Introduction:

Bee local: A comparison of productivity and pathogen load in local vs. Claifornia re-queened colonies

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Acknowledgments

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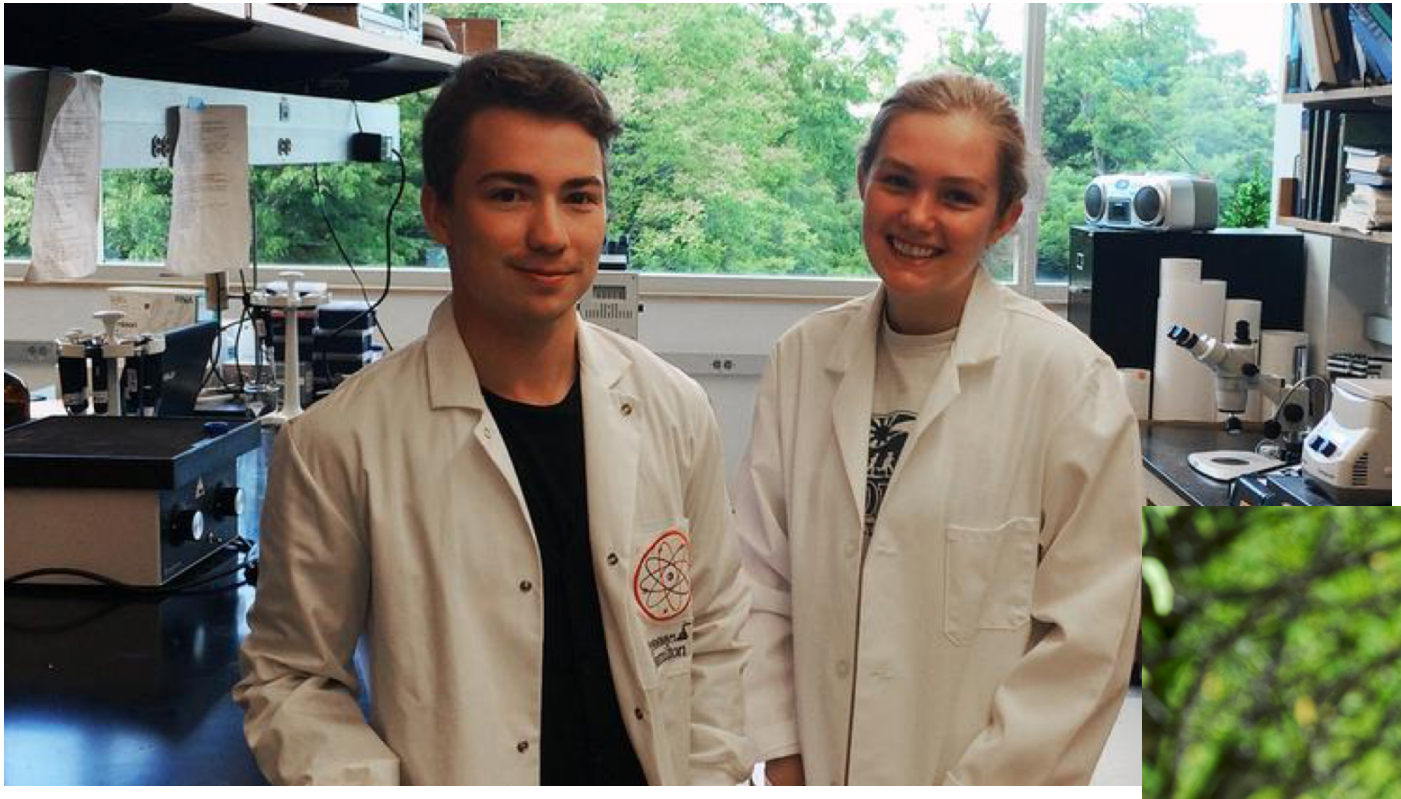
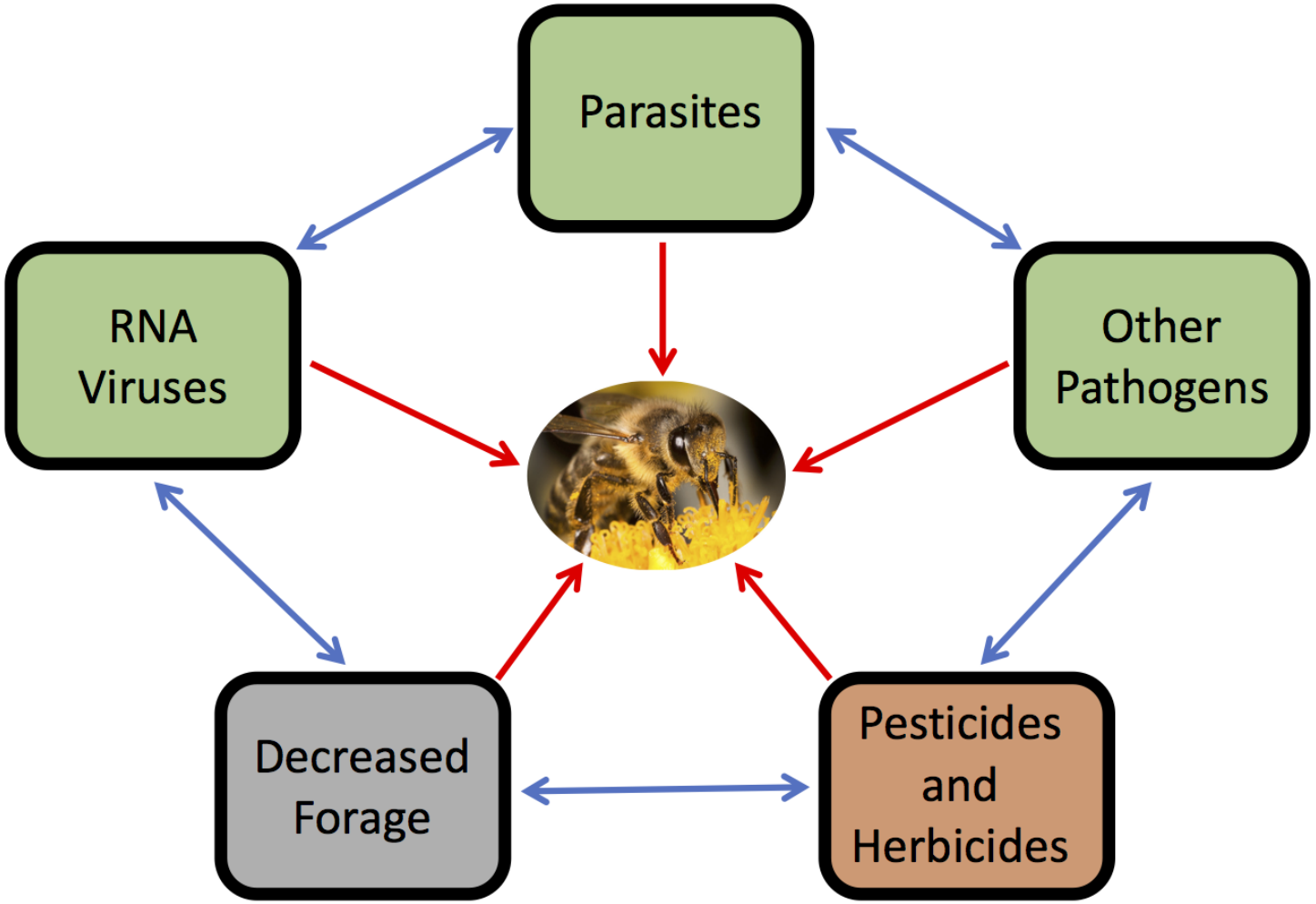
The Bee Team



Honey Bees are Important

- 30% of the world's food is derived from pollination (Aizen et al., 2009)
- Pollinators are responsible for between $235-577 billion (Gallai et al., 2009)
- Honeybees are responsible for $14 Billion in the USA (Morse & Calderone, 2000)

Threats to Bees:



Honey Bee Pathogens

VIRUSES:

- Deformed Wing
- Black Queen Cell
- Israeli Acute Paralysis

PARASITES:

- Nosema (ceranae/apis)
- Varroa Mite

Deformed wing Virus
University of Florida,
Entomology Dept.

Varroa destructor
North Carolina State University,
Cooperative Extension

American Foulbrood
Bee Informed Partnership

Troubles for Beekeepers (re-queening)

The basic premises behind this study

- Imported VS Local
- Local Adapation

The basic premises behind this study

- Mass-Produced VS Handmade
- Selection by the Breeder

The question:

"Are locally-bred queens more successful than imported queens?"

Experiemental Design

- 20 colonies re-queened with Californian-bred queens
- 20 colonies re-queened local-bred (Vermont) queens
- 2 sites, 10 Local and 10 California for each
- Sampled for pathogens and productivity measures
- Sampled at different time points for 3 months

Pictures of the Yards

What we sampled

- Growth:
  - Colony Mass
  - Brood Production
- Foraging:
  - Pollen Production
- Pathogens:
  - Varroa
  - Nosema spp.
  - RNA Viruses

Data Analysis

```
aov.out <- aov(Nosema ~ Origin * Time + Error(FieldID),
      data=QueenDF)

summary(aov.out)
```

Repeated Measures ANOVA output

```
Error: FieldID
            Df    Sum Sq   Mean Sq F value  Pr(>F)
Origin       1 3.156e+13 3.156e+13   7.972 0.00779 **
Time         1 2.589e+12 2.589e+12   0.654 0.42413
Origin:Time  1 9.223e+11 9.223e+11   0.233 0.63234
Residuals   35 1.386e+14 3.959e+12
---

Error: Within
            Df    Sum Sq   Mean Sq F value   Pr(>F)
Time         1 5.620e+10 5.620e+10   0.017 0.896098
Origin:Time  1 4.934e+13 4.934e+13  15.111 0.000275 ***
---
```

Graphics

```
NosemaSummary <- ddply(QueenDF, c("Origin", "NosemaDay"),
                       summarise,
                       n = length(Nosema),
                       mean = mean(Nosema, na.rm = TRUE),
                       sd = sd(Nosema, na.rm = TRUE),
                       se = sd / sqrt(n))
```

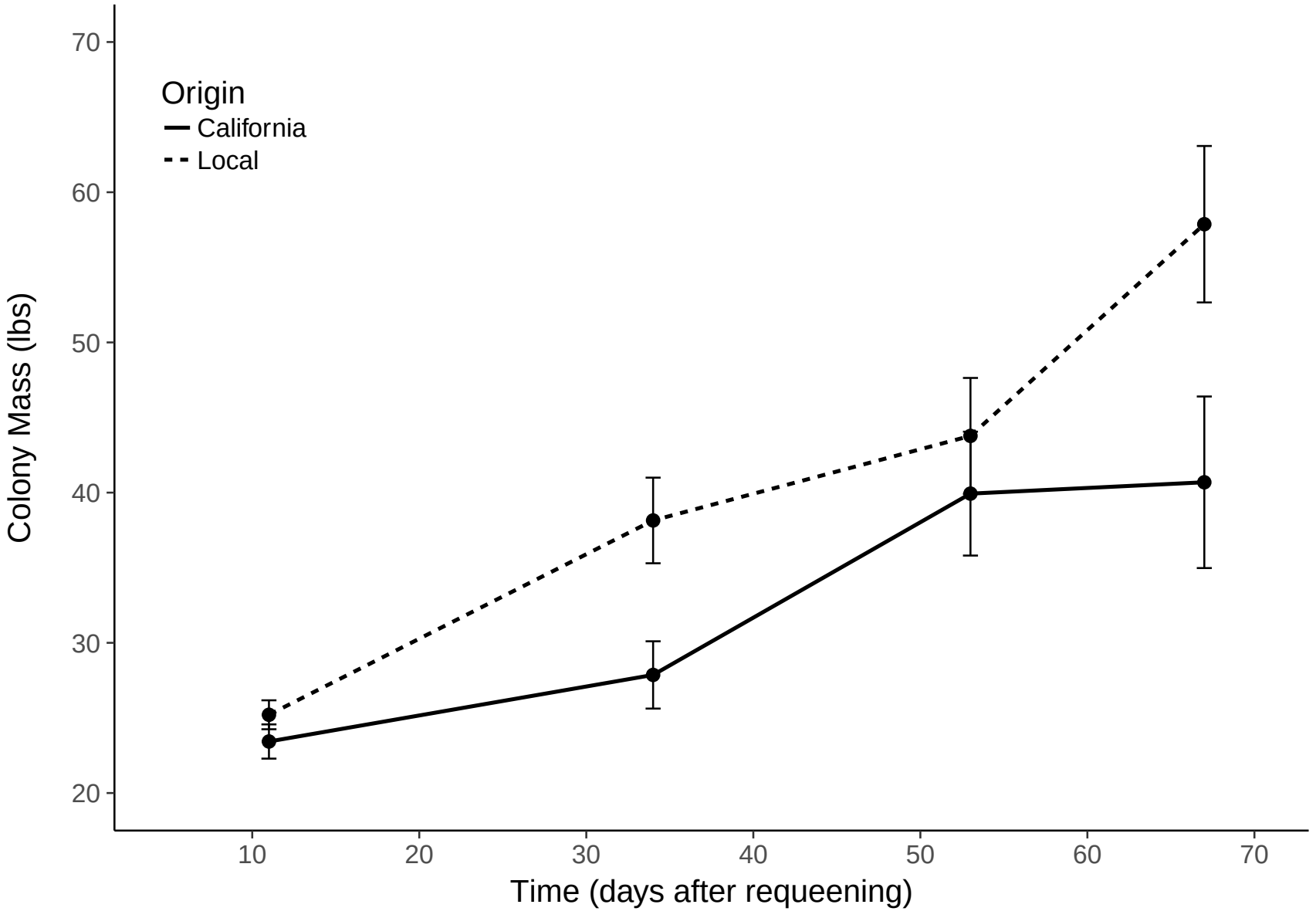
Graphics

```
nosema <- ggplot(data = NosemaSummary,
                 aes(x = NosemaDay,
                     y = mean,
                     group = Origin)
) + geom_point(size=3)
+ scale_colour_manual(values = c("black", "black"))
+ labs(x = "Time (days after requeening)",
    y = "Nosema Load (spores/bee)")
+ coord_cartesian(ylim = c(0, 4300000),
    xlim = c(10,70))
+ geom_errorbar(aes(ymin = mean - se,
ymax = mean + se, width = 0.9))
+ geom_line(aes(linetype=Origin), size=1)
+ scale_fill_brewer(palette = "Paired")
+ theme_classic(base_size = 17)
+ theme(legend.position=c(.15, .85)
+ labs(linetype="Queen Origin")
```

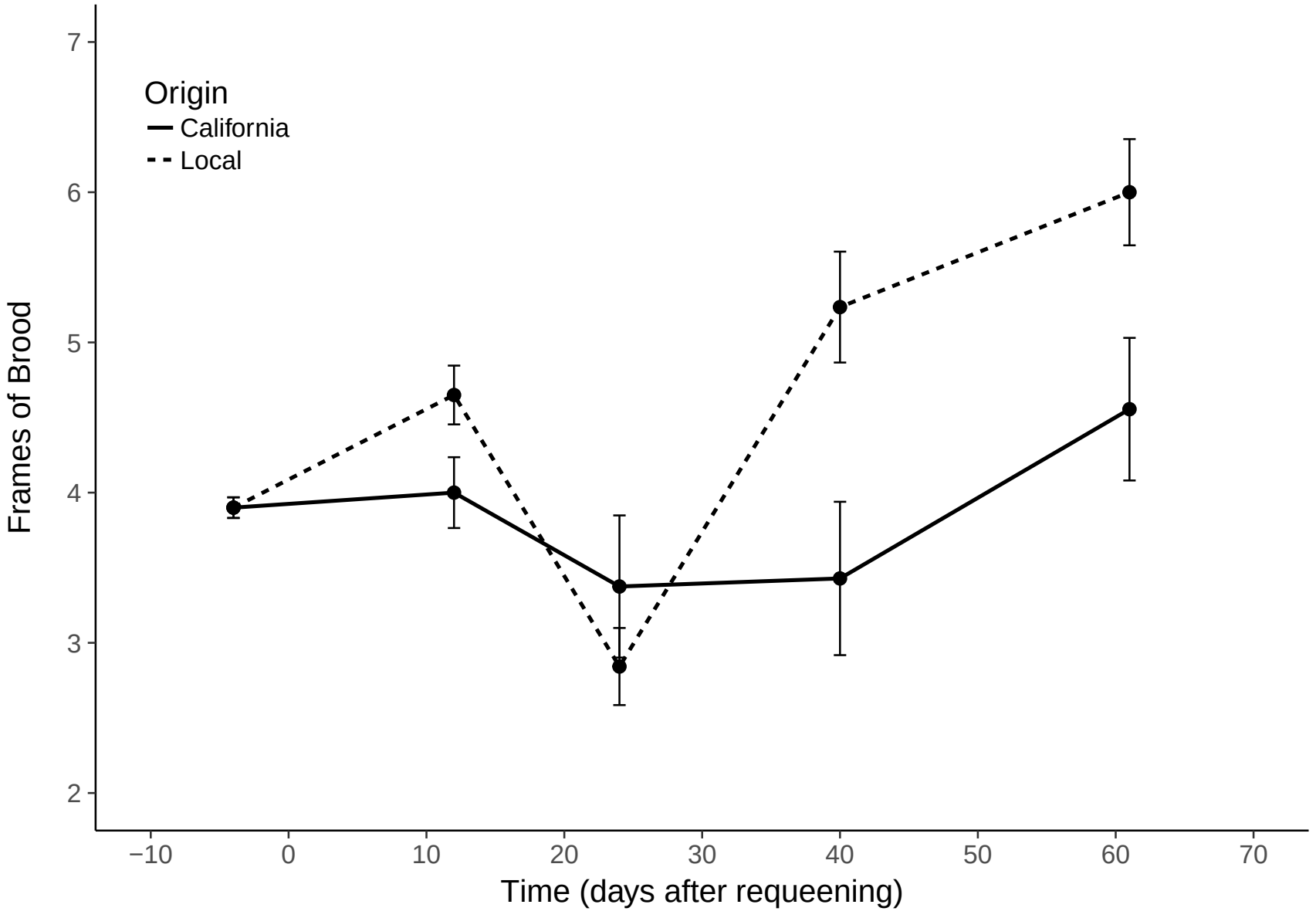
Our Predictions

- Local queens (colonies) will have higher growth through the season
- Local queens will be better foragers
- Local queens (colonies) will have lower pathogen loads

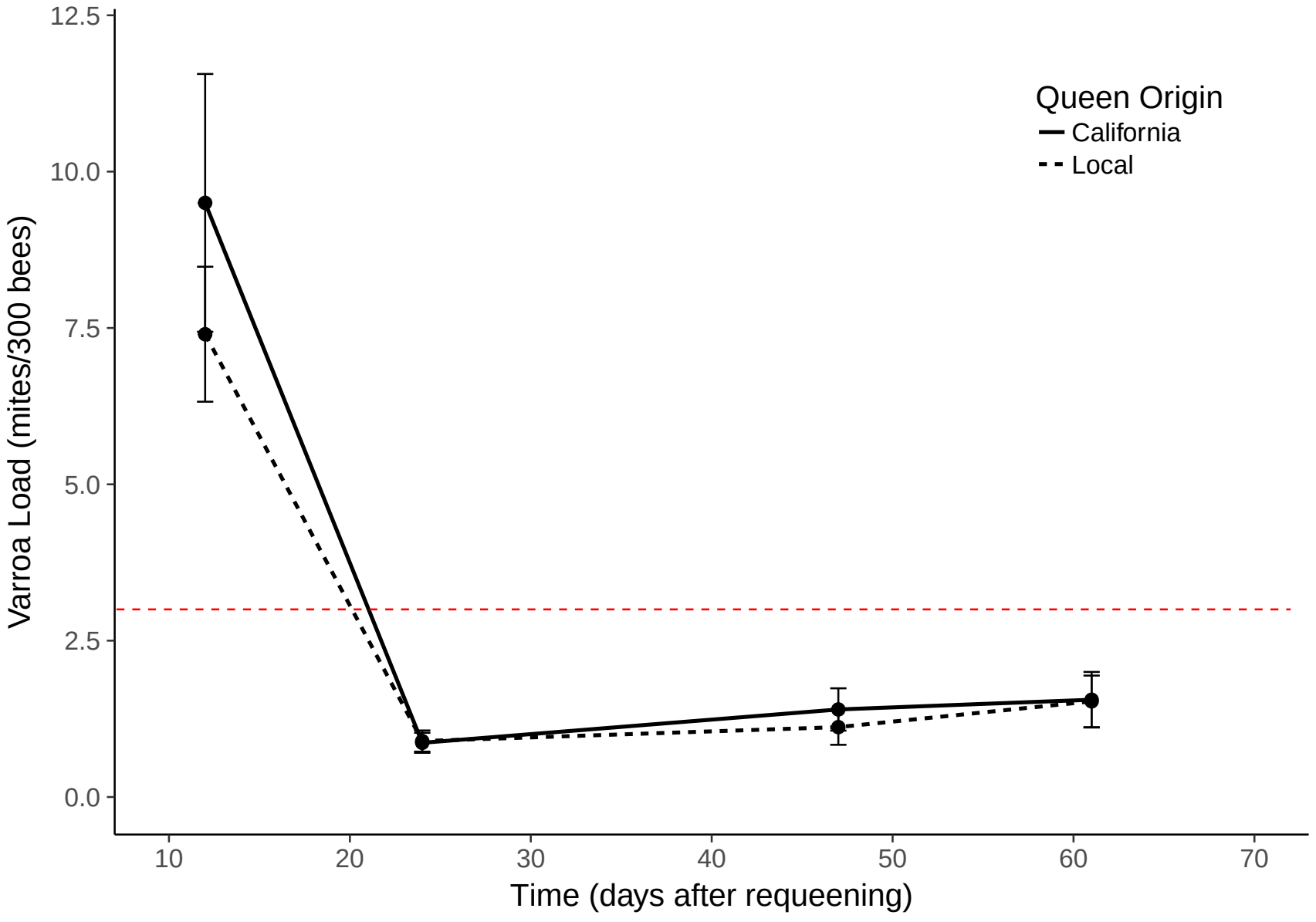
Colony Mass (growth)



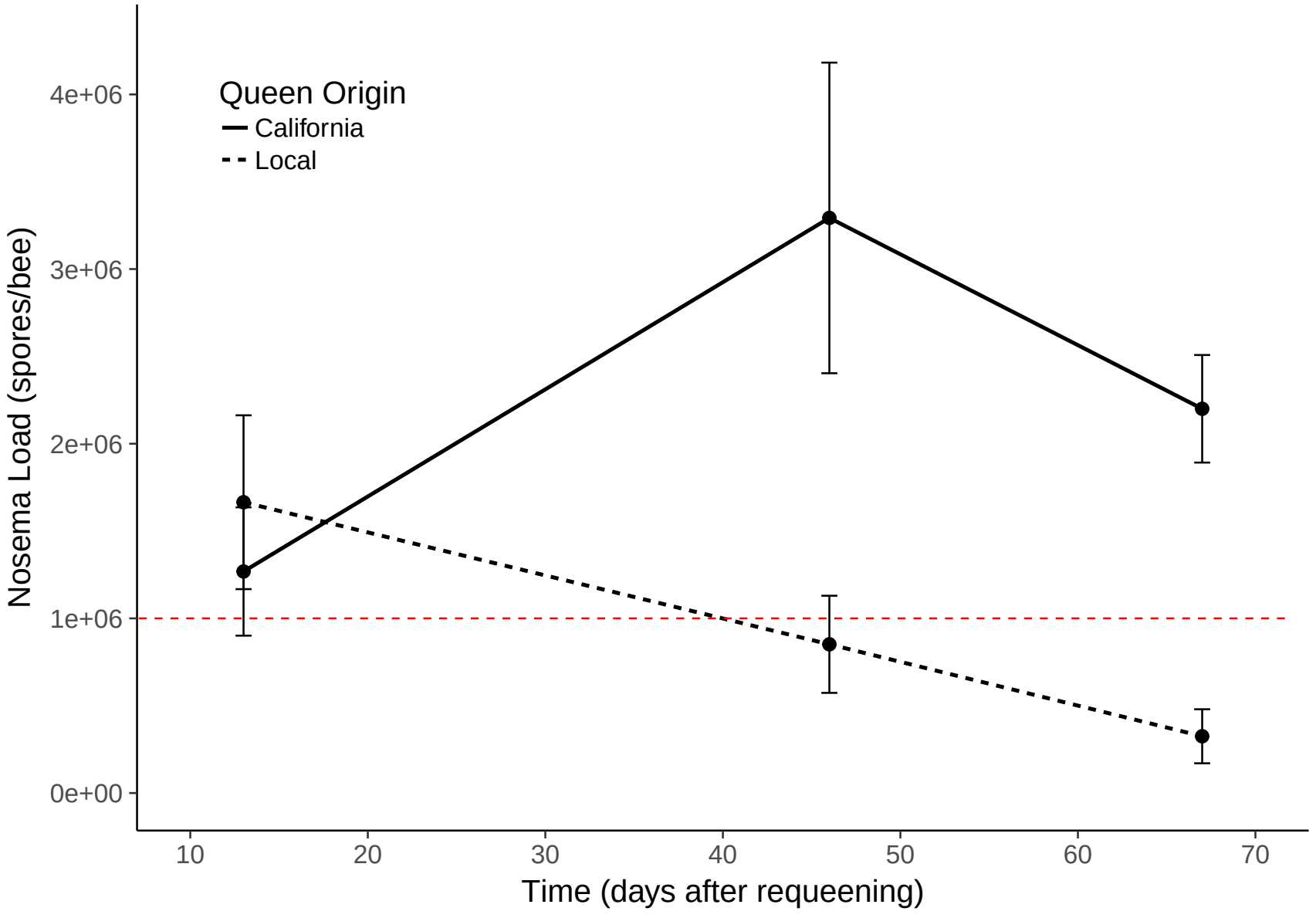
Frames of Brood (growth)



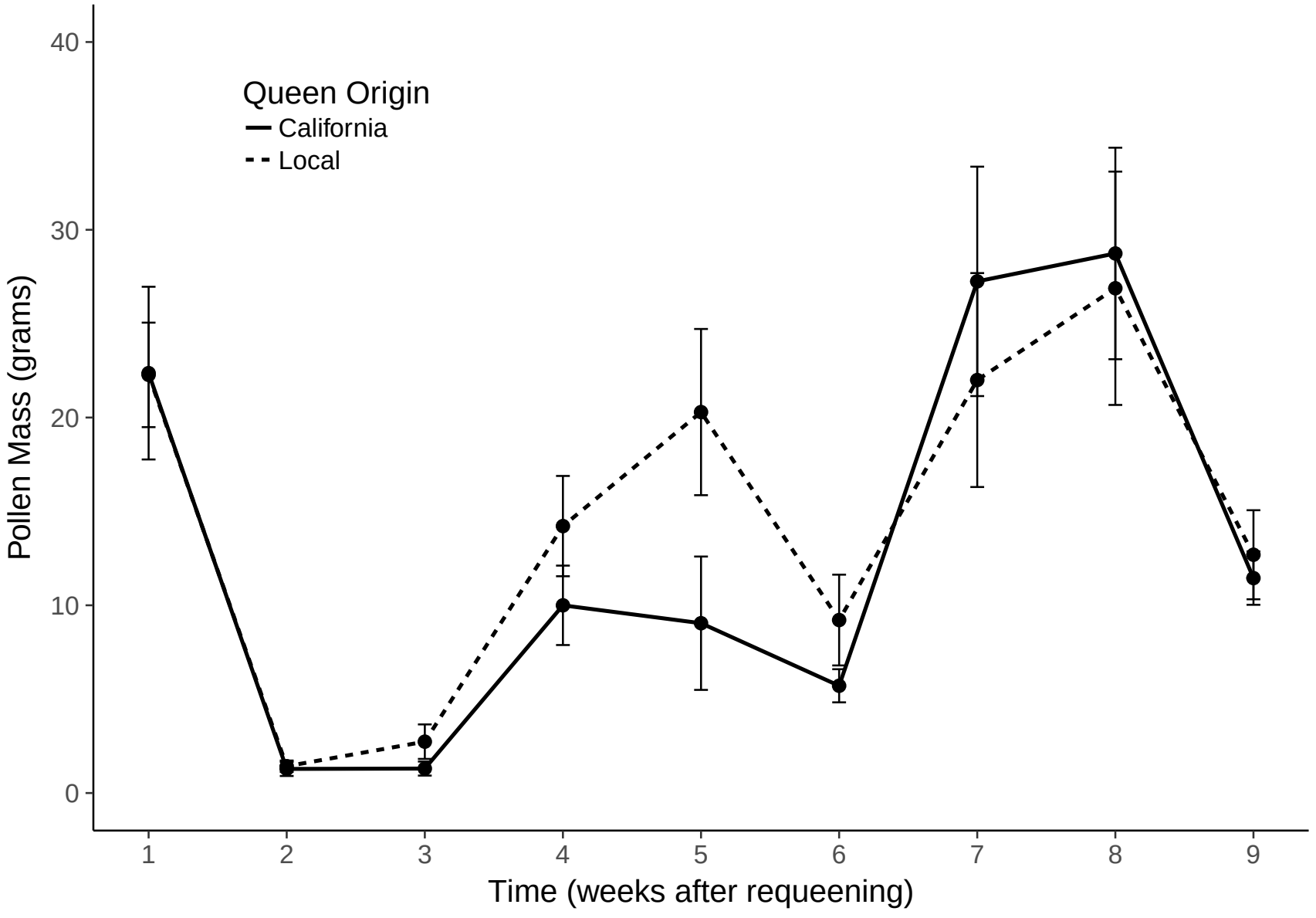
Pollen Collection (foraging)



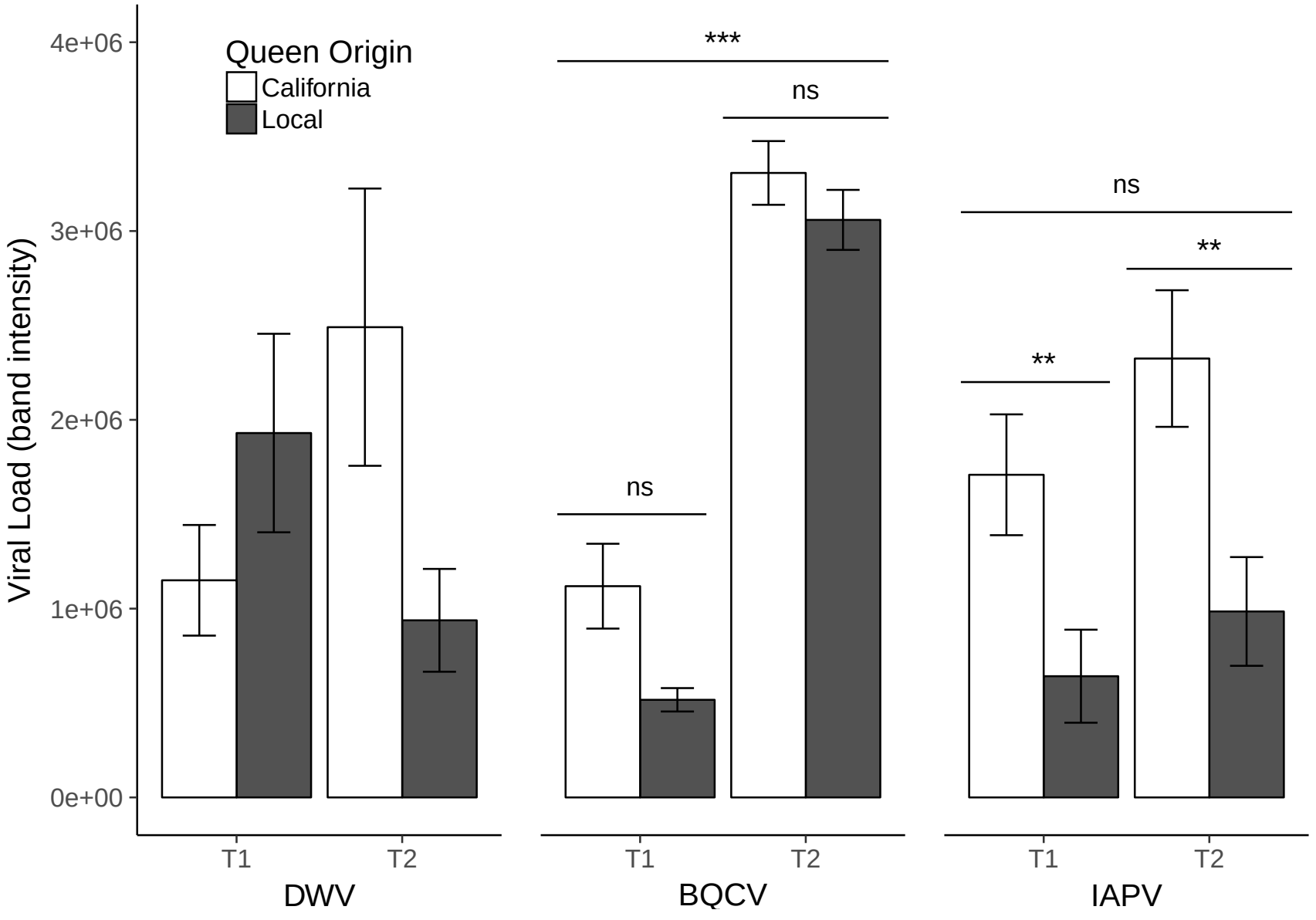
Varroa Load (pathogens)



Nosema Load (pathogens)



Viral Load (pathogens)



In Summary

- Colony Mass = **Higher in Local**
- Amount of Brood = **Higher in Local**
- Pollen Collection = **No Difference**
- Varroa Load = **No Difference**
- Nosema Load = **Lower in Local**
- RNA Viruses = **Mixed Results**

In Summary

- Overall, colonies re-queened with locally raised queens had higher growth
- Pollen collection did not seem to be involved in this growth
- Some pathogens seemed to have less of an effect on local honeybees and others had similar effects across both groups

Implications

- Locally-raised queens outperform mass-produced, California queens in their northern environment.
- This could be evidence for the importance of care in breeding stocks (mass produced vs handmade)
- **And/Or** This could be evidence for local (genetic) adaptation (imported vs. local)

Thank you!

Questions?