




BlueOrchardBeesInArizonaProject

Final Report

This is the [BlueOrchardBeesInArizonaProject](#) ('the Project') "Final Report" that documents our activities for the entire 2019 project. The Project Research Proposal ([Phase 0](#)) is shown in Appendix A. The [Project Objectives](#) are shown in Appendix B. The [Interim Report](#) was issued on 1 May 2019. All information is documented on our website and file database:



BLUE ORCHARD BEES IN ARIZONA PROJECT
"The Single Moms of the Bee World"

Home About Objective Blog Reports FAQ SAQ Resources Contact

BlueOrchardBeesInArizonaProject is non-profit, basic research on solitary bees, specifically, the *Osmia lignaria* species: Blue Orchard Bees (BOB).

There is a world wide environmental crisis that is severely impacting honeybees. Solitary bees, such as Blue Orchard Bees and Leaf Cutter Bees, can help out their cousins, the honeybee in the critical task of plant pollination.

Our Research Project will put 5,000 BOBs in four locations in Arizona to study and report their propagation. We encourage educational (K through 12) and other non-profit organizations to build on our efforts using our results and data. You can review the [Objectives](#) of our Project, [Costs](#) and original Research Proposal.

Final Report Issued


RESULTS			15-Nov-2019
Metric	CurrentValue	MaxValue	% Complete
Bees Placed / Max Value	5060	5000	101.2%
Sites Populated / All Sites	7	7	100.0%
Habitats Deployed	50	49	102.0%
Tubes Filled / Tubes Placed	10	3202	0.3%
Harvested / Deployed	0	5000	0.0%

Final Report Issued!

After completion of all three phases of the study, we have issued our Final Report and our Presentation to the OBA.


USDA Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

0 Write a comment




The Arizona Honey Bee Festival

16 Write a comment



Completing the Harvest of the Site4 Habitat

8 Write a comment



Orchard Bee Association

All activities are documented in 1,965 files totaling 63.5 GB in 9 folders as of 7 December 2019:

TreeSize Free						
File Home Scan View Options Help TreeSize Professional						
Select Directory	Stop Scan Refresh	Size Allocated Space File Count Percent	Automatic Units GB MB KB	Expand	Start TreeSize Free as Administrator	
Name	Size	Allocated	Files	Folders	% of Parent ...	Last Modified
63.5 GB G:\Projects\20190101solitary bees\	63.3 GB	63.5 GB	1,965	75	100.0 %	12/7/2019
> 63.2 GB Photos	63.1 GB	63.2 GB	1,659	54	99.6 %	12/7/2019
> 97.1 MB articles	92.4 MB	97.1 MB	50	5	0.1 %	11/1/2019
> 89.5 MB Test Sites	80.6 MB	89.5 MB	122	7	0.1 %	11/11/2019
> 23.4 MB [58 Files]	18.6 MB	23.4 MB	58	0	0.0 %	11/23/2019
> 23.1 MB Blog Entries	21.4 MB	23.1 MB	19	0	0.0 %	12/2/2019
> 17.0 MB OBA	13.9 MB	17.0 MB	29	2	0.0 %	12/7/2019
> 14.9 MB Proposal	12.4 MB	14.9 MB	24	0	0.0 %	11/25/2019
> 2.0 MB fixes	1.5 MB	2.0 MB	4	0	0.0 %	4/22/2019



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INTRODUCTION, OBJECTIVES AND METHODOLOGY, DELIVERABLES

The Project is planned in three, overlapping phases: 1. Placing the bees/habitats, 2. Monitoring the status of the bees/habitats, and 3. Harvesting the cocoons.

[We have now completed all phases of the Project.](#) This document will detail the results of all phases of the Project and some preliminary thoughts for future (2020) activities. This document will make extensive use and reference to the materials posted to the Project website, [BlueOrchardBeesInArizonaProject.com.](#)

We gratefully acknowledge the support and expertise of:

- [Dr. Natalie Boyle](#) of the [USDA-ARS](#)
- [Dr. Steve Peterson](#) of [Foothill Bee Ranch](#)
- [Mr. Jim Watts](#) of [Watts Solitary Bees](#)
- [Mr. Dave Hunter](#) of [Crown Bees](#)
- [Mr. Glen Trostle](#) of the [Pollination Systems, LLC](#)
- And of the [Orchard Bee Association \(OBA\)](#)

- **The objective is to study the propagation of BOBs (Osmia lignaria) in a set of diverse Arizona environments**
 - **Most studies and information on BOBs are in relatively cold climates**
- **Methodology**
 - **Place the bees/cocoons and applicable habitats at four geographically and environmentally diverse sites in Arizona**
 - **Key Metric: R_s = Replication Rate per Site = cocoons harvested per site divided by cocoons placed**
- **Deliverables**
 - **Final Report (this document)**
 - **Presentation to the OBA**



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- **An open source website capturing all the activities and data of the project augmented with a computer file structure containing all of the electronic files produced during the project**



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PHASE 1: PLACING THE BEES/HABITATS

In Phase 1, we received the cocoons donated by the OBA, ordered and received the habitats, and placed them at the four Arizona sites:

Site1: March 10-11, 2019 Gilbert, AZ, 1,237 ft. Elevation, Residential Lakeside Lots

[March 11, 2019: Set-up Site1a1 \(220 cocoons, 3 habitats, 176 tubes\)](#)

[March 10, 2019: Set-up Sites 1a2 \(580 cocoons, 5 habitats, 338 tubes\)](#)

Site2: March 27, 2019 Cornville, AZ, 3225 ft. Elevation, Residential Family Farms

[Set-up Site2a \(1,000 cocoons, 14 habitats, 960 tubes\)](#)

[Set-up Site2b \(1,000 cocoons, 14 habitats, 960 tubes\)](#)

Site3: March 28, 2019 Payson, AZ, 4606 ft. Elevation, Master Garden and Residential Lot

[Set-up Site3a \(1,900 cocoons, \(60 cocoons, 9 habitats, 528 tubes\)](#)

[Set-up Site3b \(300 cocoons, 4 habitats, 192 tubes\)](#)

Site4: May 10, 2019 Flagstaff, AZ, 6,910 ft. Elevation, Master Garden

[Set-up Site4 \(60 cocoons, 1 habitat, 48 tubes\)](#)

Each setup/trip was documented with computer files and via the above hyperlinks to our website BlueOrchardBeesInArizonaProject.com. We surpassed 100% of “Bees Placed” by purchasing some additional bees/habitat to complete our efforts.

Complete details of the characteristics (property type, local environment, geographic location, elevation, lot size, plant fauna) can be seen in our ‘Master Site Characteristics, Data and Summary Results.xlsx’ spreadsheet, summary in Appendix C; and the [complete spreadsheet is available on the website](#). The site maps (not to scale) are in Appendix D and in the spreadsheet.



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PHASE 2: MONITORING THE STATUS OF THE BEES/HABITATS

Once the cocoons have been placed and the habitats set up properly; we have been observing and monitoring bee activity. We have documented this with counts of tubes filled, [temperature and humidity data sets](#), [67 blog posts](#), [costs of the study](#), and an extensive set of observations documented with photos, videos, text files, doc files, ppt files and hand written logs. We have also observed phenomena such as [evidence of parasitic wasps](#), [native Leafcutter bee activity in Phoenix](#), and the [preference of shaded habitats for desert locations](#).

Site1: Gilbert, AZ, 1,237 ft. Elevation, Residential Lakeside Lots

[Bees Emerging and Bird Danger](#)

[The Birds Came Back](#)

[We Added Another Habitat](#)

[We Added One More Habitat to Site1a1 and Some Updates](#)

<https://www.blueorchardbeesinarizonaproject.com/post/a-busy-bee>

[Success!!! - Three Tubes Filled!!!](#)

Site2: Cornville, AZ, 3225 ft. Elevation, Residential Family Farms

[First Inspection of Site2 in Cornville](#)

Site3: Payson, AZ, 4606 ft. Elevation

[First Inspection of Site3 in Payson/Flowing Springs - Ditches and Witches](#)

[Completing the Site3 Visit; Bees in a Woodpile, Hummingbirds, and Free Range Cattle](#)

Site4: Flagstaff, AZ, 6,910 ft. Elevation, Master Garden

[Site4: Extensive List of Flora at the Flagstaff Location](#)



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PHASE3: HARVESTING THE COCOONS

We have harvested the habitats for all four Sites. In general, propagation of Blue Orchard Bees in the four Arizona sites was sporadic. At this point we are not able to draw any general conclusions since there are too many variables. For example, the cocoons/bees (labeled UT for “Utah”) that we placed at Site2 were definitely viable since we had a significant portion of bees emerging from the cocoons. We saw limited emergence at Site3 (labeled PA for “Pennsylvania”) but also observed a significant number of unhatched cocoons. To complete Phase 3, we harvested all the retrieved habitats:

Site1: March 10-11, 2019 Gilbert, AZ, 1,237 ft. Elevation, Residential Lakeside Lots

[Harvesting the Habitats/Cocoons](#)

Site2: March 27, 2019 Cornville, AZ, 3225 ft. Elevation, Residential Family Farms

[Harvesting Selected Habitats of Site2 and Site3](#)

Site3: March 28, 2019 Payson, AZ, 4606 ft. Elevation

[We Examine a Habitat From the Payson Site](#)

[Harvesting Selected Habitats of Site2 and Site3](#)

[We Examine a Habitat From the Payson Site](#)

Site4: November 16, 2019 Flagstaff, AZ, 6,910 ft. Elevation, Master Garden

[Retrieving the Habitats from Site4 in Flagstaff](#)

[Completing the Harvest of the Site4 Habitat](#)

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Habitats Deployed	50	49	102.0%
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FINAL OBSERVATIONS and NEXT STEPS

- In general, propagation of Blue Orchard Bees in the four Arizona sites was sporadic.
- Our observation is that Blue Orchard Bees located in desert conditions perform [better in full shade](#). We have no tubes filled in the sunny, partially sunny habitats; tubes are filled in all three fully shaded habitats.
- Placing mud sources near the nest does not seem to matter. We have not observed any bees using the provided mud sources. Obviously, they are finding mud somewhere else as evidenced by the completed tubes.
- We had [sporadic success](#) in propagating blue orchard bees (BOBs) in Arizona. Our results are complicated by exogenous effects such as the [sun/shade](#) above, [bees emerging early](#), bees not emerging or simply dispersing without using the supplied habitats. We have also had anecdotal evidence of propagation of BOBs in the Phoenix area.
- The parasitic wasps (“[Those are Monodontomerus larvae. They are not uncommon unfortunately.](#)”) were observed.
- [Native population of leafcutter bees have been observed](#) in the low desert conditions. Since leafcutter bees are active at higher temperatures than BOBs, they may be a better choice for Arizona locations.

Submitted on 15 November 2019

Respectfully,

[Michelle Sarina, Gene DeBonz, Jim Sarina](#)





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Appendix A – Research Proposal

RESEARCH PROPOSAL

by Gene DeBons, Michelle Sarina, Jim Sarina

Rationale for conducting this research

- Study the propagation of Blue Orchard Bees (BOBs) in several different environments in Arizona.

Where will the study be conducted and why these sites were specifically chosen?

Four locations in the state of Arizona (chosen for):

1. Phoenix Metro Area, 1200 ft elevation; two sites: a lakeside residential site with a mixture of landscape and decorative plants; and a commercial orange orchard (different plant fauna).
2. Cottonwood, AZ, 3200 ft elevation; two sites: a 6-acre apple orchard and a 5-acre pear orchard (different bloom times).
3. Payson, AZ riparian region (on the East Verde River), 4600 ft elevation; two sites: a one acre, master garden located 1/8 mile from the river and two residential lots (totaling 1.5 acres) on the river with minimal plant coverage (plant density).
4. Sedona, AZ, 4350 ft elevation; master garden location(s); specific sites, approximately 1 acre each, to be determined upon visiting the sites (different plant fauna).

These sites provide a diversity of climate, elevation, bloom time, plant species, plant mixture and hydrology.

Methodology

- Several models of BOB housing nesting kits will be obtained from “Watts Solitary Bees” and placed as appropriate for each environment.
- The bees (roughly 1000 per acre/location) will be released on a timeline consistent with the flowering of plants in that area.
- The primary study methodology will be regular visual observation and data collection of bee activity and habitat and real-time environmental conditions.
- After the completion of season, the cocoons will be counted and evaluated for general quality (e.g., health, male/female ratio, size) by established BOB experts.

Who will conduct the study?

- The study will be organized and conducted by Gene DeBons, Michelle Sarina, and Jim Sarina. Gene has previously conducted a smaller scale, similar study in Gilbert, AZ in 2018.
- Expert advice will be provided by Jim Watts and Steve Peterson and other associates of the Orchard Bee Association on an as necessary basis.
- Regular, on-site inspection, review and documentation (photos, notes, videos) will be conducted by local personnel.

What outcomes are expected?

- Measurable and verifiable data collection methods and analytics within diverse Arizona environments to determine BOB behavior, ideal habitats and population sustainability.
- Understanding and development of best practices to insure BOB propagation in these diverse environments.

What deliverables will be provided?

Three deliverables:

- one: a thorough report in a publishable format encompassing all the activities of the study,
- two, a presentation that summarizes the results of the study to be delivered at the December meeting of the OBA,
- three, a website (<https://www.blueorchardbeesinaronaproject.com/>) which captures the week-to-week activities and results of the study for educational and reporting purposes.



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Appendix B – Objectives of the Project

The BlueOrchardBeesInArizonaProject has three objectives:

1. **BASIC RESEARCH** – Conduct basic research in the propagation of mason bees in multiple Arizona environments differentiating among geographic, altitude, urban, rural, plant fauna, water resources and more.

Prime metric 1 (quantitative): the number of viable cocoons harvested divided by the number of cocoons placed. This metric, R equals 'Replication Rate', needs to be greater than one (> 1) to ensure successful propagation.

2. **EDUCATION** – Produce materials useful for educational purposes in K-12 schools.

Prime metric 2 (qualitative): Production of a set of traceable materials including text, timelines, photos, videos (e.g., in-the-field or animated), and numerical data sets to allow educators to create teaching materials explaining the scientific method at the K-12 school level. These materials can be used to demonstrate various aspects of the scientific method including correlation, interaction of variables in an experiment, methods of analysis, experiment setup concepts and limitations, and basic concepts in physics, biology, engineering (e.g., thermal), and environmental impact.

3. **MARKETING** - Produce materials useful for marketing and fund raising purposes for the OBA and education of the general public on the importance of solitary bees in our ecosystem.

Prime metric 3 (qualitative): Production of a set of entertaining and informative materials including text, timelines, photos, videos (e.g., in-the-field or animated), cost information to allow marketers to create materials explaining the role of the OBA and the critical role that solitary bees and other pollinators play in our ecosystem and food chain.



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Appendix C – Detailed Results as of 7 December 2019

RESULTS			15-Nov-2019
Metric	CurrentValue	MaxValue	% Complete
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Site	City (AZ)	Location	Lat/Long	Elevation (ft)	Description	Size (acres)	# of Bees	# of Habitats	# of Tubes	# of Tubes Filled	# of Cocoons Harvested
1a1.	Gilbert	Val Vista Lakes	33.376125, -111.750427	1,237	Lake Side Residential Lot	0.41	220	3	176	7	
1a2.	Gilbert	Val Vista Lakes	33.376041, -111.749390	1,237	Lake Side Residential Lot	0.27	580	5	338	3	
2a.	Cottonwood	Cornville	34.753271, -111.889603	3,225	Family Farm	5	1000	14	960	0	
2b.	Cottonwood	Cornville	34.751925, -111.889659	3,225	Family Farm	5	1000	14	960	0	
3a.	Payson	Flowing Springs	34.316621, -111.333613	4,606	Master Garden	1	1900	9	528	0	
3b.	Payson	Flowing Springs	34.315490, -111.334790	4,606	Riverside Residential Lot	0.8	300	4	192	0	
4a.	Flagstaff		35.217587, -111.647934	6,910	Residential Lot	0.26	60	1	48	0	
Total							5060	50	3202	10	0
Date	7-Dec-19					Max Value	5000	49	3154	3154	



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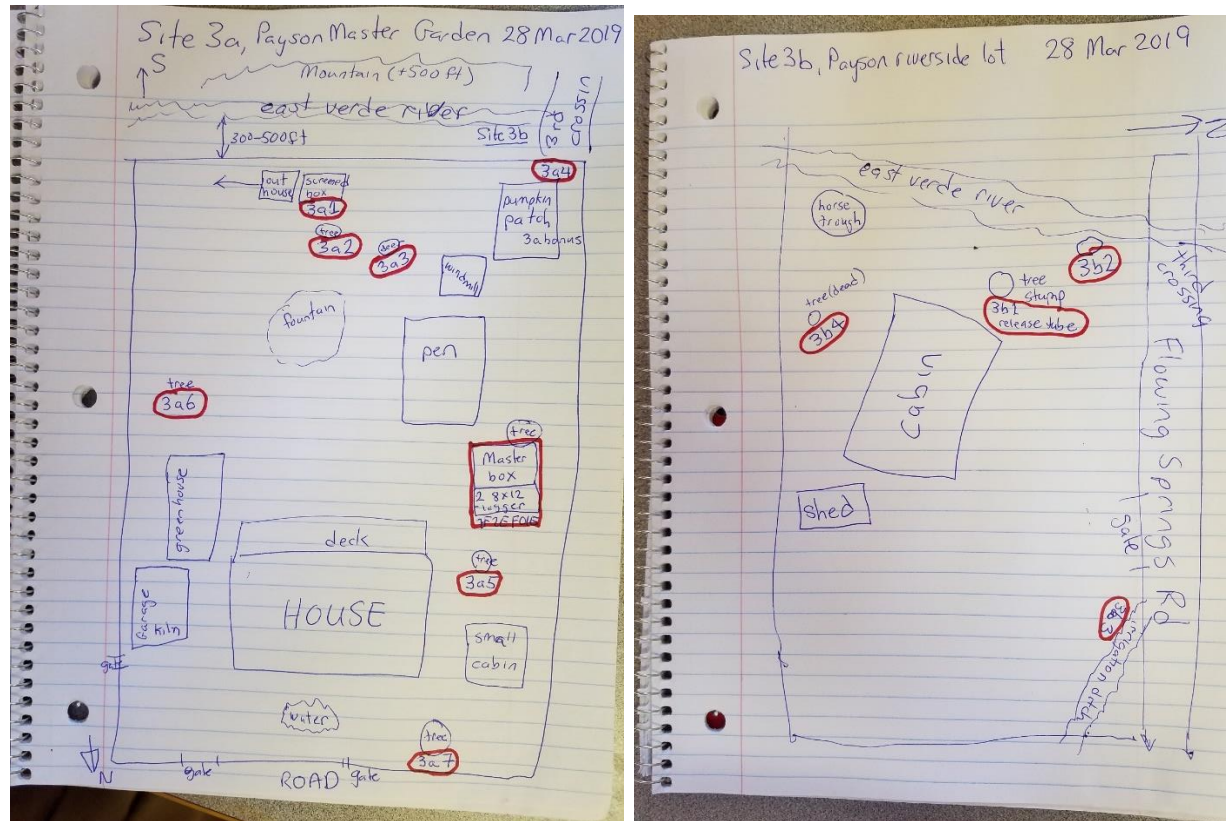
Appendix D – Site Maps







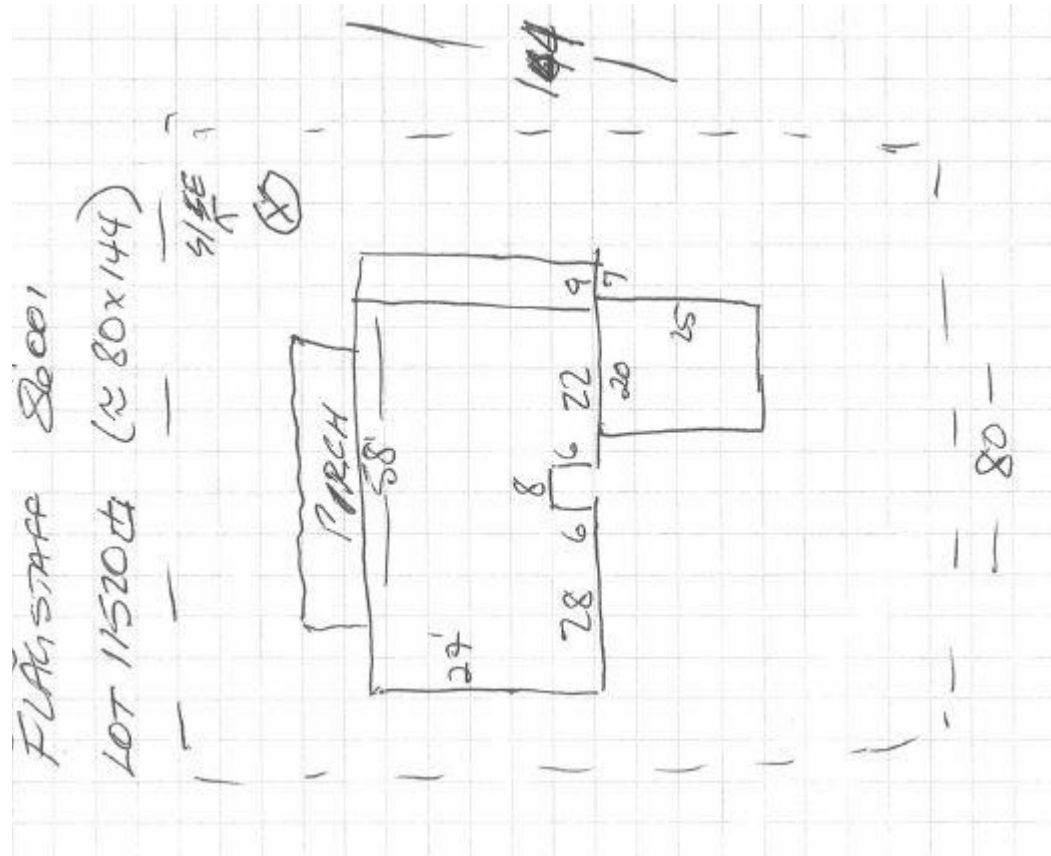
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Site3a and Site3b



Blue Orchard Bees In Arizona Project



Site 4