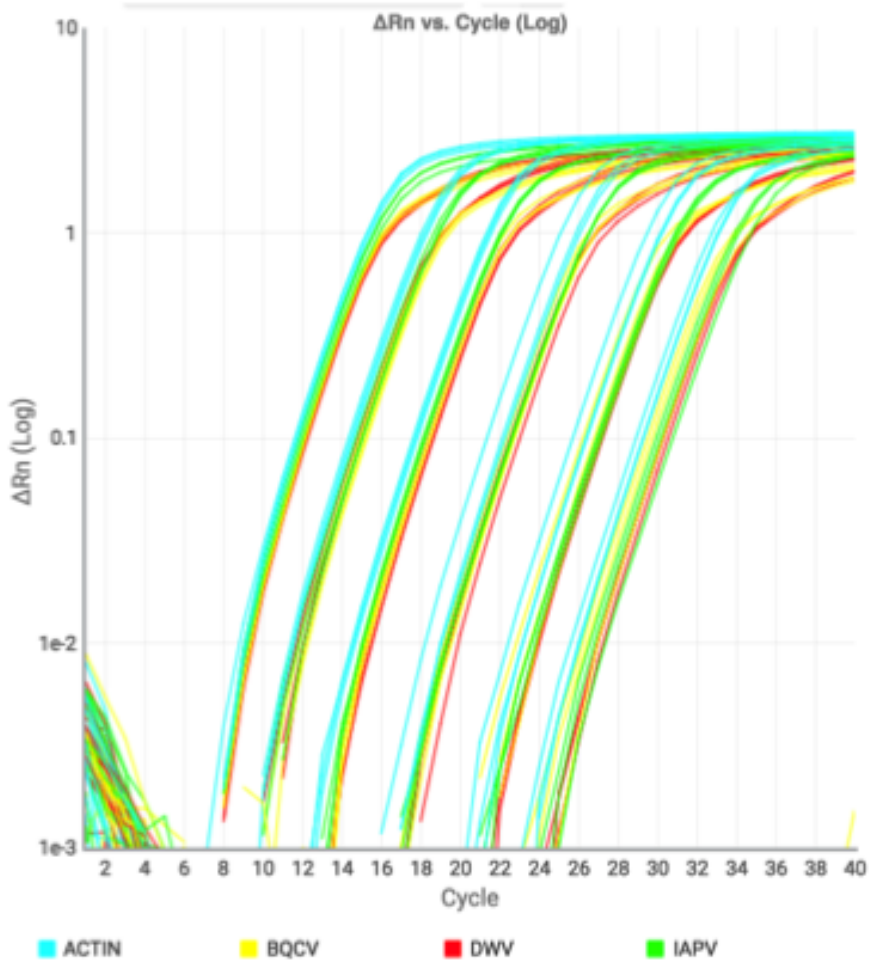
Final Map


Site Type:
Apiary Absent
Apiary Present
Google
Imagery ©2017 TerraMetrics

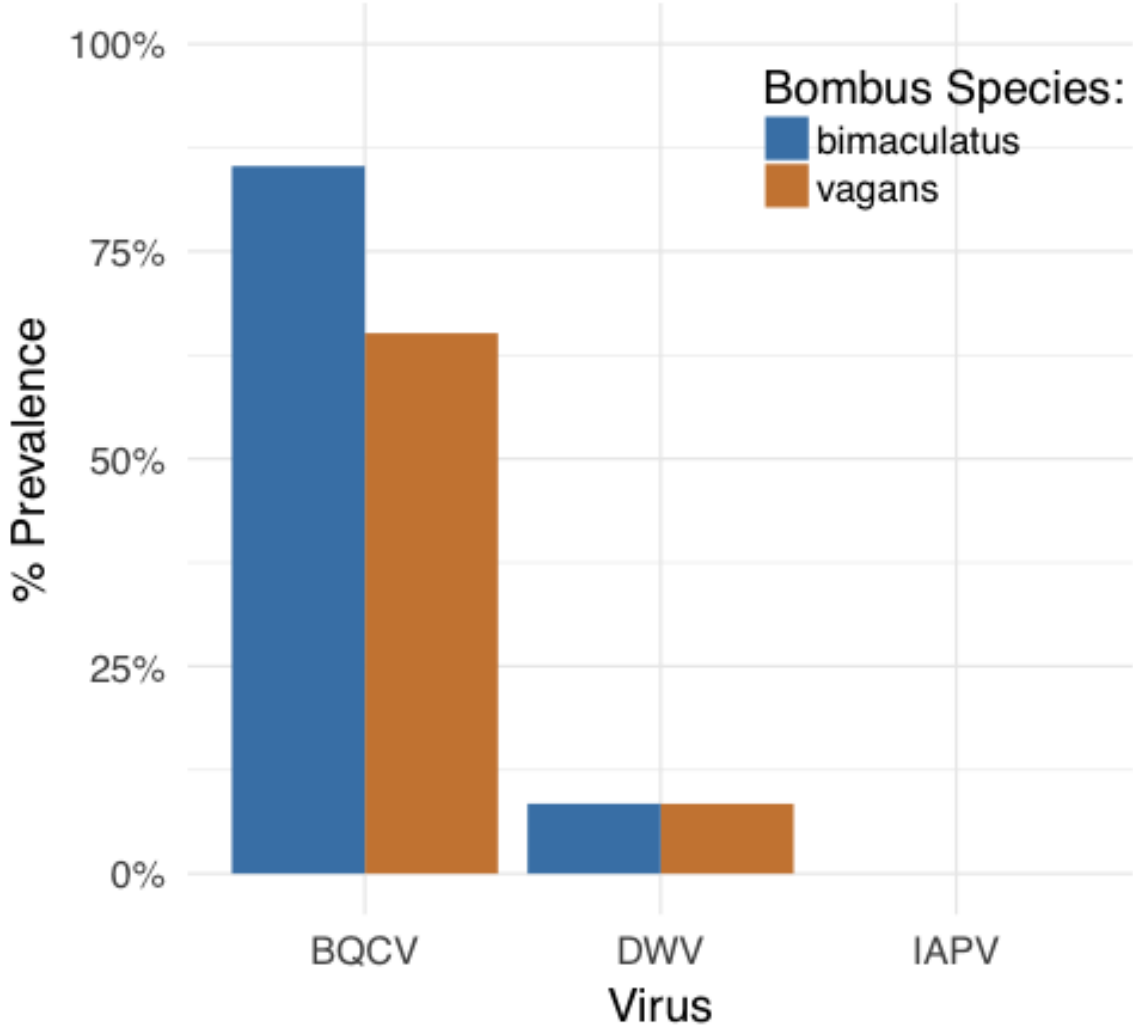
Part I: Survey

QPCR

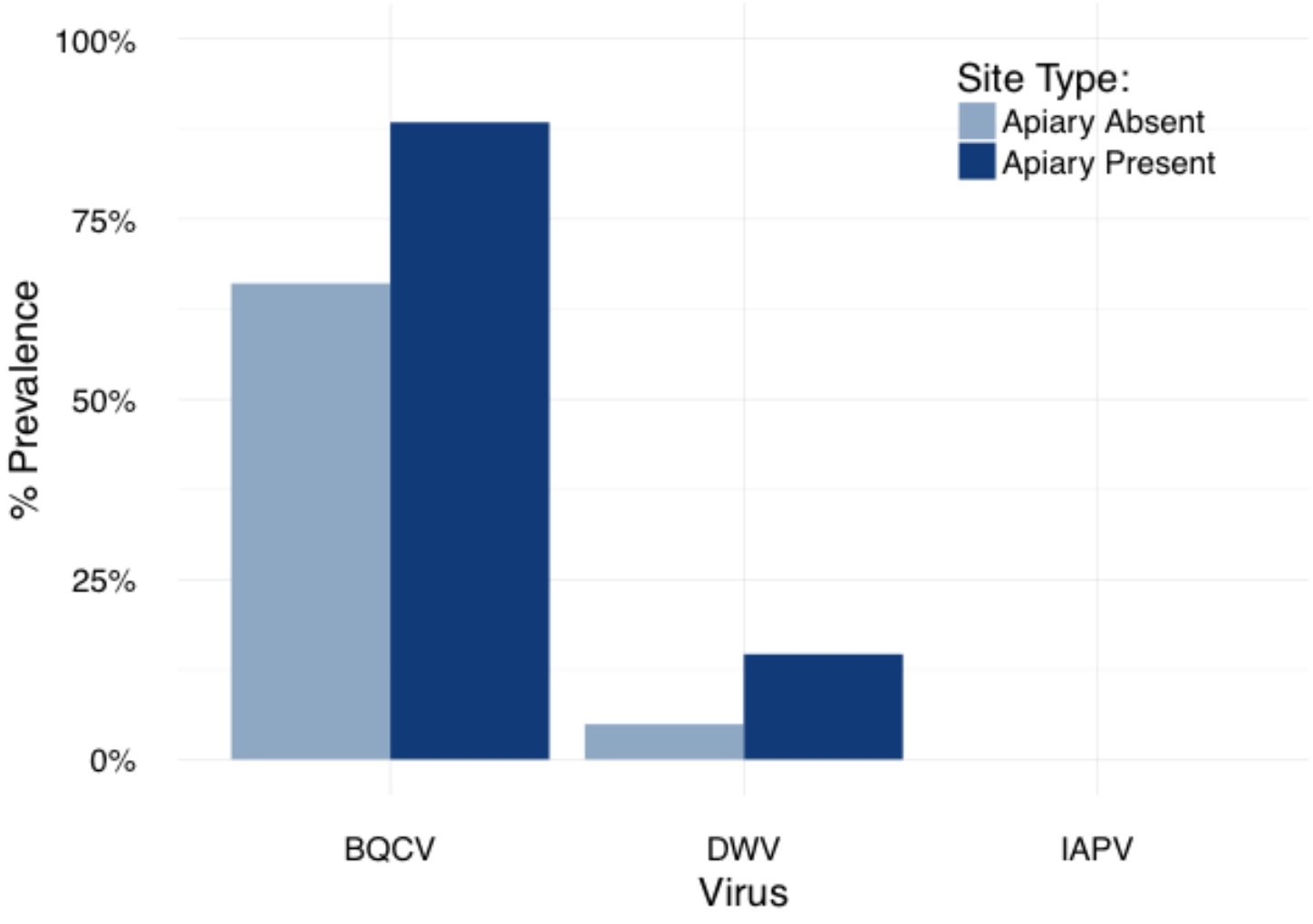

A
B
Base Pairs
-1200
-800
-500
-200
IAPV
BQCV
DWV

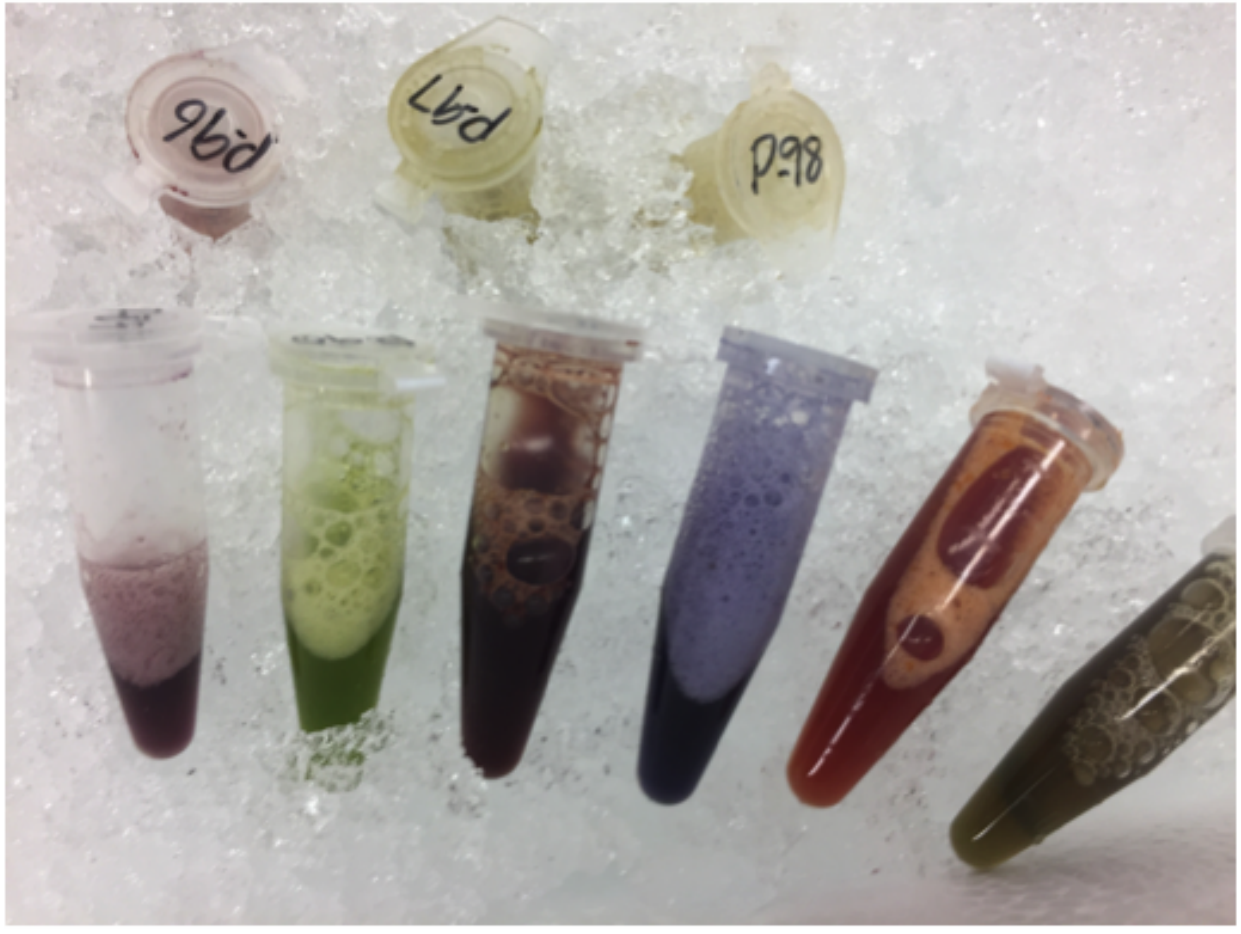

ΔRn vs. Cycle (Log)
ΔRn (Log)
10
1
0.1
1e-2
1e-3
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
Cycle
ACTIN
BQCV
DWV
IAPV

BQCV More Prevalent in *bimaculatus*

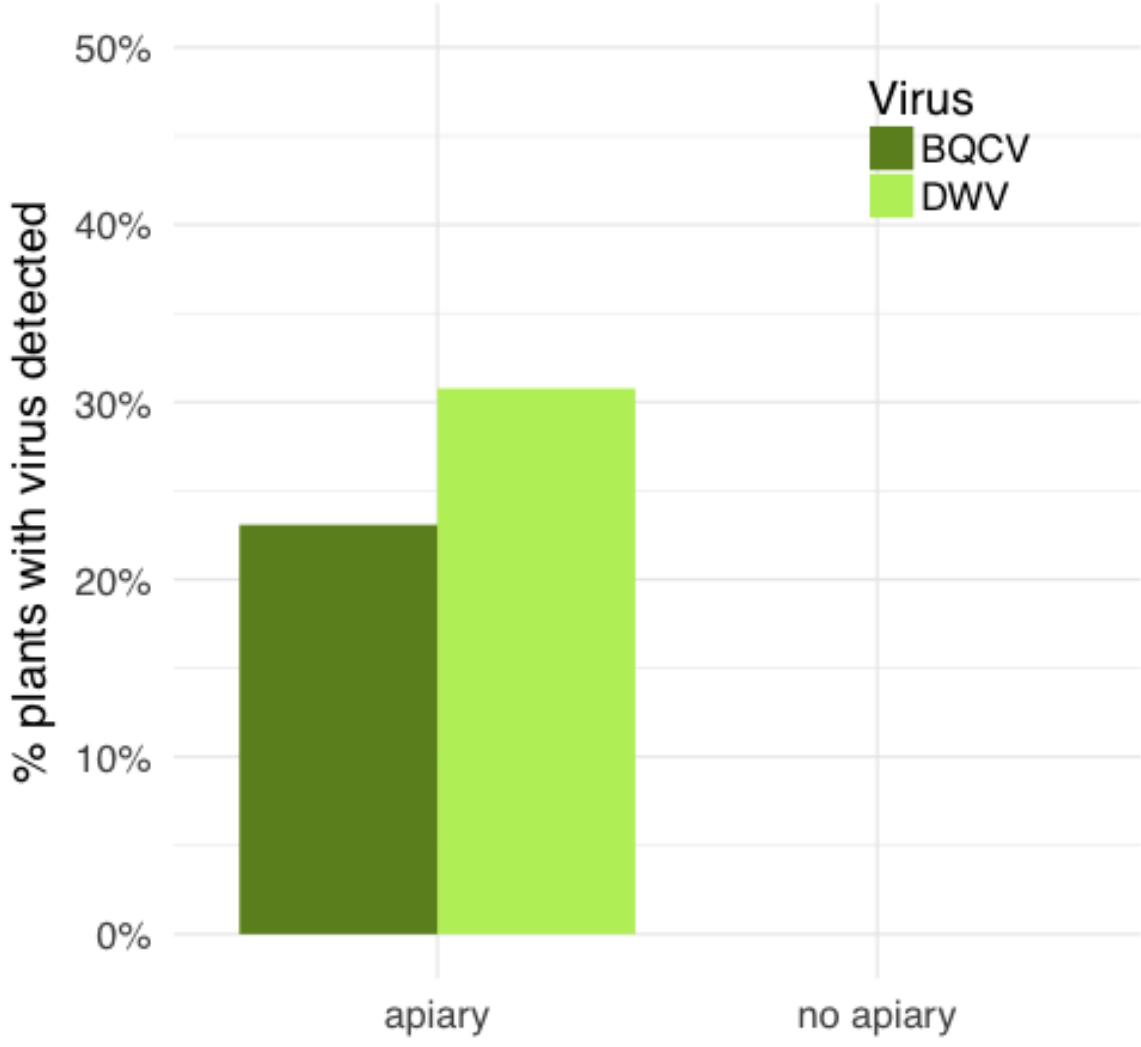


Viruses More Prevalent in Bumble Bees near Apiaries




P96
P97
P98

Viruses detected on plants collected only in apiaries!



Research Questions

Part I.

What is the prevalence of RNA viruses in bumble bees?

-**BQCV is most common, followed by DWV**

Is there evidence for disease spillover from managed honey bees?

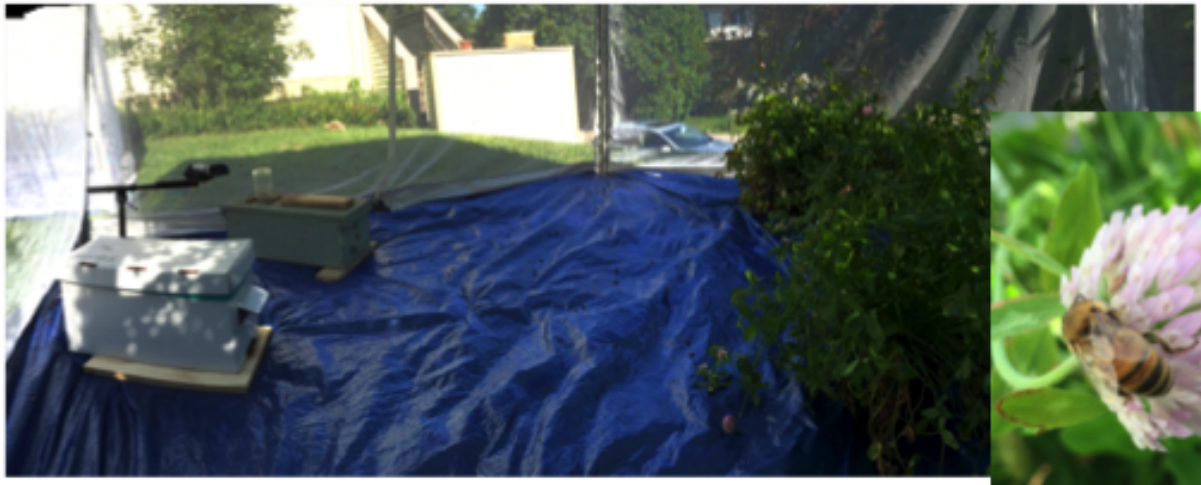
-**Yes, bumble bees are more likely to be infected when caught near an apiary and when the apiary has high viral loads**

Part II.

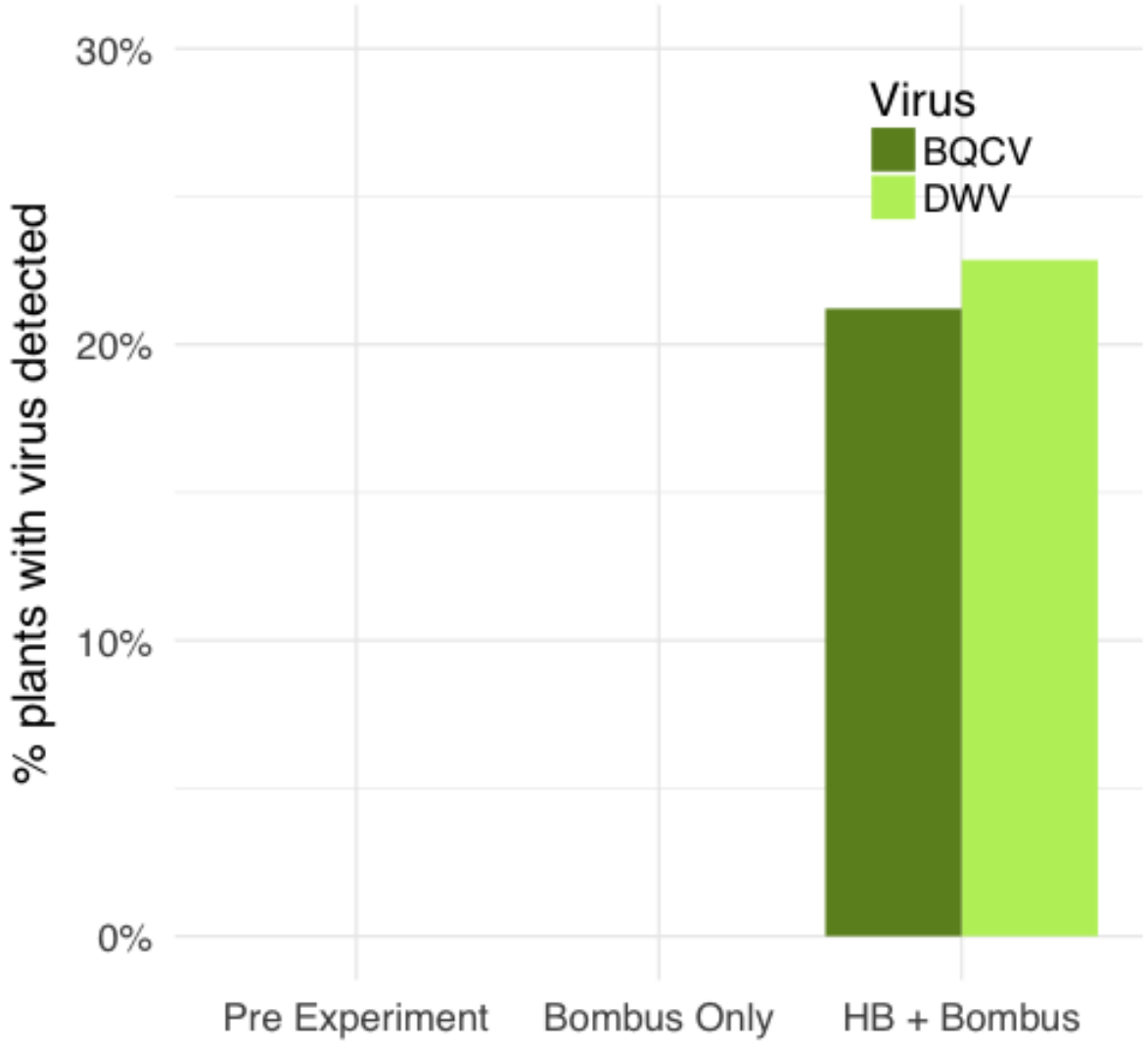
Can flowers act as bridges in disease transmission?

5
2
11
6
9
10

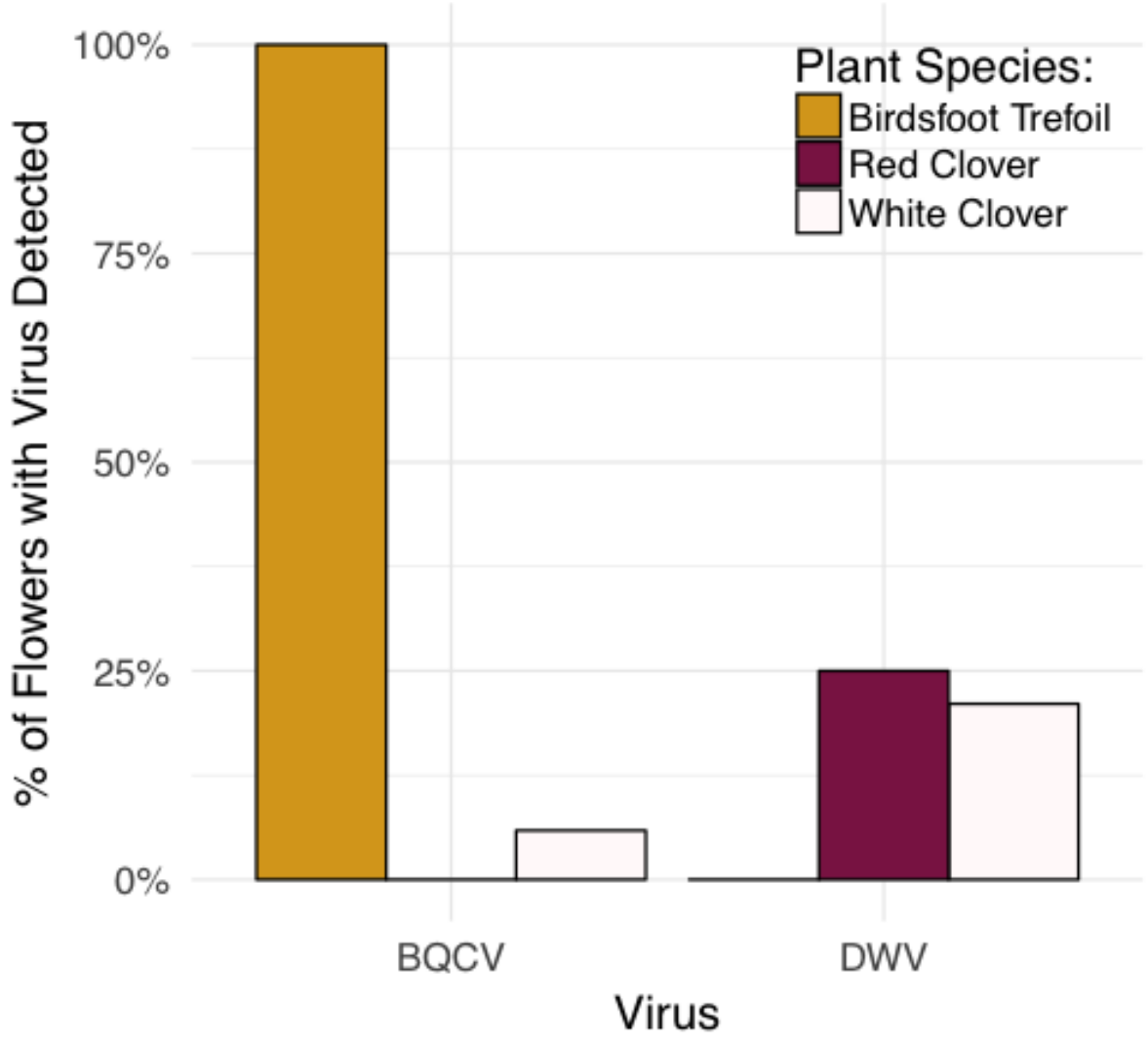
Experimental Setup



Viruses detected only on plants visited by honeybees



Does plant species matter?


100%
75%
50%
25%
0%
% of Flowers with Virus Detected
Plant Species:
Birdsfoot Trefoil
Red Clover
White Clover
BQCV
DWV
Virus

Conclusions

Part I.

What is the prevalence of RNA viruses in bumble bees?

-BQCV is most common, followed by DWV

Is there evidence for disease spillover from managed honey bees?

-Yes, bumble bees are more likely to be infected when caught near an apiary and when the apiary has high viral loads

Part II.

Can flowers act as bridges in disease transmission?

-Bees can deposit viruses on flowers

-Plant species and virus matter!

Questions for future work...

-Can bees become infected after visiting an infected flower?
-Are there differences in how viruses are shed?
(Fecally vs. Orally) -Does floral morphology matter?

Implications

-BQCV is common in bumble bees and its effects should be studied
-Reducing honey bee viral loads (mite management) could lessen spillover of DWV
-Recommendations for ‘pollinator friendly’ habitat

Contributors and Collaborators

- Alex Burnham
- Vermont Beekeepers
- Leif Richardson
- Melanie Kazenel
- Anna Smith & Caitlin Danehy
- Sarah Erskine
- Andrew Nguyen
- Alison Brody
- Joseph Schall
- Sara Helms Cahan
- Taylor Ricketts