# Farming for Native Bees in SoCal and NorCal

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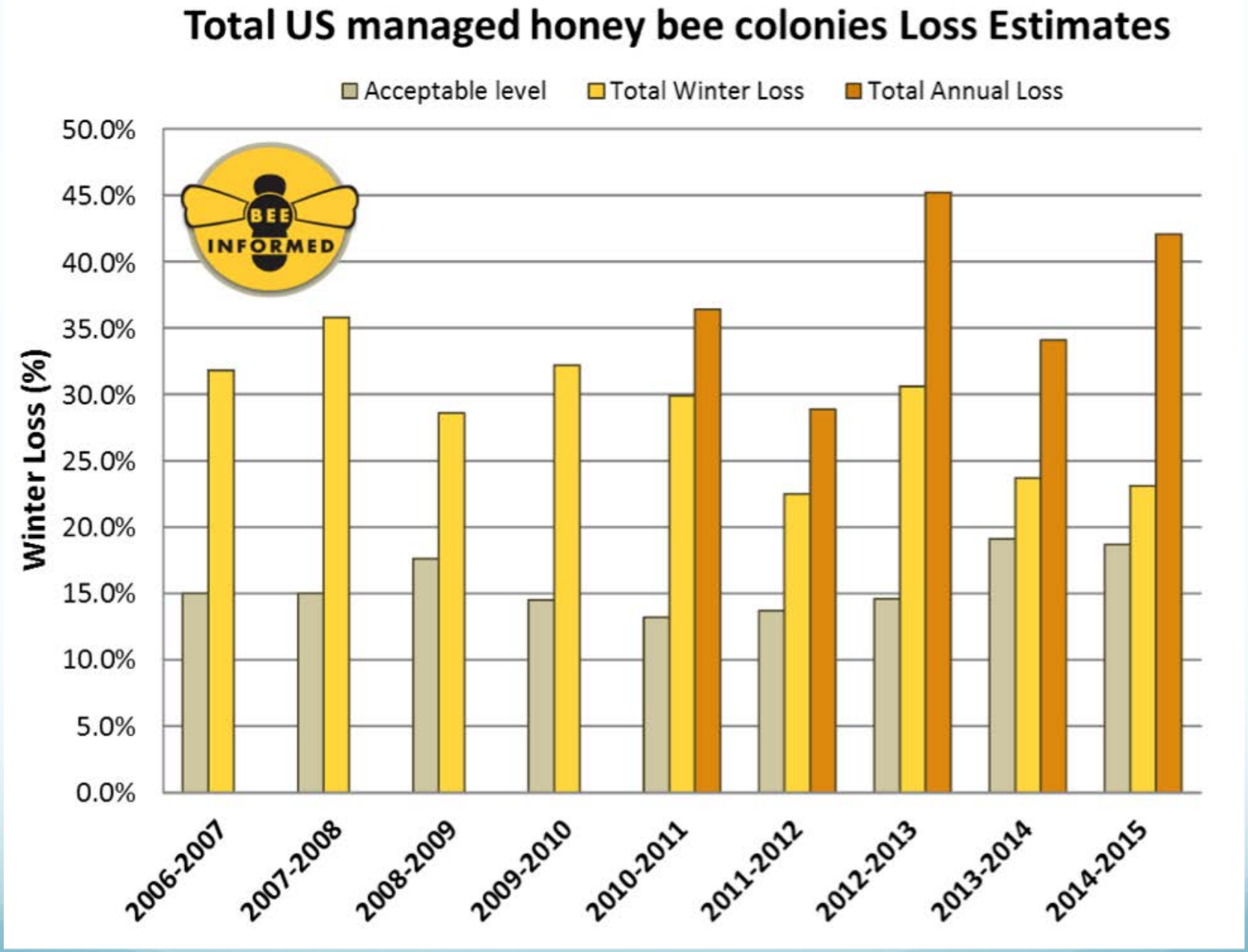
# Introduction

- Honey bees (Hb) are in trouble in U.S. and elsewhere
- U.S. winter mortality: normal avg. ~15%
  - 2013 winter mortality: ~34%
  - 2014 annual mortality: ~42%
    - 2014 winter losses were down from 2013 to 23.1% but summer losses were 27.4%, exceeding winter losses for the first time




Graph from Steinhauer et al 2015 Colony Loss Report from the Bee Informed Partnerhsip, USDA, and Apiary Inspectors of America

# Hb Decline

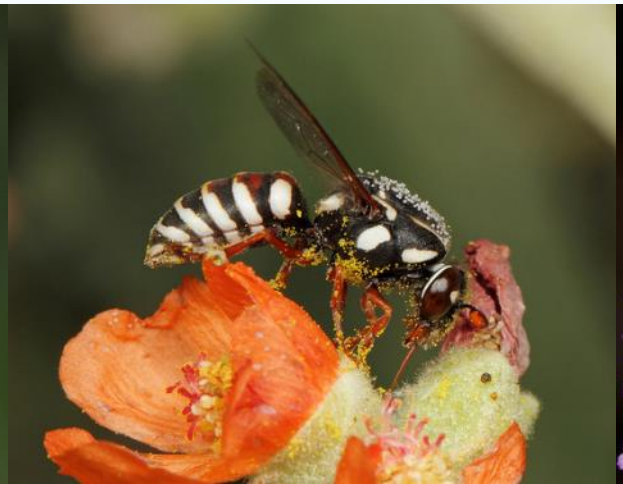
- Several reasons advanced to explain Hb decline:
  - Poor nutrition
  - Pesticides (esp. neonics)
  - Hive movements (long-distances)
  - Increases in natural enemies (e.g. mites, viruses)
  - Extreme weather

# White House Call for Action: Sept. 2015

- More research on Hb
- More attention to monarch butterflies
- More attention to other pollinators (e.g. native bees)

# Alternatives to honey bees

- Native bees
- Flies, butterflies, wasps, beetles
- What we currently know about these flower visitors


# Outline

1. Native bees as supplements to Hb
2. Overview of CA native bees
3. Native bee ecology
4. Goal of Ag research
5. Brentwood project
6. Avocado project

# Native bee species as supplements to Hb pollinator services

- Why?
- Known for Ag pollination services from anecdotal studies by researchers
- Some species well known already: blue orchard bee (BOB), alkali bee (single species approach)

# Overview of CA Native Bees

- ~ 4,000 bee species native to North America
- ~1,600 bee species recorded in California
- 6,500+ flowering plant species (angiosperms) in California

*Centris rhodopus*

*Ceratina* spp.

# Importance of Bee Pollination

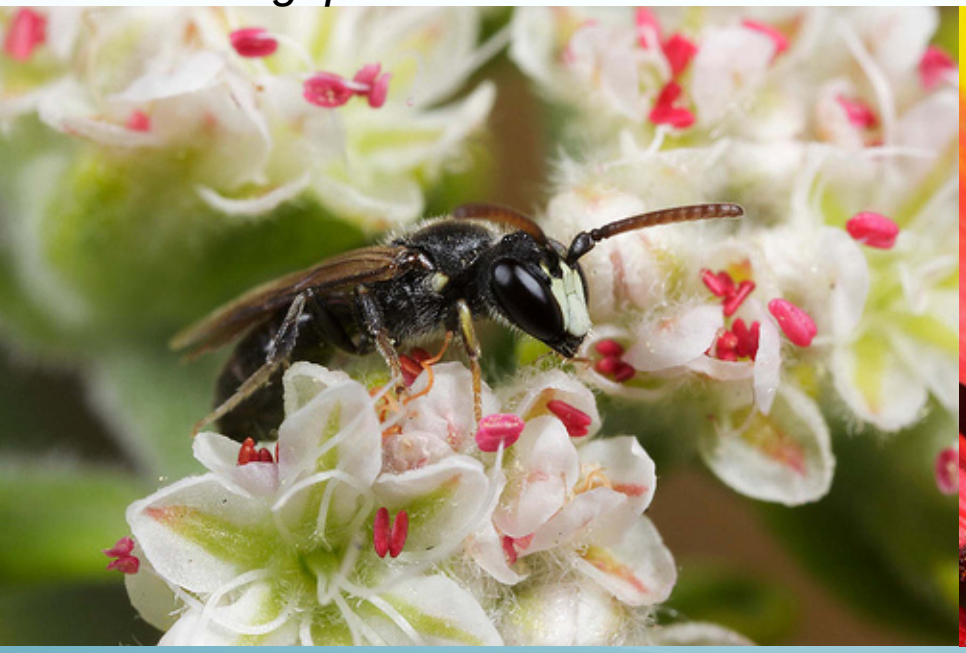
- In the U.S. and Canada, about 100 crops are pollinated by bees
- Food from bee pollinated crops comprise ~30% of our daily diet
- Some crops require bee pollinators: alfalfa, avocado, almond, apple, berries, cantaloupe, kiwi, plum, squash, sunflower, watermelon, ….
- Economic value of bees: high

# Native Bee Biology, Behavior & Ecology

- Much variation among bee species
- **Each bee species has its own story**
- Fertile ground for research and outreach

*Agapostemon texanus*

*Melissodes* sp.



*Hylaeus* sp.

*Megachile perihirta*

*Xylocopa varipuncta*

*Trachusa bequarti*

*Halictus* sp.

*Andrena nigrocaerulea*

# Native Bee Ecology

- Most native bees are solitary nesters
- ~ 70% of bees nest in the ground; 30% in pre-existing cavities
- Nesting implications for habitat gardening

# Pre-existing Cavity Nesters:

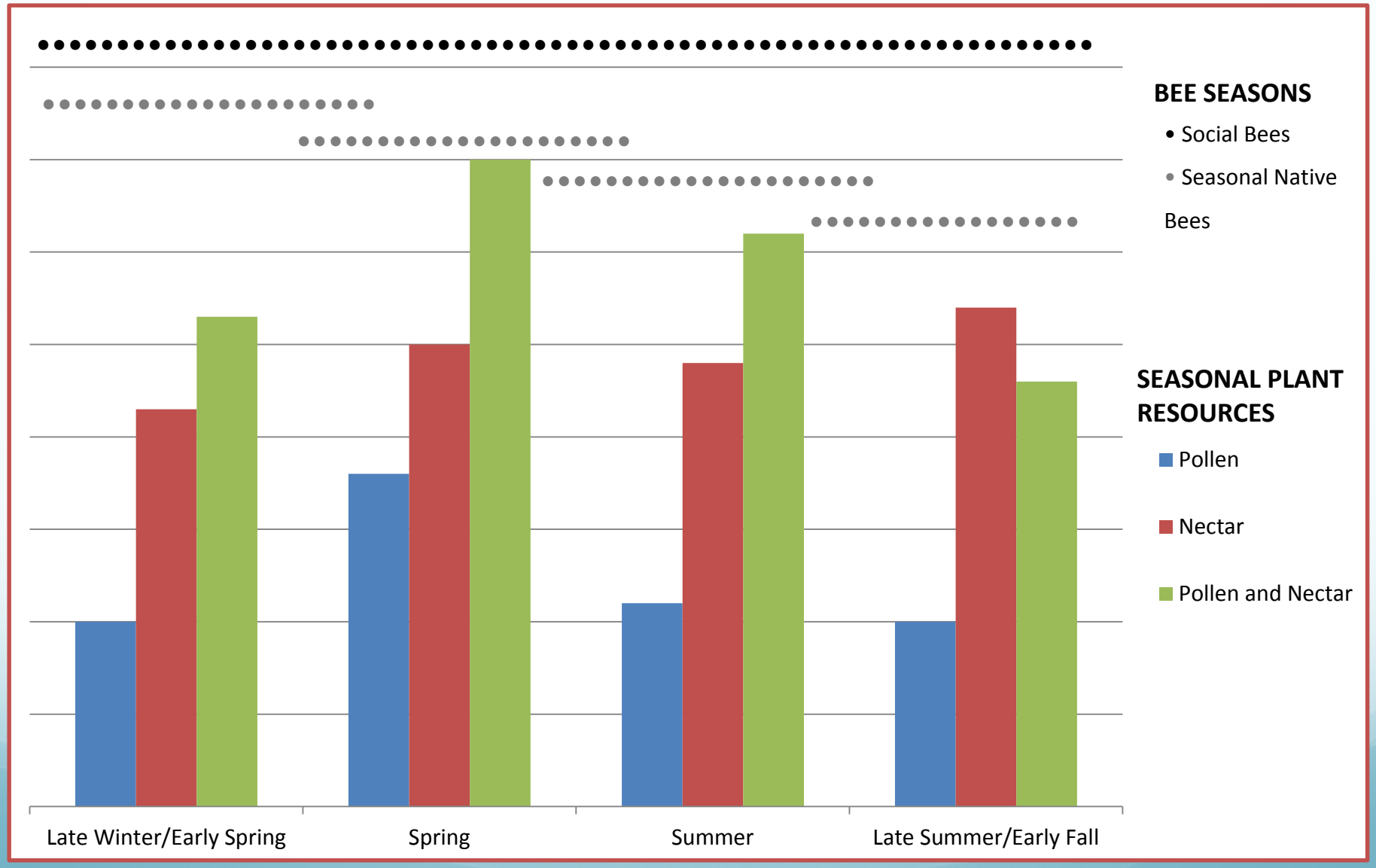
## Leaf cutters in wooden trap nests

# Native Bee Ecology

- Three things bees need: pollen, nectar, and mating
- Only females sting!
- Three types of pollen collection, depending on bee group

*Xylocopa varipuncta* male

# Native Bee Ecology



# Goal of UC Berkeley Research: Farming for Native Bees Project

Evaluate native bees as **supplemental** pollinators to honey bees of crop flowers.

Same goal for SoCal and NorCal.

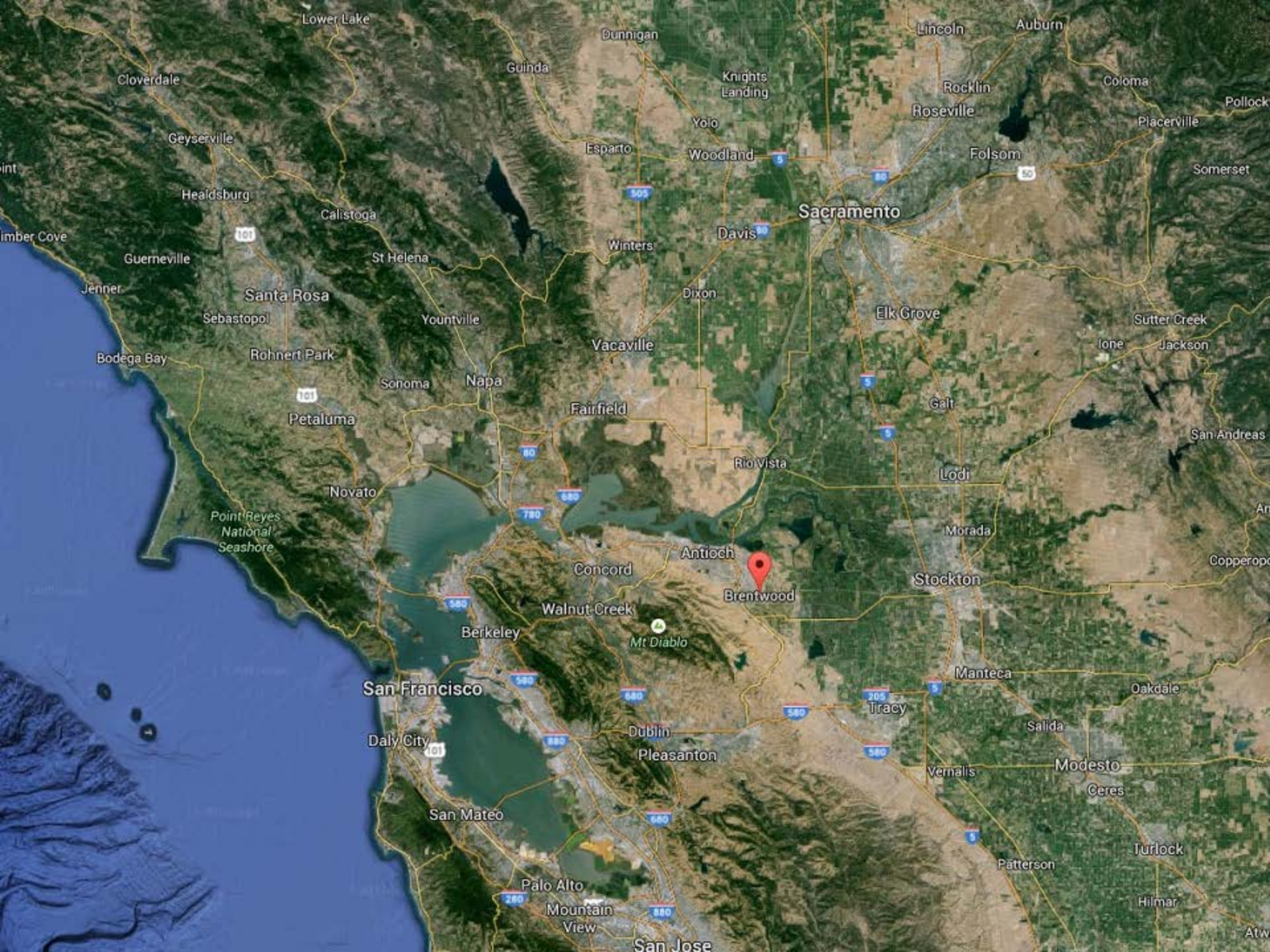
# Research Goals cont.:

- Develop habitat for native bees in Ag. Areas.
  - Flowers- pollen and nectar
  - Synchronize flg of bee plants with crop flowers
  - Nesting resources- soil and cavity nesters
  - Security
- Can we also expect farmers to adopt the info that we develop on these bees?

# Brentwood Project

- Invitation in 2009: To bring urban bee-plant knowledge to Frog Hollow farm to:
  - Construct habitat in orchards to attract native bees to **supplemen**t honey bee pollination
  - **Monitor populations** of native bees through time
  - **Partner** with farmers to **outreach** information to agr. professionals, USDA-NRCS, UCCE, Brentwood Agr. Land Trust, schools, and CNPS

NRCS
Natural Resources Conservation Service


Lower Lake
Dunnigan
Lincoln
Auburn
Cloverdale
Guinda
Knights Landing
Rocklin
Coloma
Roseville
Pollock
Placerville
Geyserville
Yolo
Esparto
Woodland
Folsom
Somerset
Healdsburg
Calistoga
Sacramento
Davis
Winters
Guerneville
St Helena
Jenner
Santa Rosa
Dixon
Elk Grove
Sebastopol
Yountville
Sutter Creek
Vacaville
Ione
Jackson
Bodega Bay
Rohnert Park
Sonoma
Napa
Galt
Petaluma
Fairfield
San Andreas
Rio Vista
Lodi
Novato
Point Reyes National Seashore
Morada
Antioch
Concord
Stockton
Brentwood
Walnut Creek
Berkeley
Mt Diablo
Manteca
San Francisco
Oakdale
Tracy
Salida
Daly City
Dublin
Pleasanton
Modesto
Vernalis
Ceres
San Mateo
Turlock
Patterson
Palo Alto
Hilmar
Mountain View
San Jose


FROG HOLLOW FARM
organically grown

# Dwelley Farm

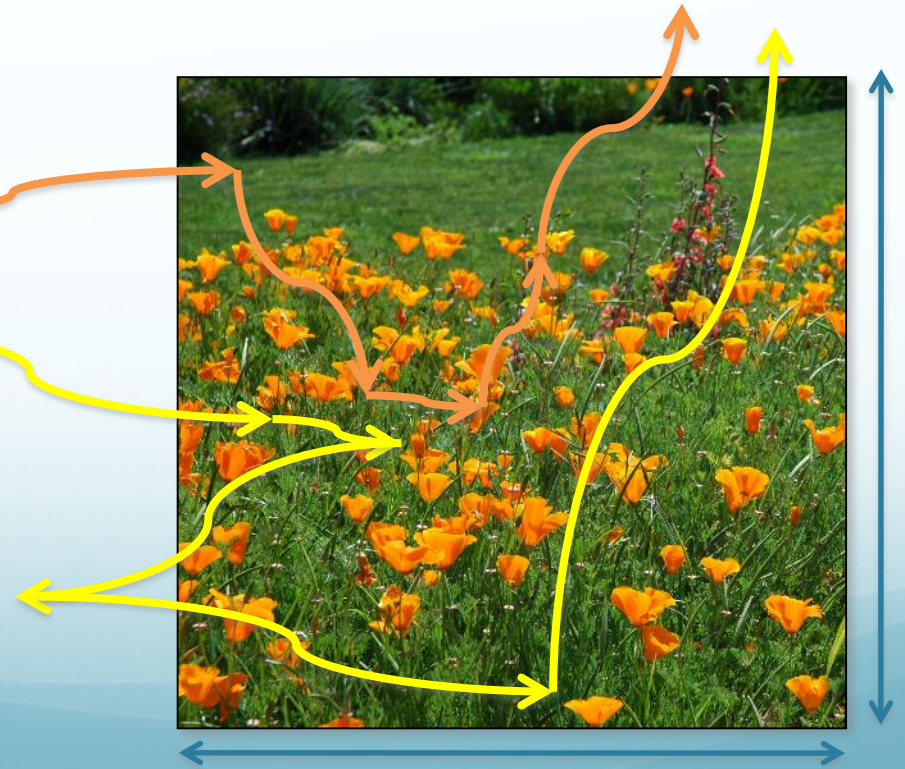
# Bee Monitoring 2010-2015

- **Pan** trapping and **aerial** collections (netting)
- Establish baseline native bee diversity and abundance
- No. of sample periods per year (3)

# Bee Monitoring Cont.

- **Identify** bee groups moving from bee plants to crops
- Flower **visitation counts**

**Count bee visits to 1.5 $m^2$ patch of flowers**



# Brentwood Farm Results: Bees

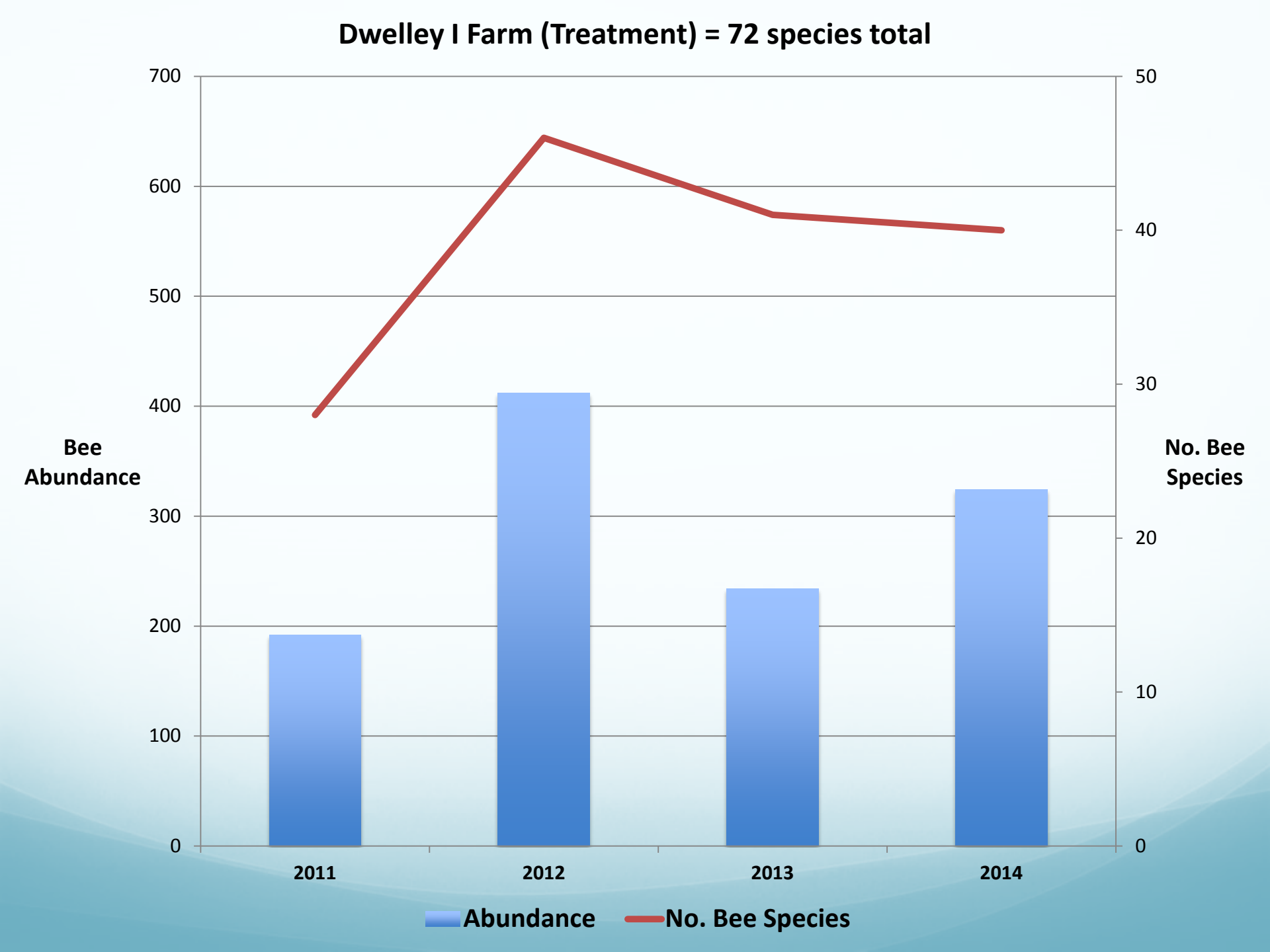
- Numerous bee plants (**80+ types**) added in 2010-2015 attracted **127 species** of bees

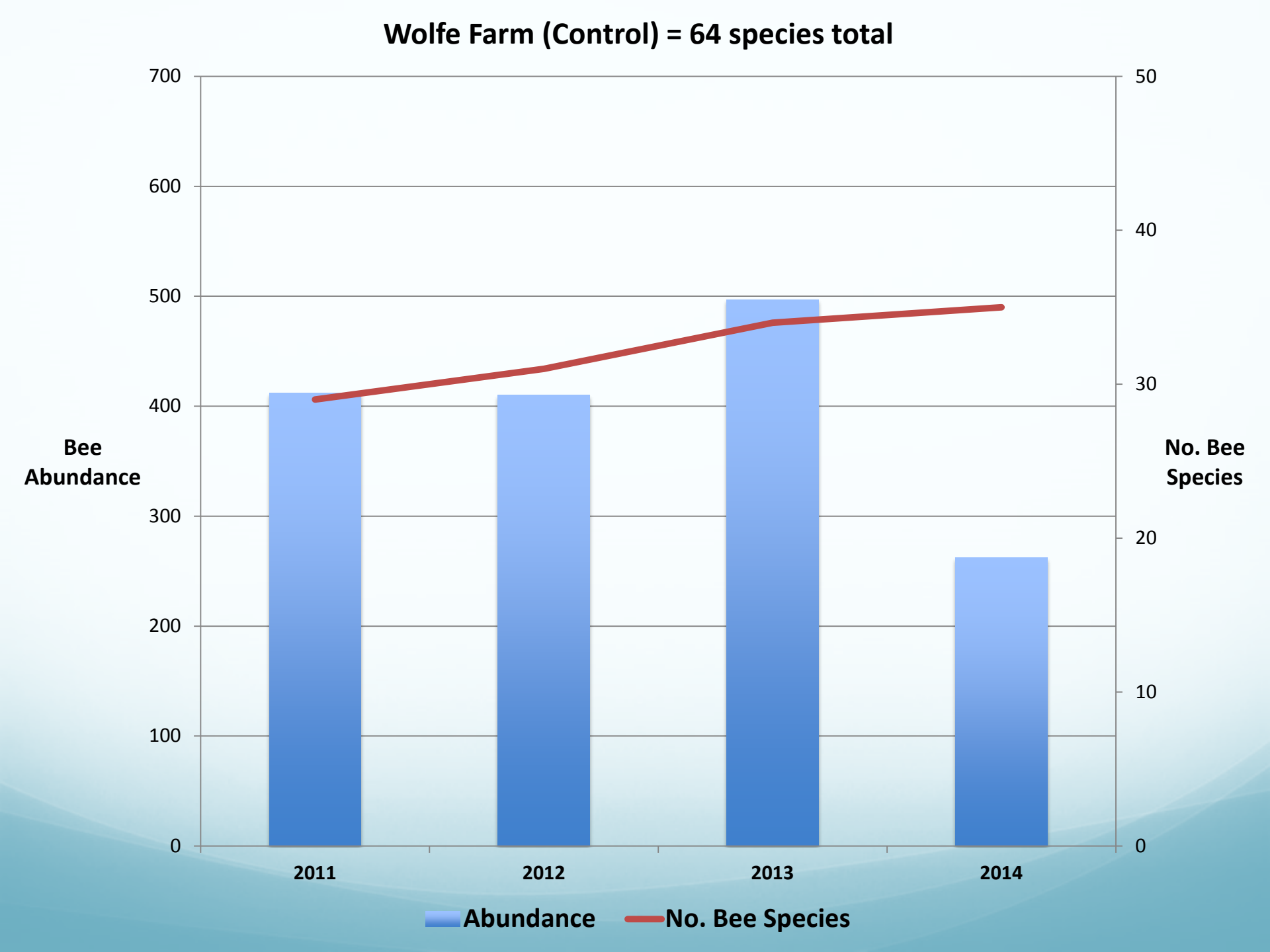
- Main bee groups moving between bee plants and crop flowers
  - 2 species of *Bombus* (Bumble bees)
  - 2 species of *Ceratina* (Small carpenter bees)
  - >4 halictid species (Sweat bees)
  - Several *Osmia* species (Mason bees and Leaf Cutter bees)
  - Several *Andrena* species (Mining bees)
  - Apids (*Anthophora* and *Habropoda)* species (Digger bees)

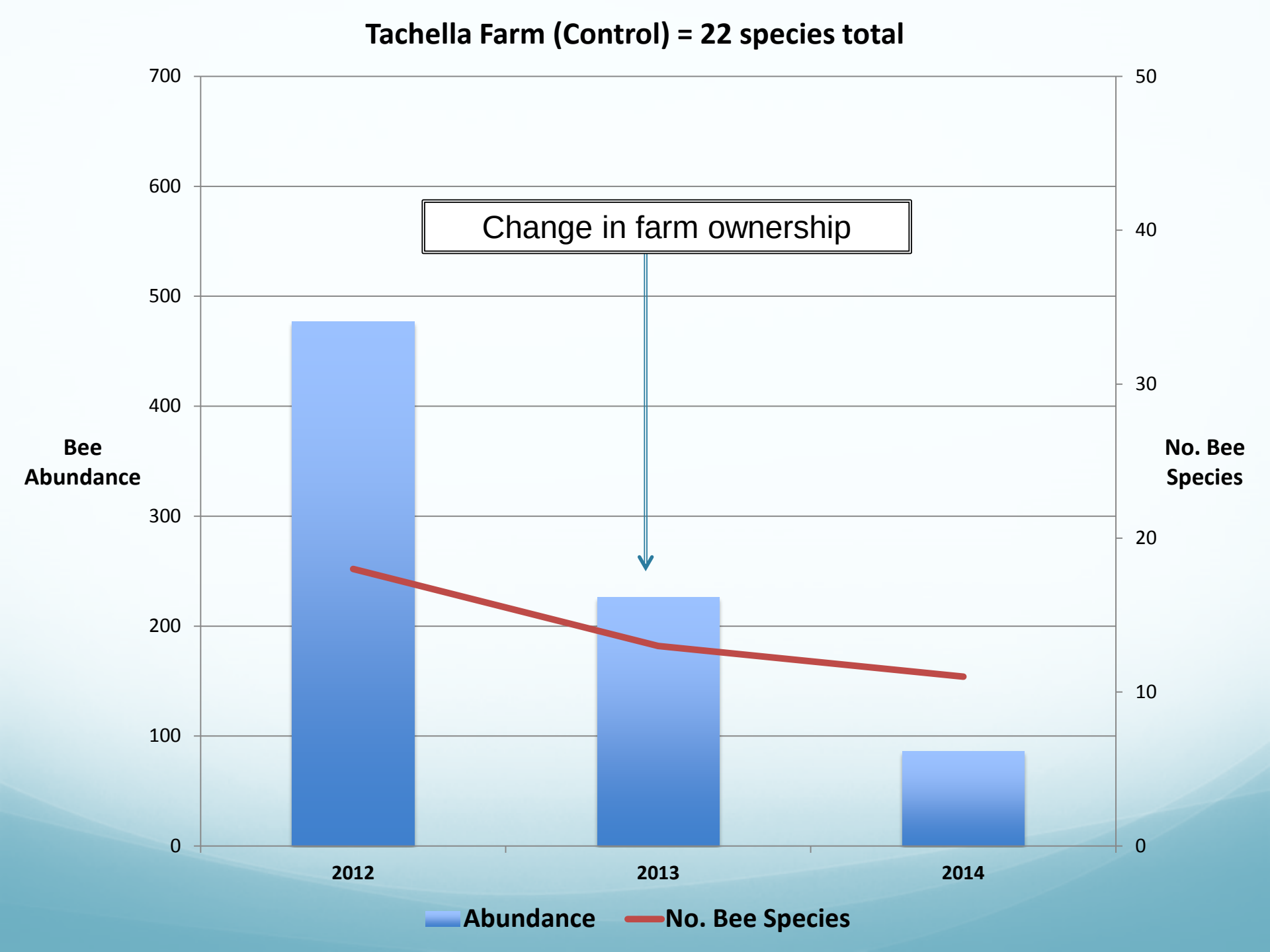


# Brentwood Farm Results: Species

| | Farm | 2010 | 2011 | 2012 | 2013 | 2014 | Total Unique Spp. |
|---|---|---|---|---|---|---|---|
| Treatment | Dwelley I (Delta) | -- | 28 | 46 | 41 | 40 | **72** |
| | Enos Farm | -- | 13 | 18 | 23 | 35 | **47** |
| | Frog Hollow | 11 | 20 | 28 | -- | 22 | **46** |
| | Bookside Farm | -- | 35 | 29 | 31 | 35 | **57** |
| | | | | | | | |
| Control | Dwelley II (Concord) | -- | -- | 19 | 14 | 17 | **27** |
| | Knoll Farm | 13 | -- | 19 | 18 | 13 | **31** |
| | Tachella Farm | -- | -- | 18 | 13 | 10 | **22** |
| | Wolfe Farm | -- | 29 | 31 | 39 | 35 | **64** |
| | **Total Unique Spp.** | **18** | **58** | **87** | **73** | **75** | **127** |


Dwelley I Farm (Treatment) = 72 species total
Bee Abundance
No. Bee Species
700
600
500
400
300
200
100
0
50
40
30
20
10
0
2011
2012
2013
2014
Abundance
No. Bee Species


Wolfe Farm (Control) = 64 species total
700
600
500
400
300
200
100
0
50
40
30
20
10
0
Bee Abundance
No. Bee Species
2011
2012
2013
2014
Abundance
No. Bee Species


Tachella Farm (Control) = 22 species total
Change in farm ownership
Bee Abundance
No. Bee Species
700
600
500
400
300
200
100
0
50
40
30
20
10
0
2012
2013
2014
Abundance
No. Bee Species

Halictid on Bristly Ox-tongue (*Picris echioides*)

Honey Bee on Bristly Ox-tongue (*Picris echioides*)

# Where do native bees come from?

# East Contra Costa Hills


Urban-Ag Interface

# Additional Results

- New information on managing bee plants in Ag systems
- Bee plants also provide pollen and nectar for resident honey bees
- Interfacing **bee ecology** info with **farming ecology**
- **Partnering** with farmers to share and exchange knowledge

New bee condo work

# Brentwood Conclusions

1. **Can attract** diverse native bees to constructed habitats in urban and Ag areas.
2. **Can synchronize** flowering of crop plants with flowering of bee plants.
3. **Can attract** native bees to crop flowers.
4. **Can encourage target native bee species** with floral and nesting resources

# Brentwood Conclusions cont.

5. New **partnerships** with farmers can guide implementation. **Pollinator Habitat Advisor (PHA)**
6. Analysis of **business/economics** of implementation of ecological data
7. Challenges and opportunities: more Ag space, more nesting info, farmer adoption methods, extreme environmental factors

# Beyond Brentwood: Avocado Orchards in Ventura Co.2014-2017

Goals & Methods

(Same as Brentwood)

1. Establish bee habitat garden
2. Synchronize bee flg periodicity with avocado flg
3. Record bee spp. visiting bee flrs. thru time—monitoring
4. Conduct bee visitation counts on avocado flrs. adj to bee garden

# Avocado Partners

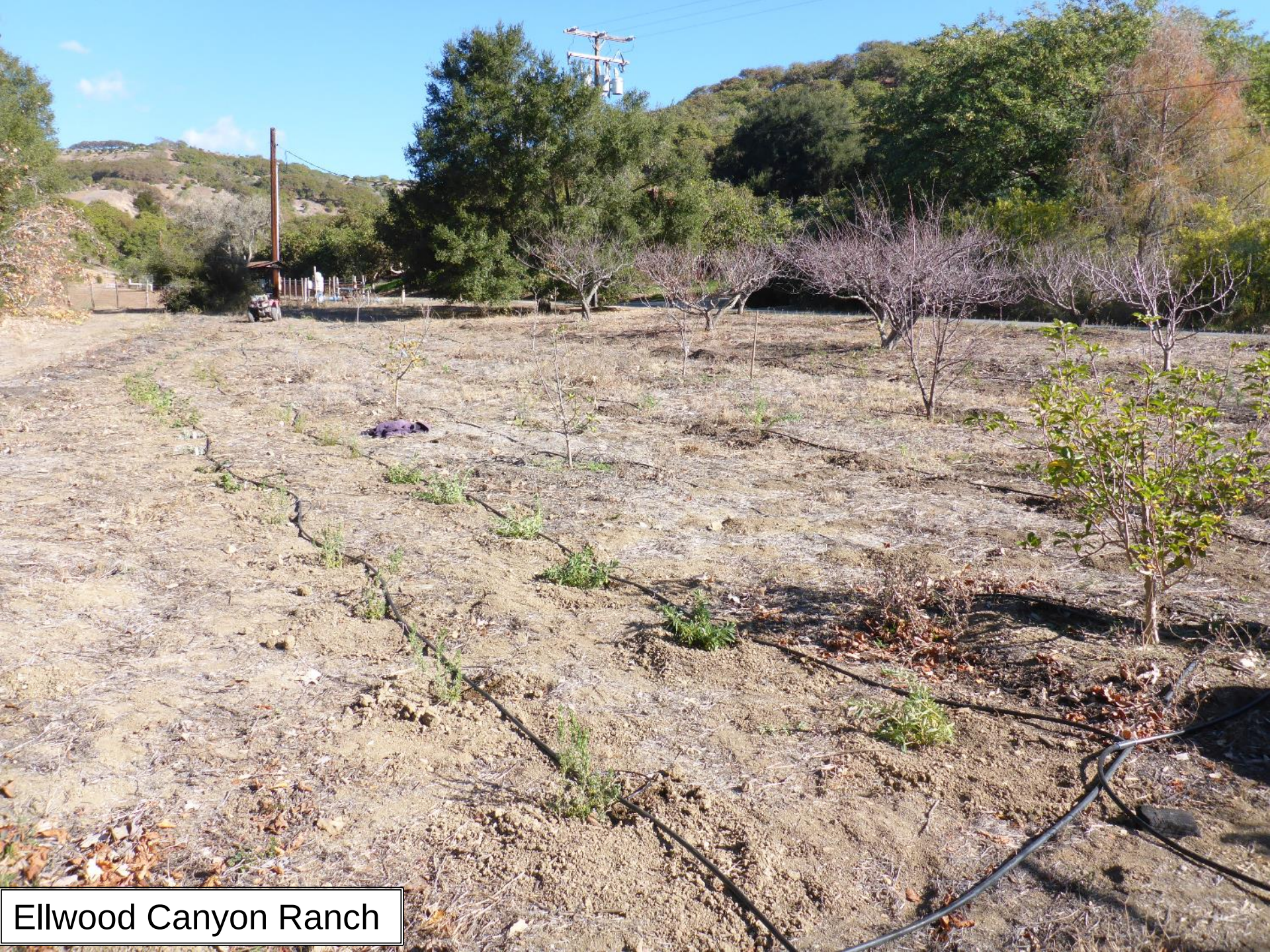
- Thille Orchard — Santa Paula
- J. Lloyd-Butler Orchard — Saticoy
- Ellwood Canyon Ranch — Goleta
- Hilltop Farm (new in 2016?) — Carpinteria

-AND-

- McGrath Family Farm (row crops) — Camarillo

# Avocado Orchards (SoCal)

Thille Orchard


Ellwood Canyon Ranch


Ellwood Canyon Ranch

Ellwood Canyon Ranch


Ellwood Canyon Ranch

J. Lloyd-Butler Orchard

J. Lloyd-Butler Orchard

Pleasant Valley Historical Society & Museum, Camarillo, CA

# Results: 2014-Jan. 2016

- Completed **baseline data** at all farms:
  - Low bee diversity due to ongoing drought
  - Late rains in April 2015—spurt of bee activity; implications for upcoming year
- Established **3 habitat gardens**:
  - Ellwood Canyon: 99 plants; 22 plant types
  - J. Lloyd Butler: 85 plants; 17 plant types
  - McGrath: 98; 20 plant types
- Hb **visitation counts** on avocado flowers
- **Outreach** to farmers

# Thank you to our funders!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