FD-ISHB Research

Shannon Lynch and Akif Eskalen
Plant Pathology Department
UC Davis

Virtual Meeting of SDMMP Research Update

October 27, 2021

Acer negundo

Acacia melanoxylon

Koelreuteria elegans

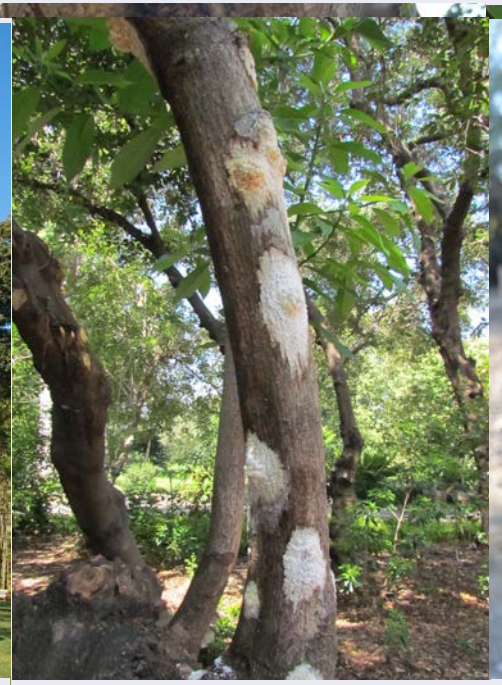
Quercus agrifolia

Albizia kalkora

Platanus racemosa

Ficus sp.

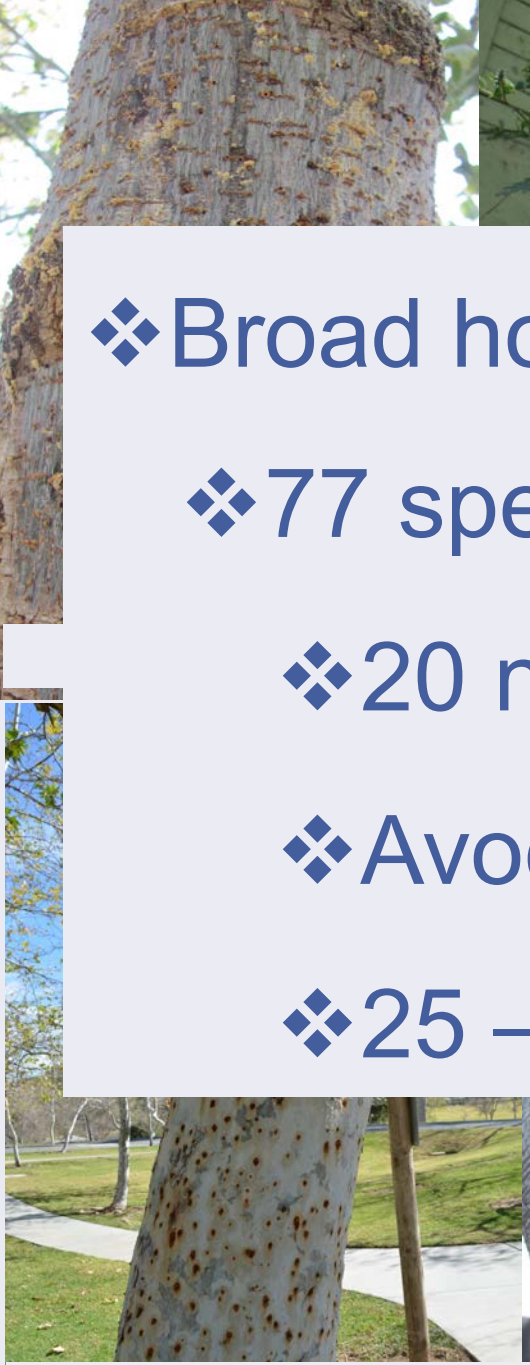
Quercus robur



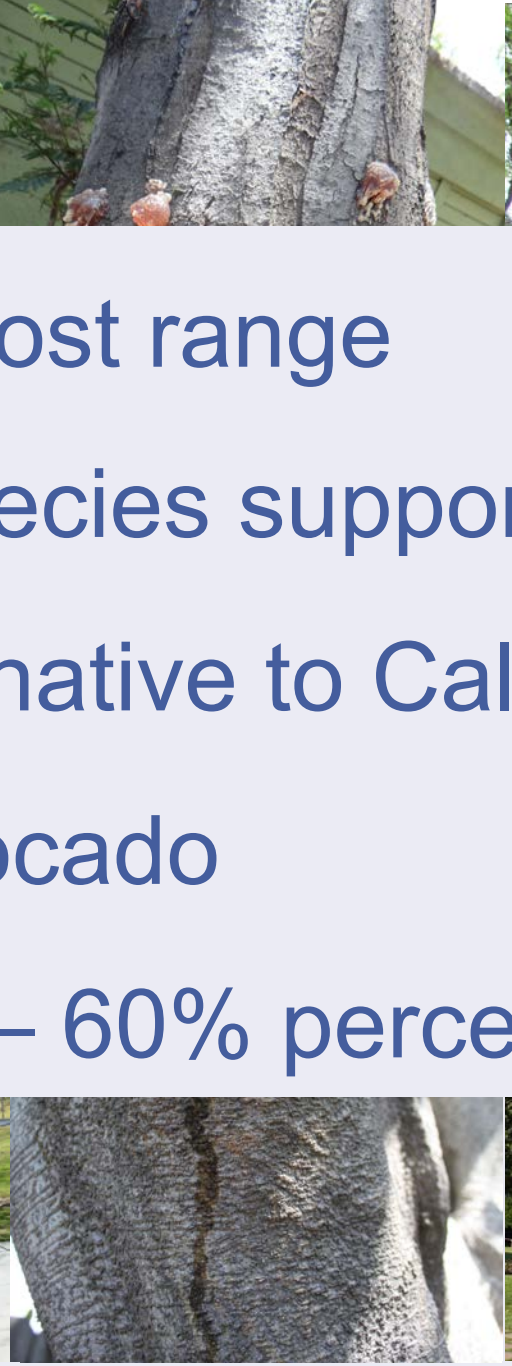
Persea americana

Populus fremontii

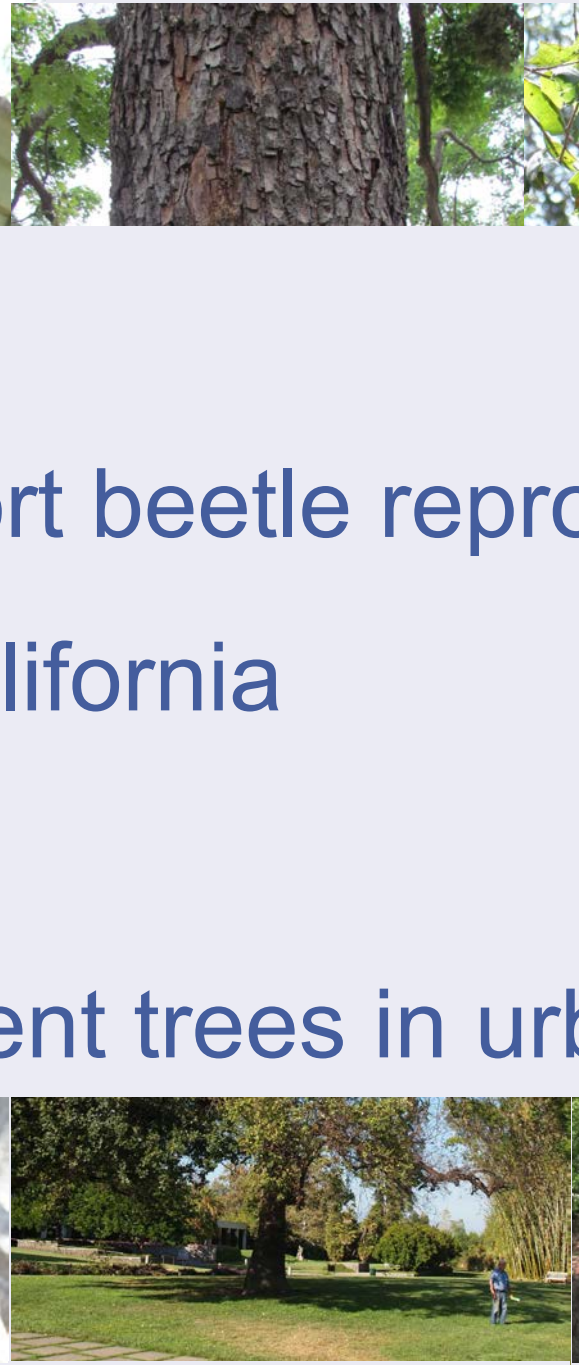
- Broad host range
  - 77 species support beetle reproduction (competent)
    - 20 native to California
    - Avocado
    - 25 – 60% percent trees in urban landscape



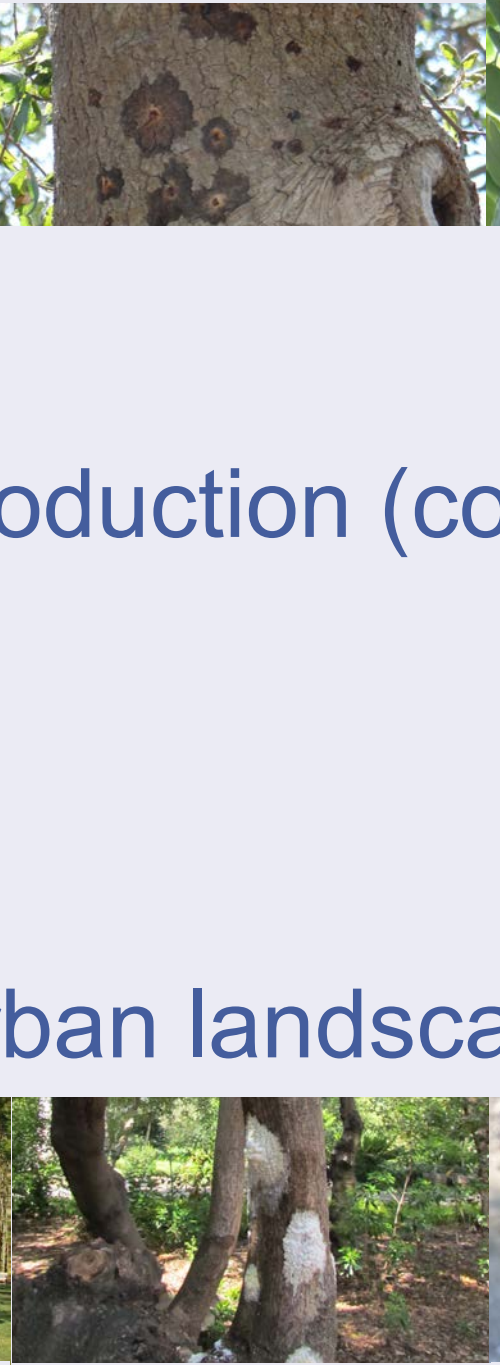
Platanus racemosa



Ficus sp.



Quercus robur



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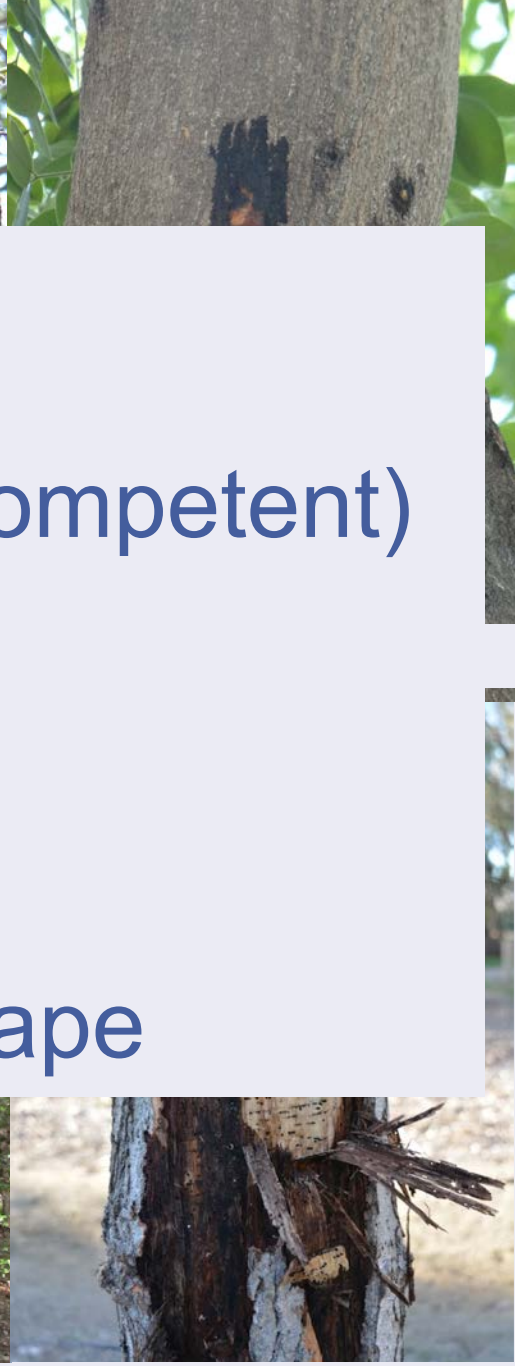
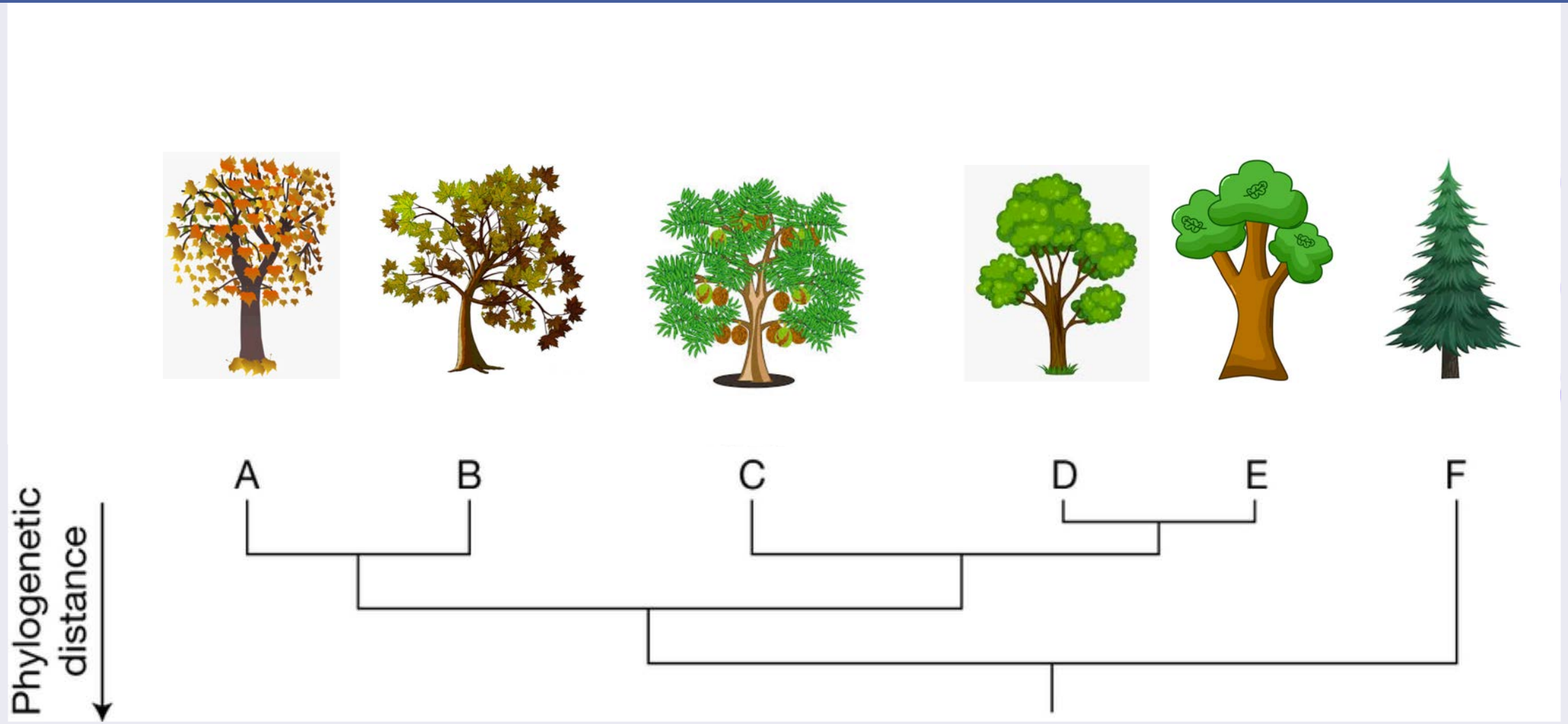


Populus fremontii

Phylogenetic Signal in Host Range



Lynch et al. 2021 *Evolutionary Applications*, 14:1083; Gilbert and Webb 2007

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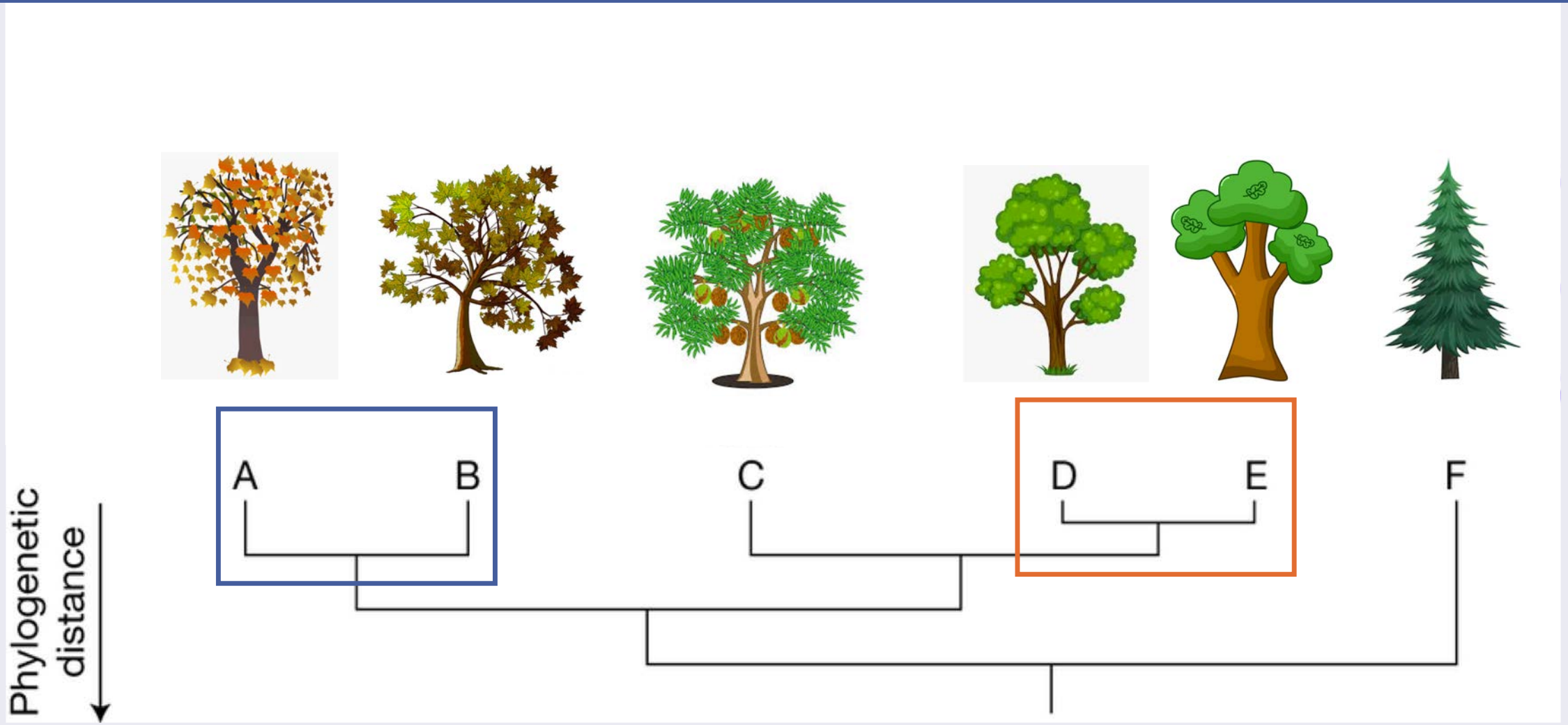

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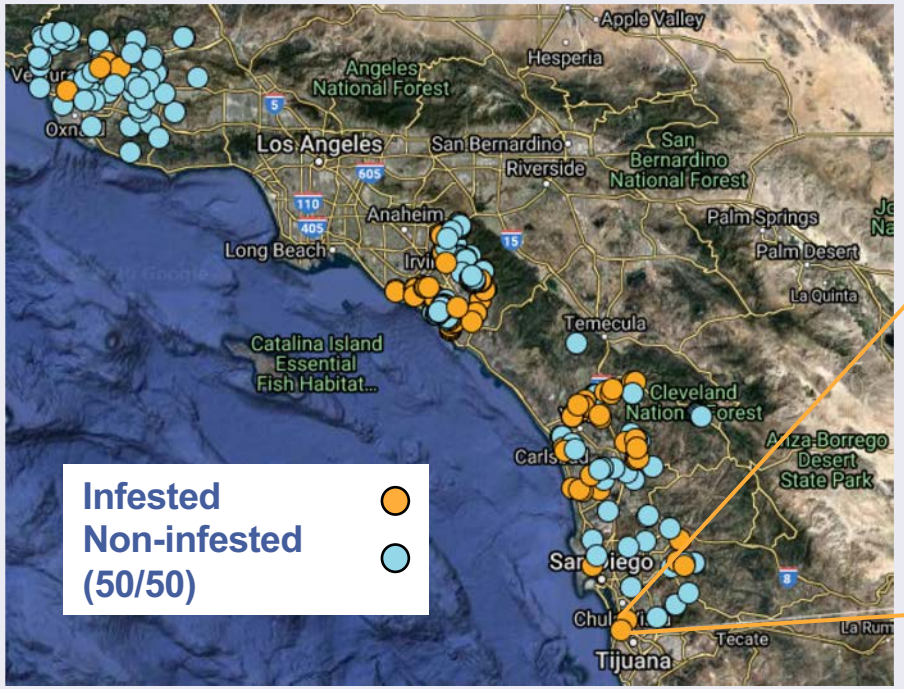
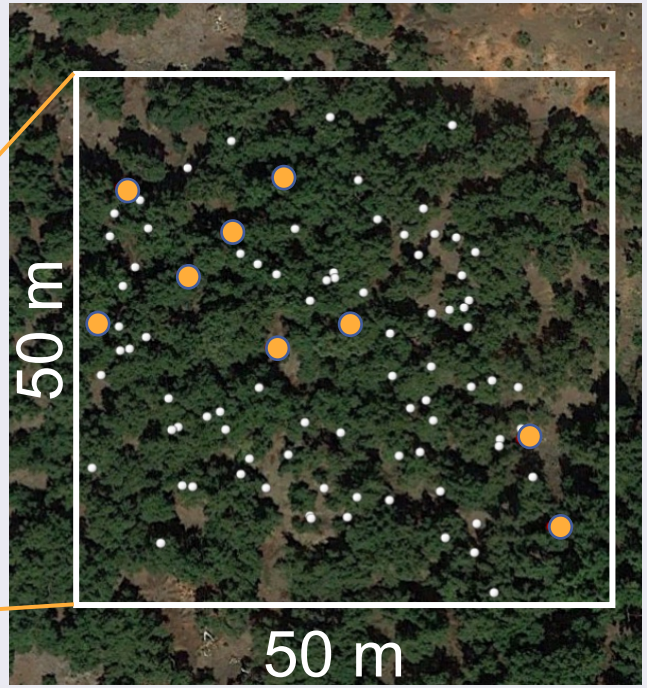
Predicting disease establishment in heterogeneous landscapes

Methods: Network of 260 Monitoring Plots

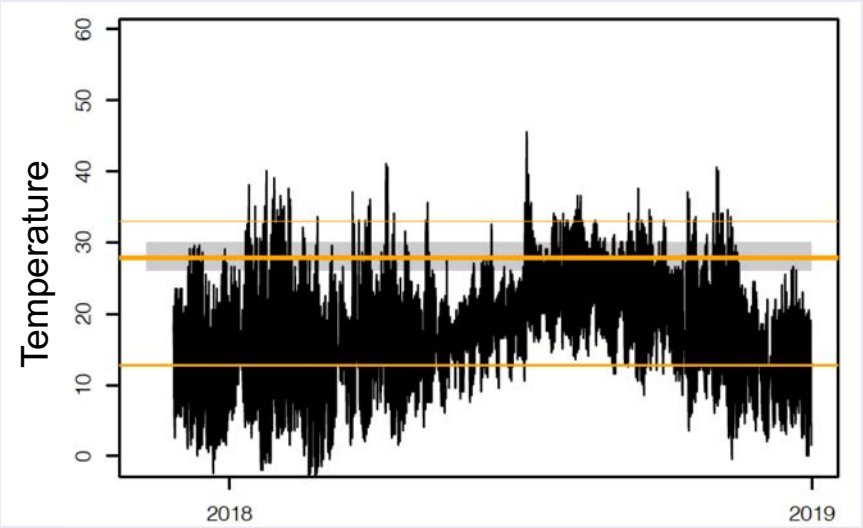




260 monitoring plots

- 83 in San Diego Co.

❖ Host Composition
❖ Microclimate
❖ Disease Severity
❖ Monitor annually since 2017

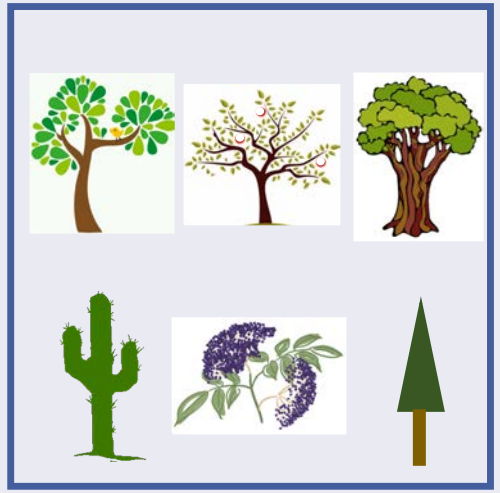


Predicting Disease Establishment

Host Abundance and Phylogenetic Structure

wpS =

Site Susceptibility Based on Phylogenetic Composition



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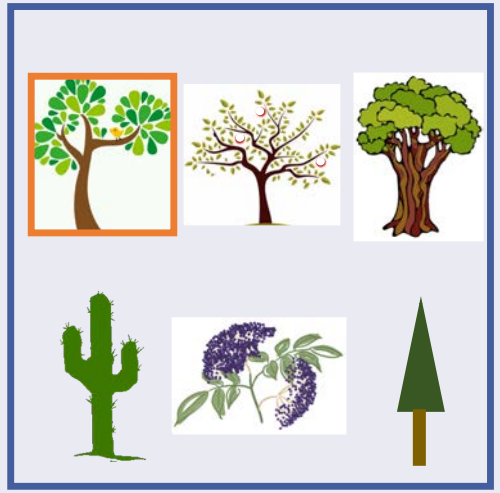

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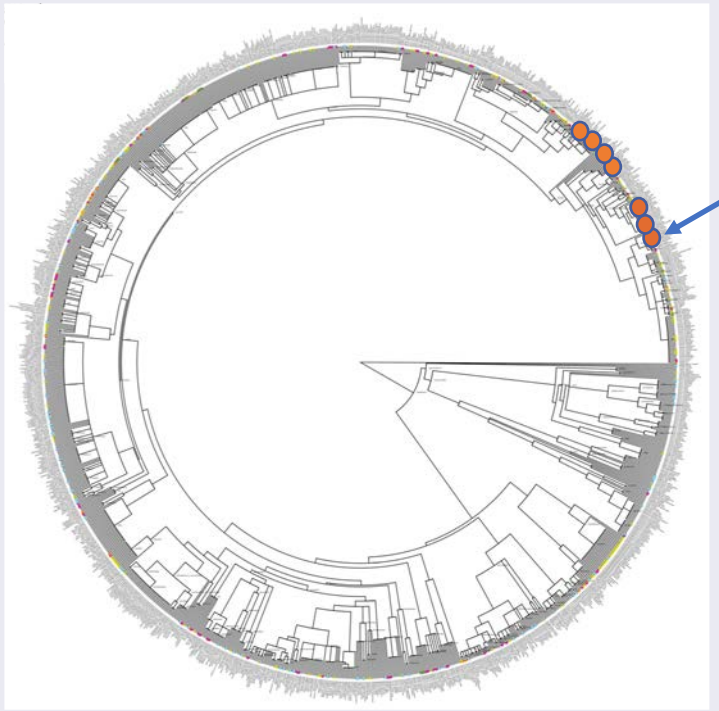

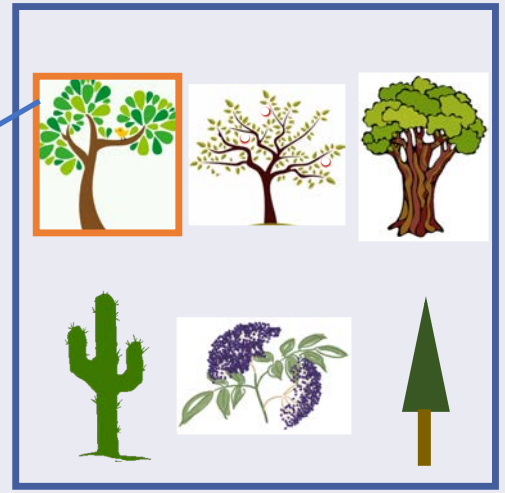

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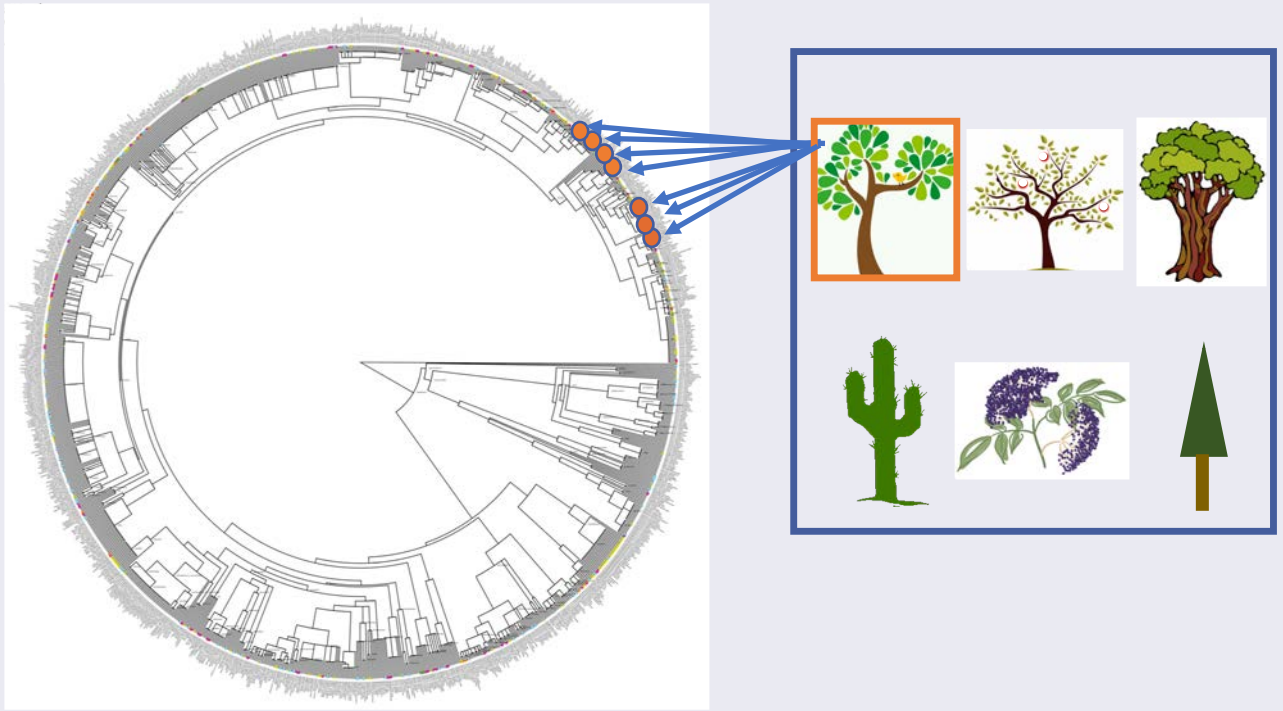

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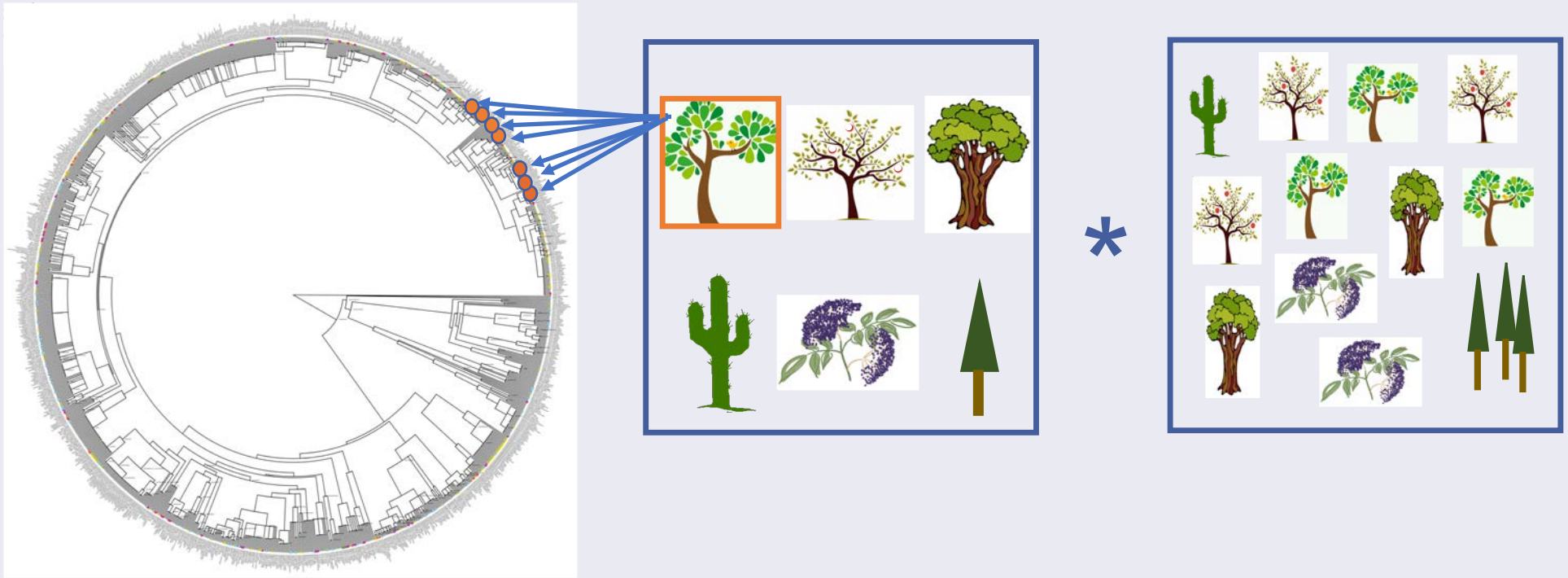
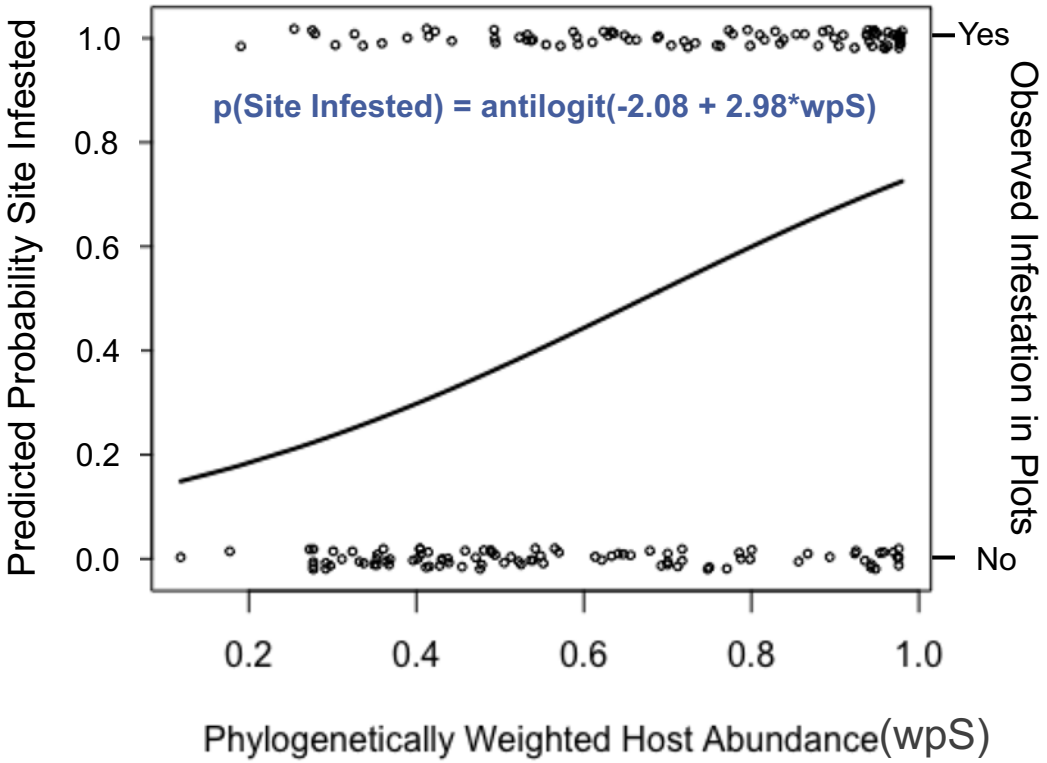


How well does wpS predict observed infestation in plots?



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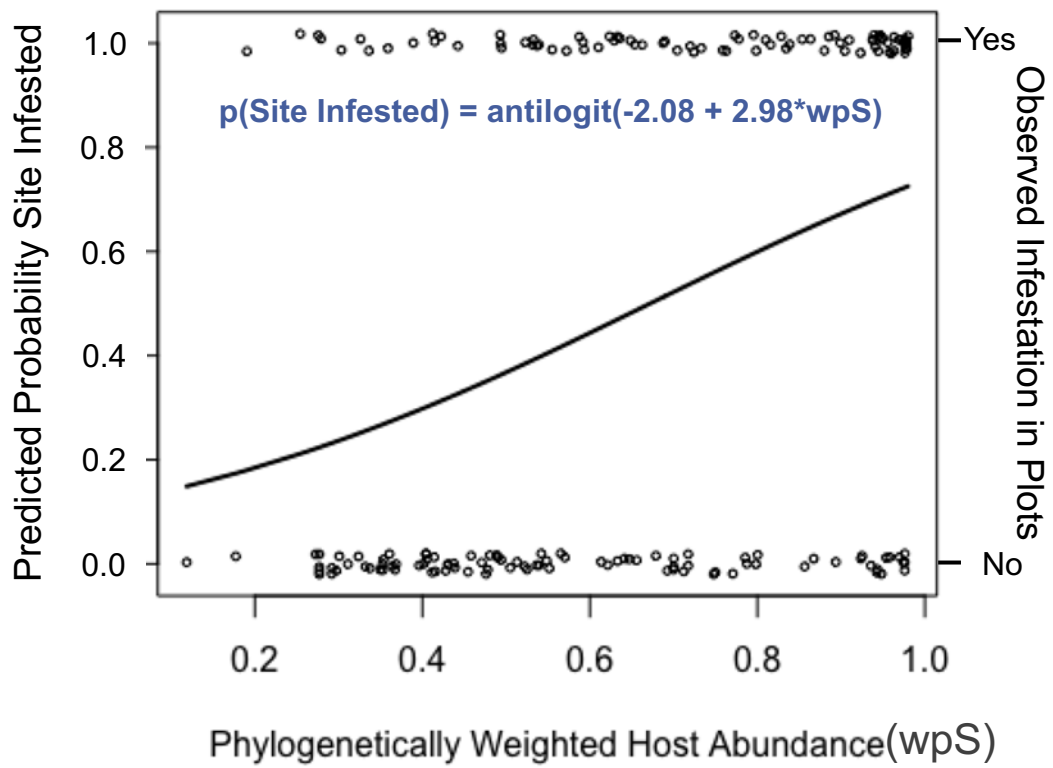

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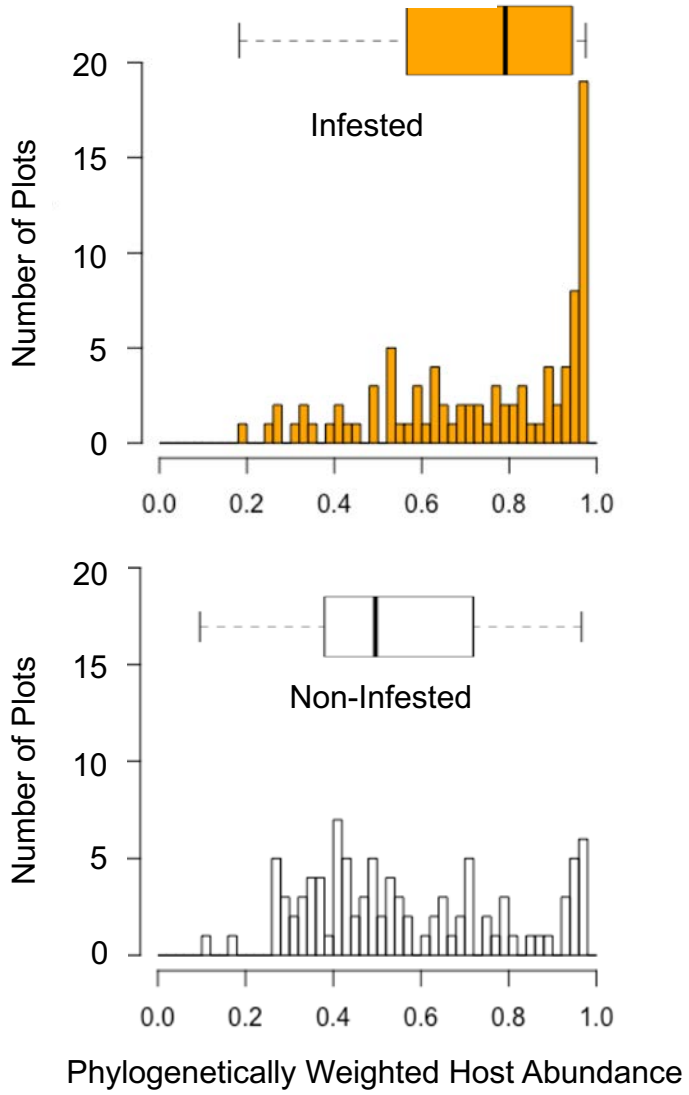

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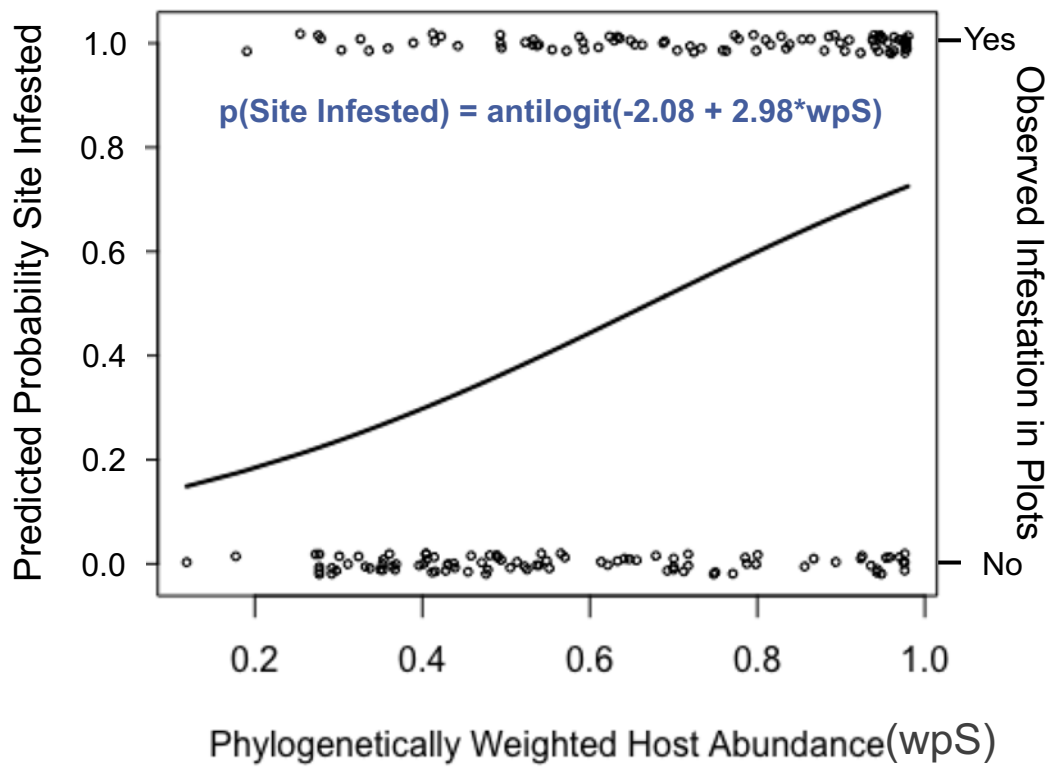

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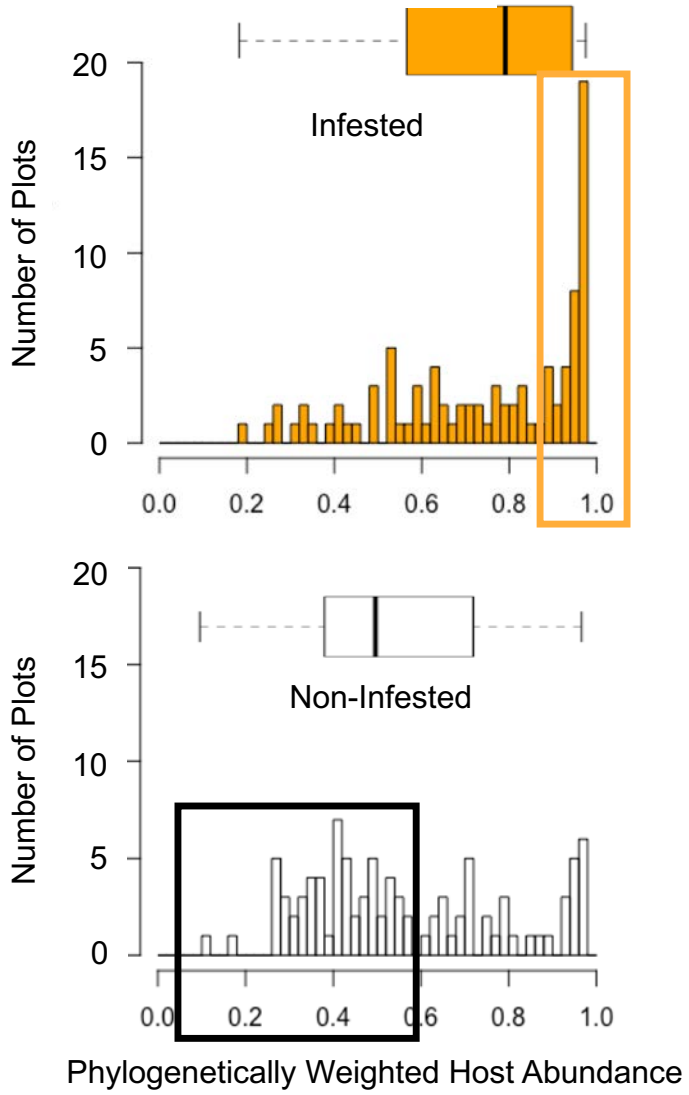

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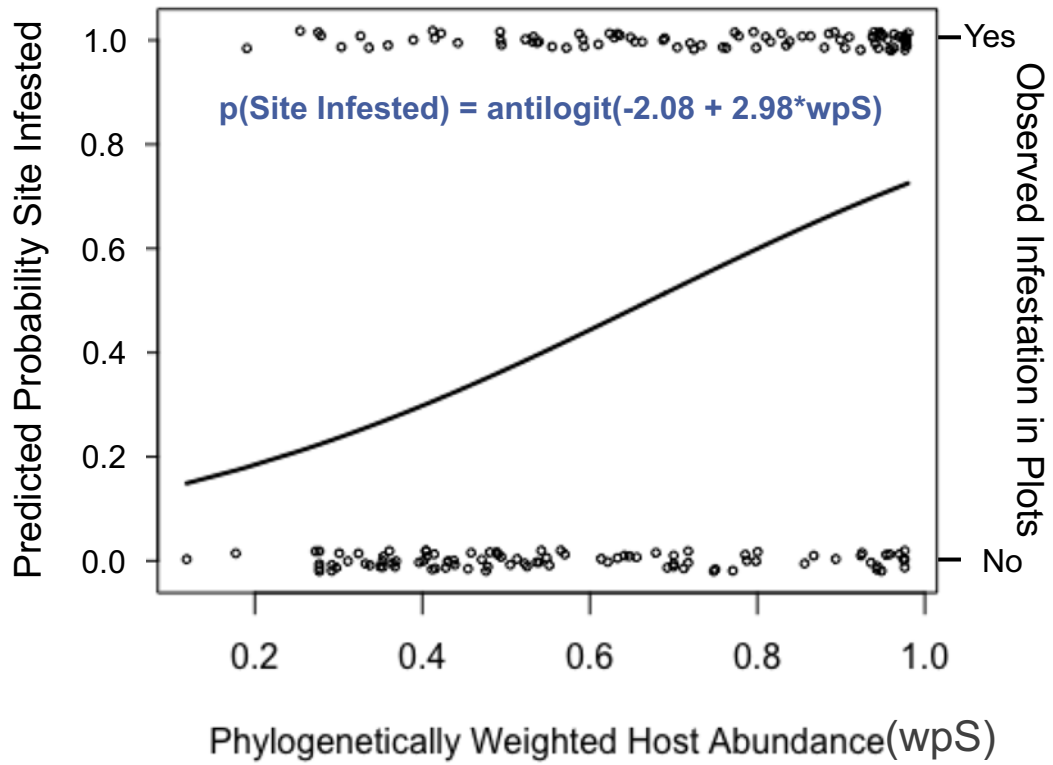

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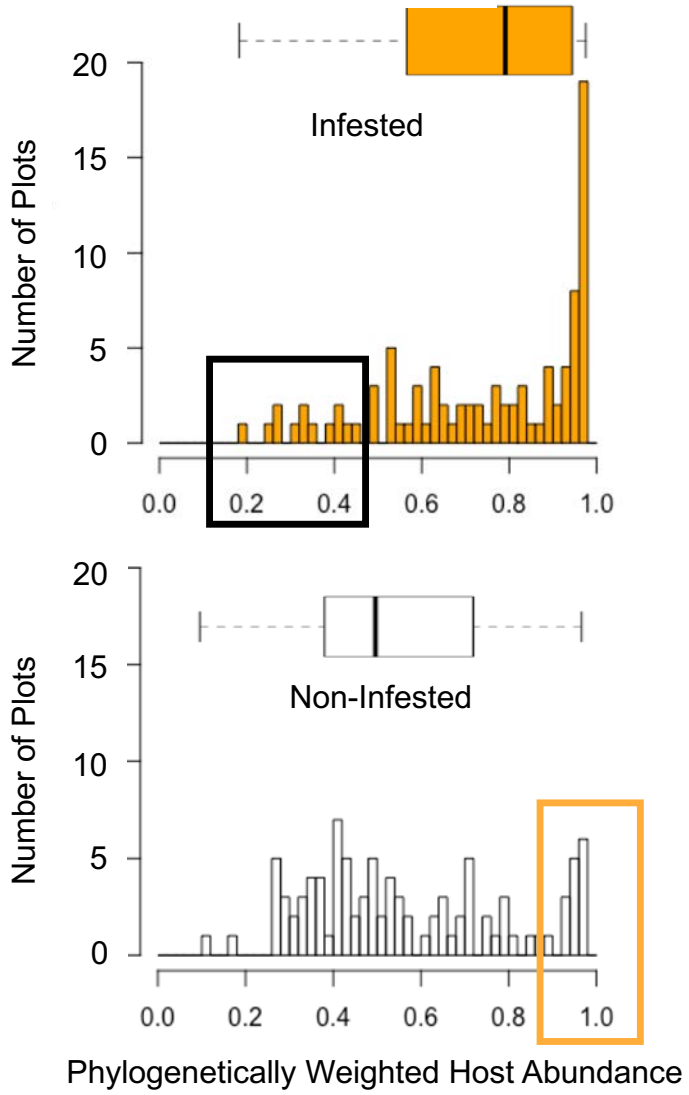
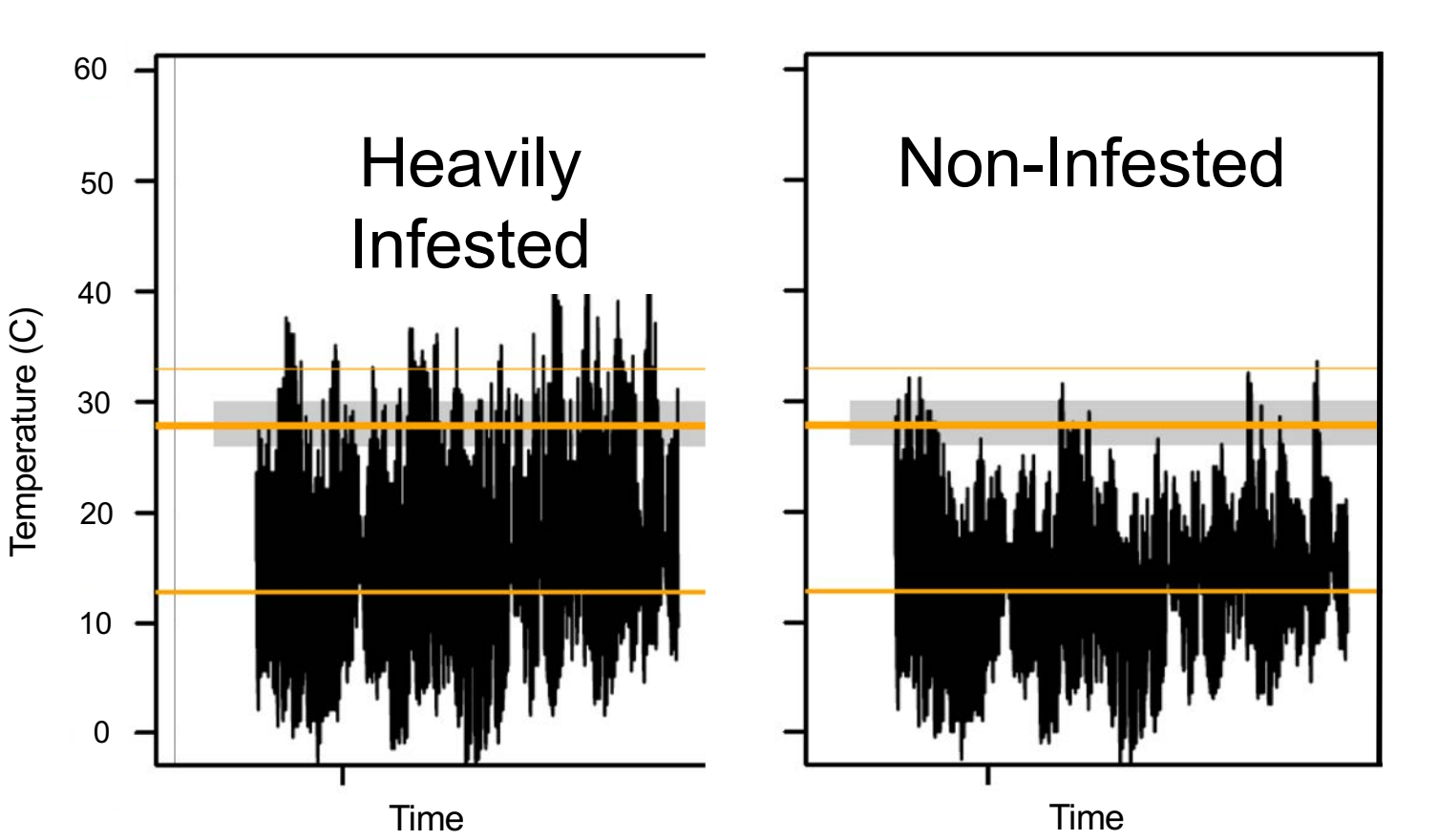


Degree Day Models and ISHB Development



Species	T_{min}	T_{opt}	T_{max}	K	Reference
PSHB	13.34	27.51	33.08	398	Umeda & Paine 2018
KSHB	12.77	28.04	31.99	318	Dodge & Stouthamer (*in review*)

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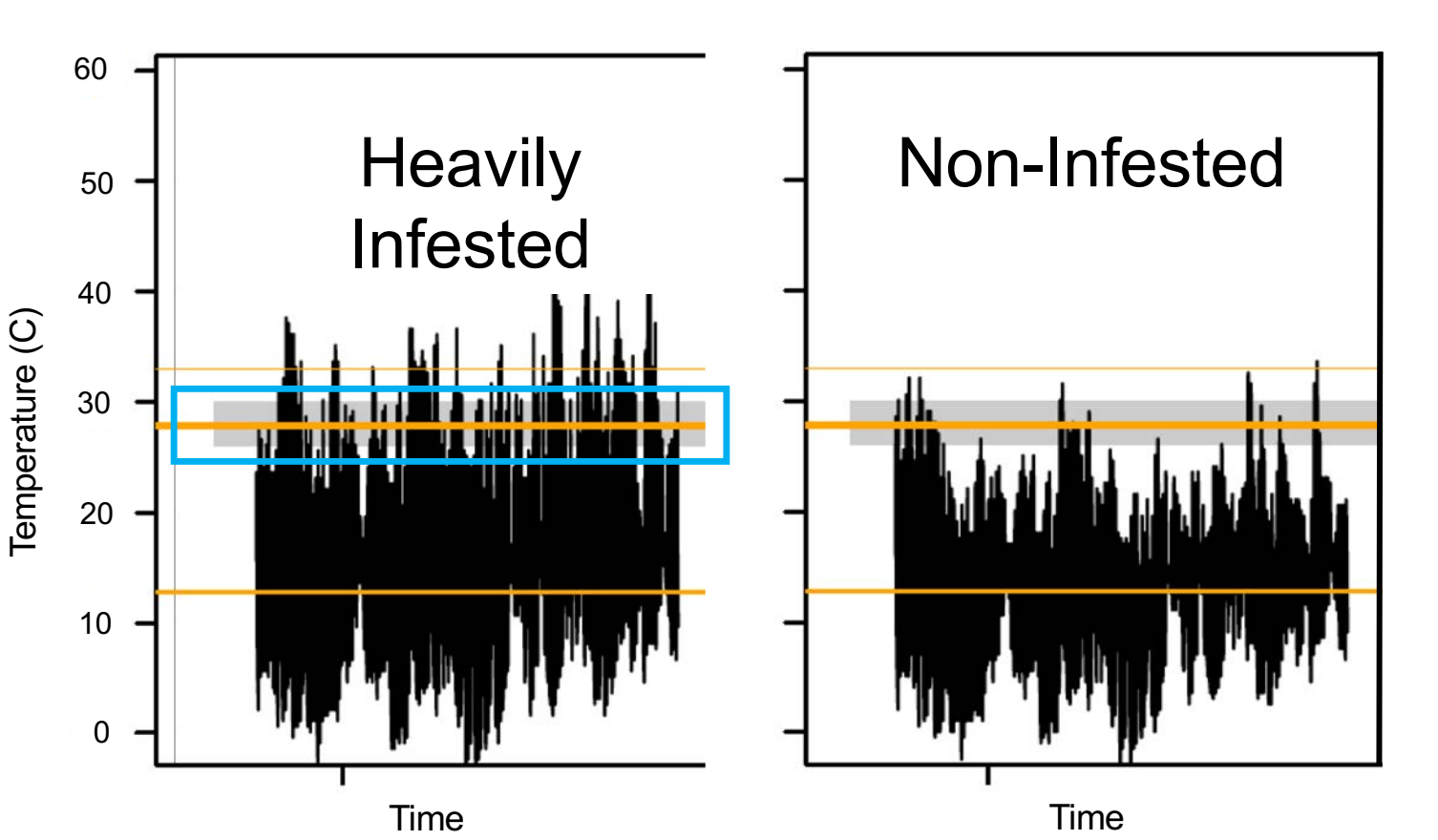

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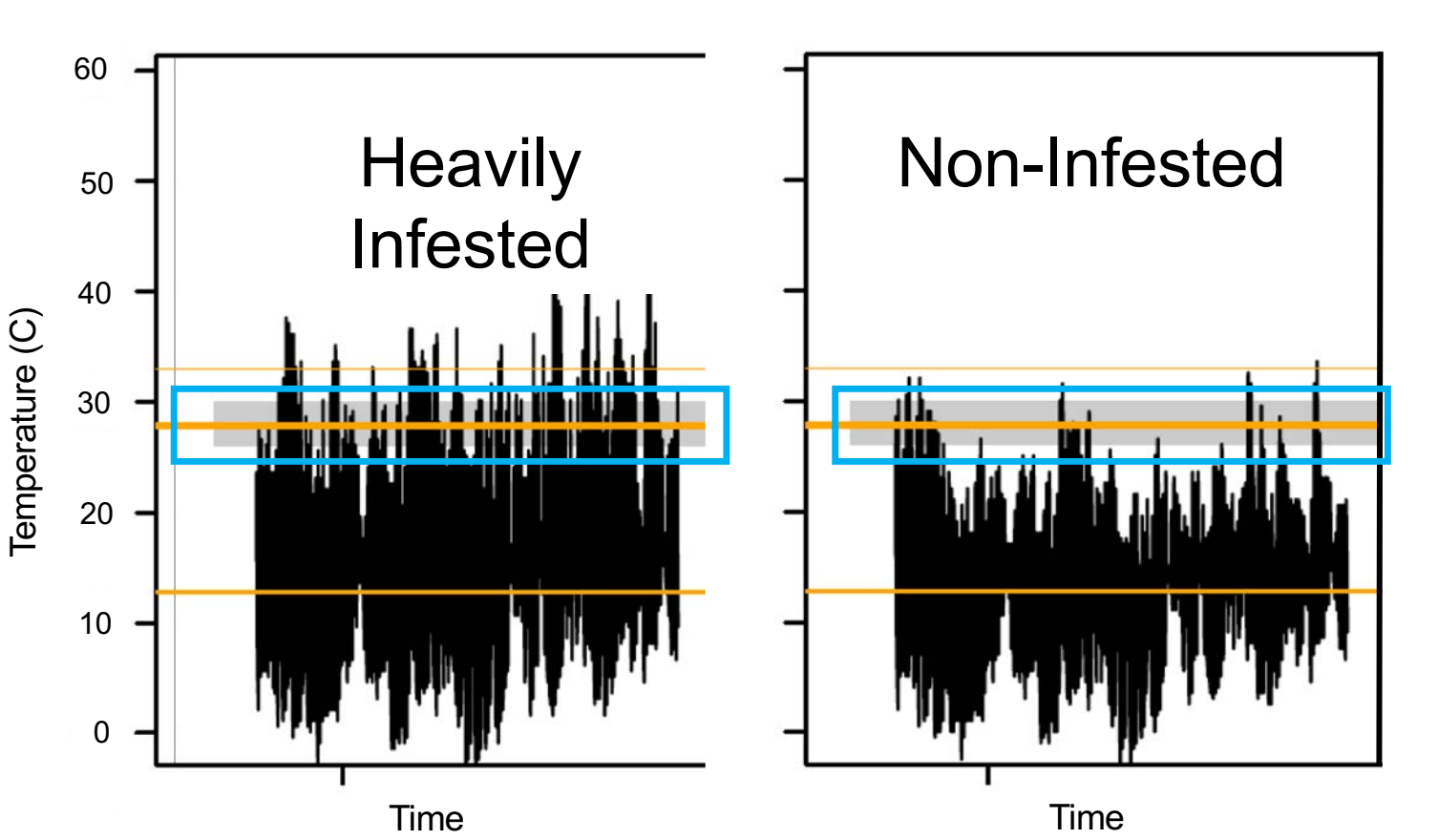

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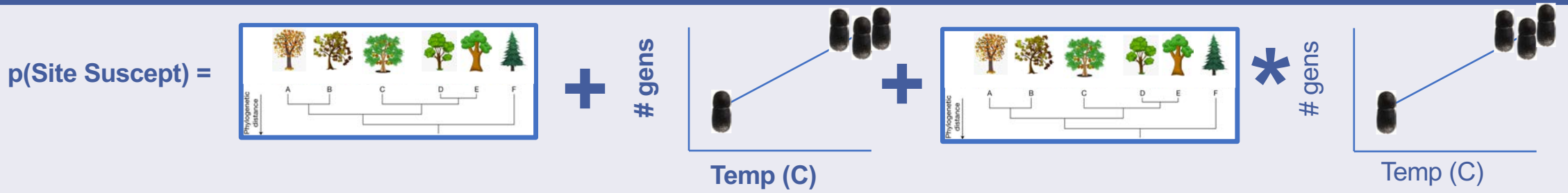
Community Structure and Climate Effects



Community Structure and Climate Effects

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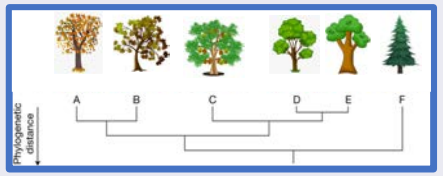
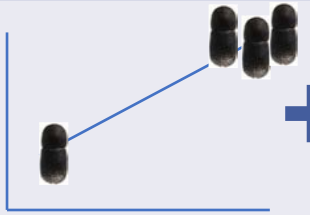


+ # gens



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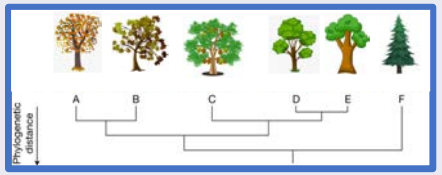

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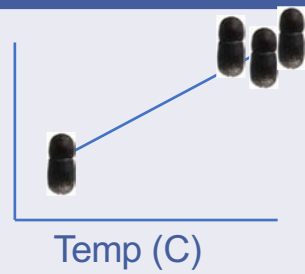
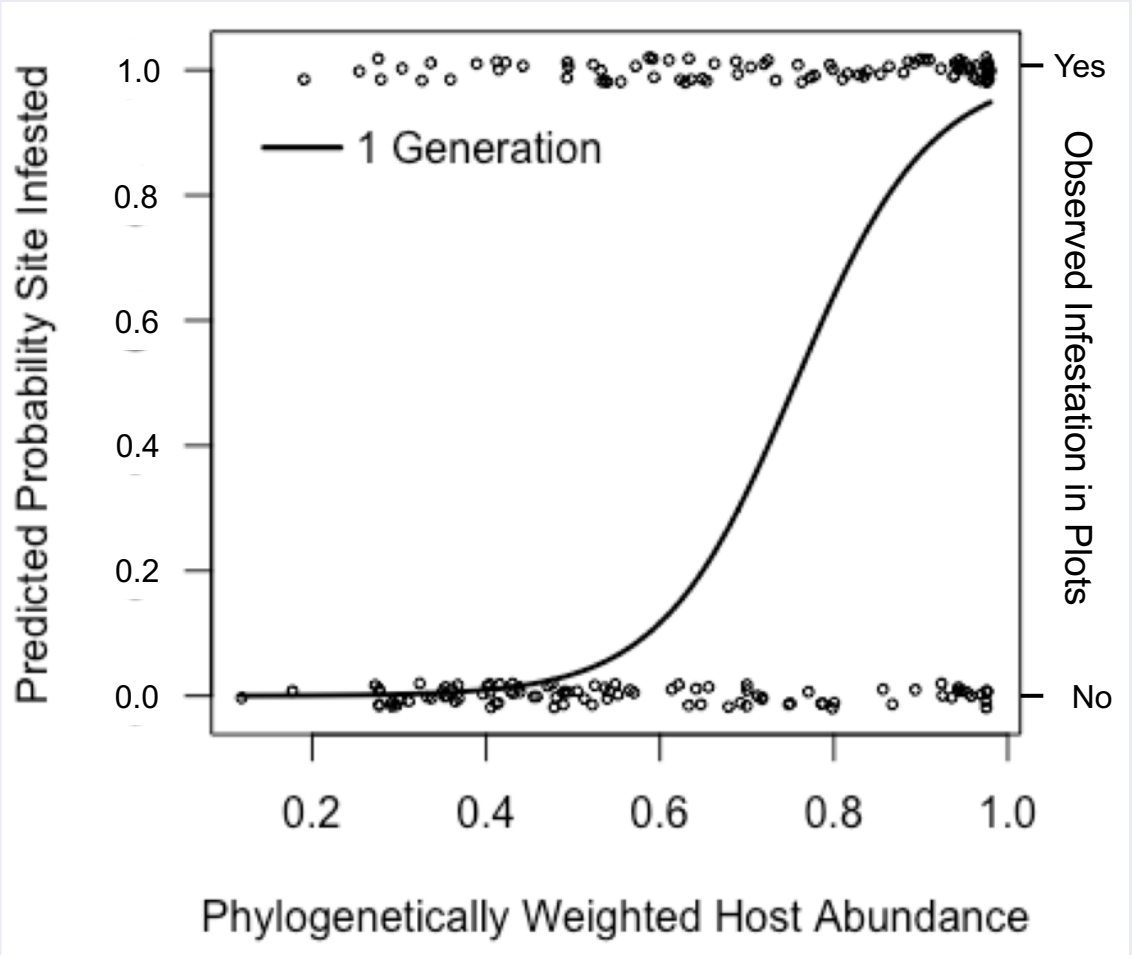
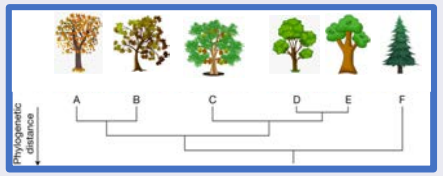
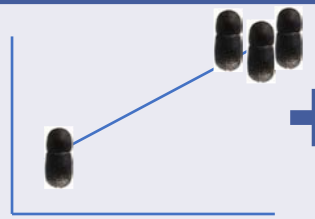


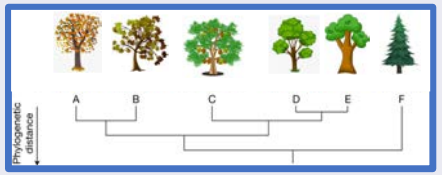


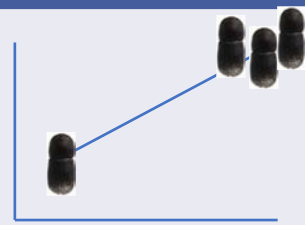
p(Site Suscept) = 16.9*wpS + 3.1*Gen – 3.9*(wpS*Gen) – 12.9

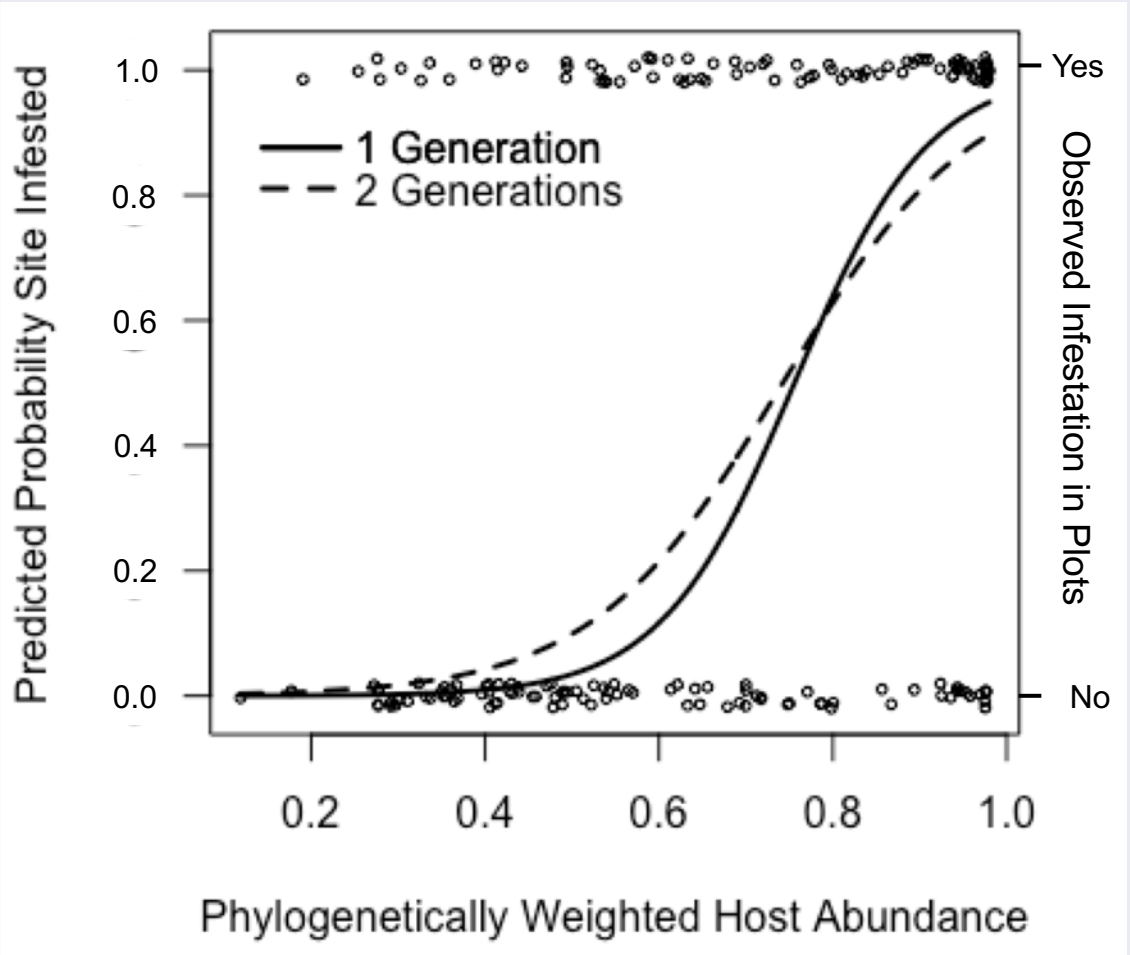
Community Structure and Climate Effects

p(Site Suscept) = 

+ # gens 

+ 

* # gens 



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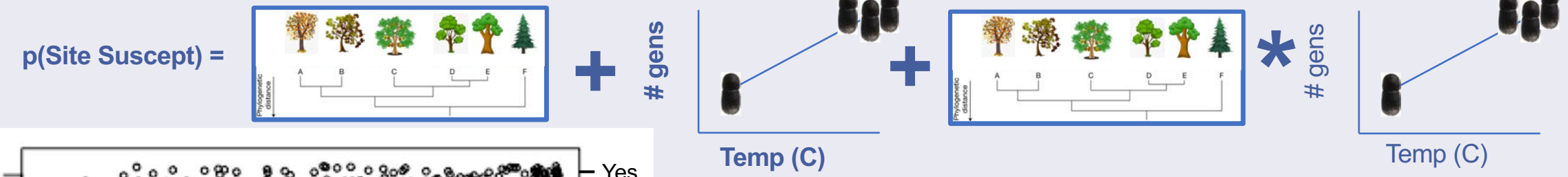
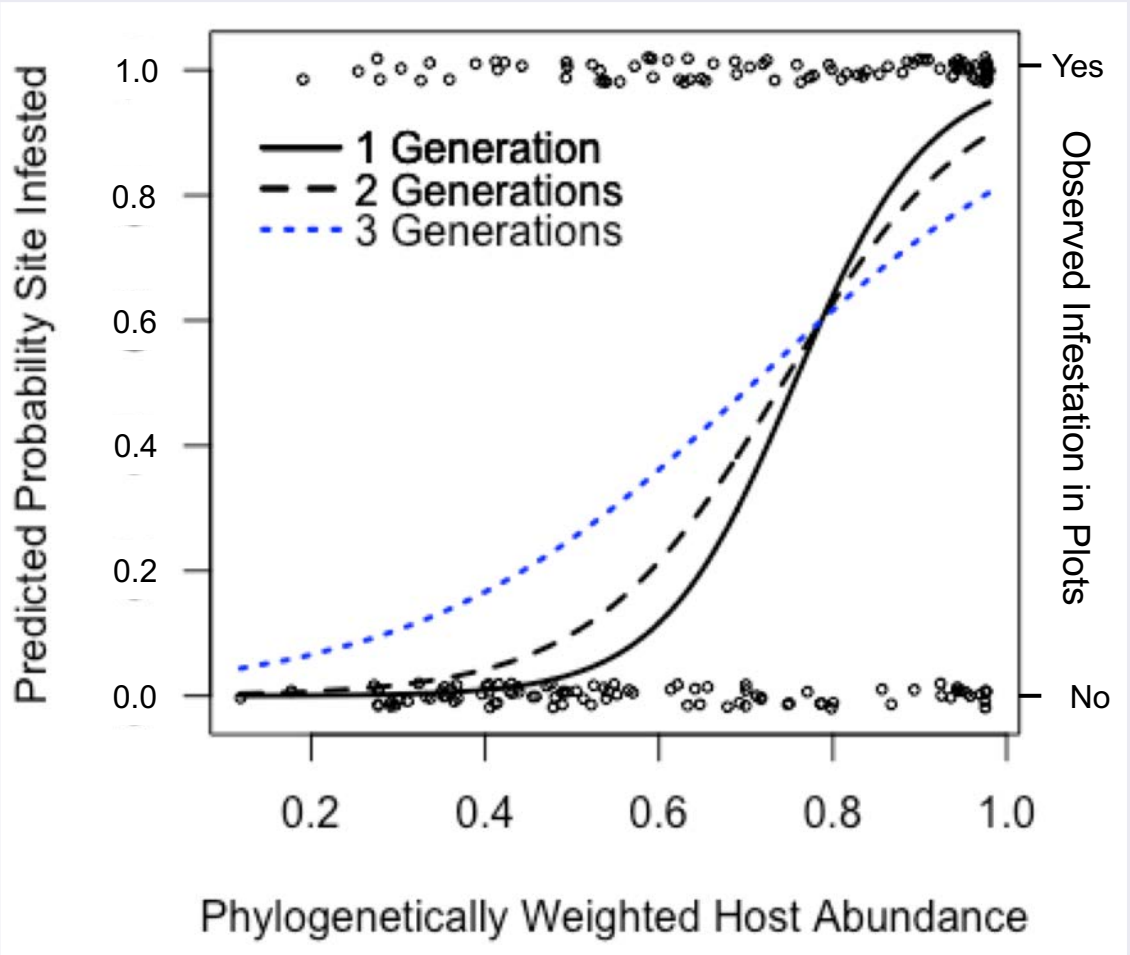
Community Structure and Climate Effects





Warmer Conditions = More beetle generations

Unfavorable communities are more susceptible

p(Site Suscept) = 16.9*wpS + 3.1*Gen – 3.9*(wpS*Gen) – 12.9

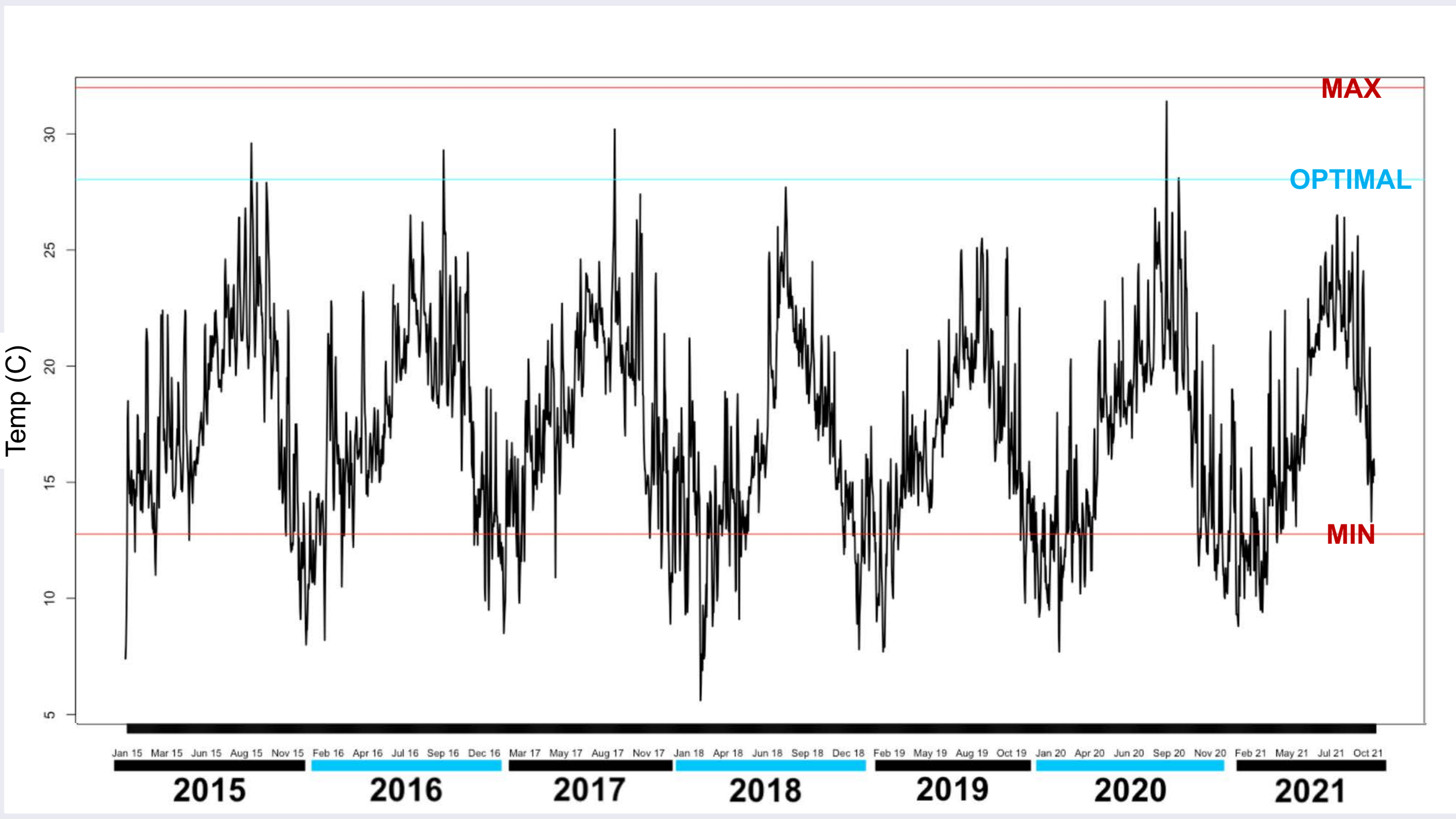
Management and Monitoring Recommendations

Warmer Conditions = More beetle generations

Unfavorable communities are more susceptible

- Focus monitoring resources in non-infested locations with high likelihoods of being infested

- Prioritize management actions in infested locations where community composition AND microclimate are most favorable for beetle establishment


MAX
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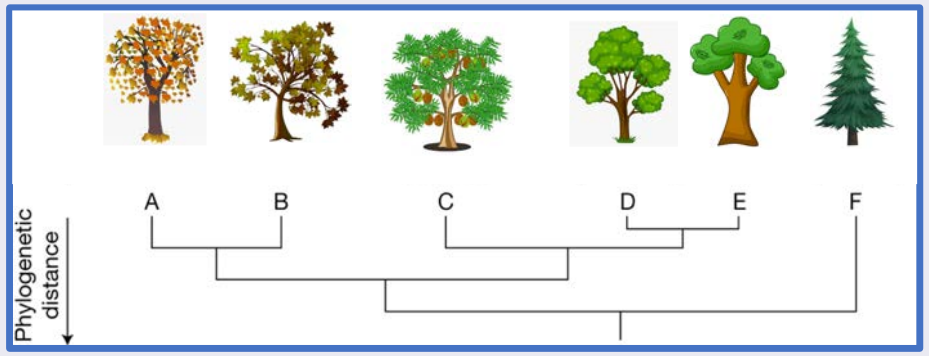
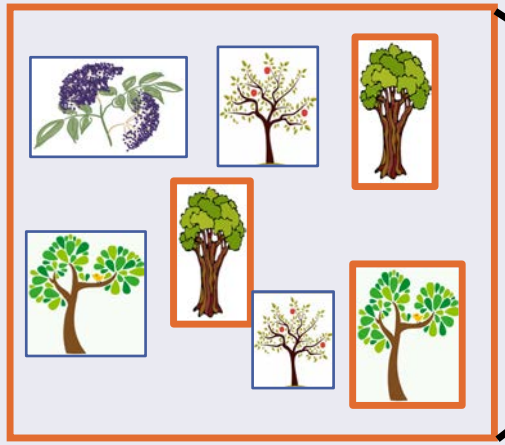
2015
2016
2017
2018
2019
2020
2021

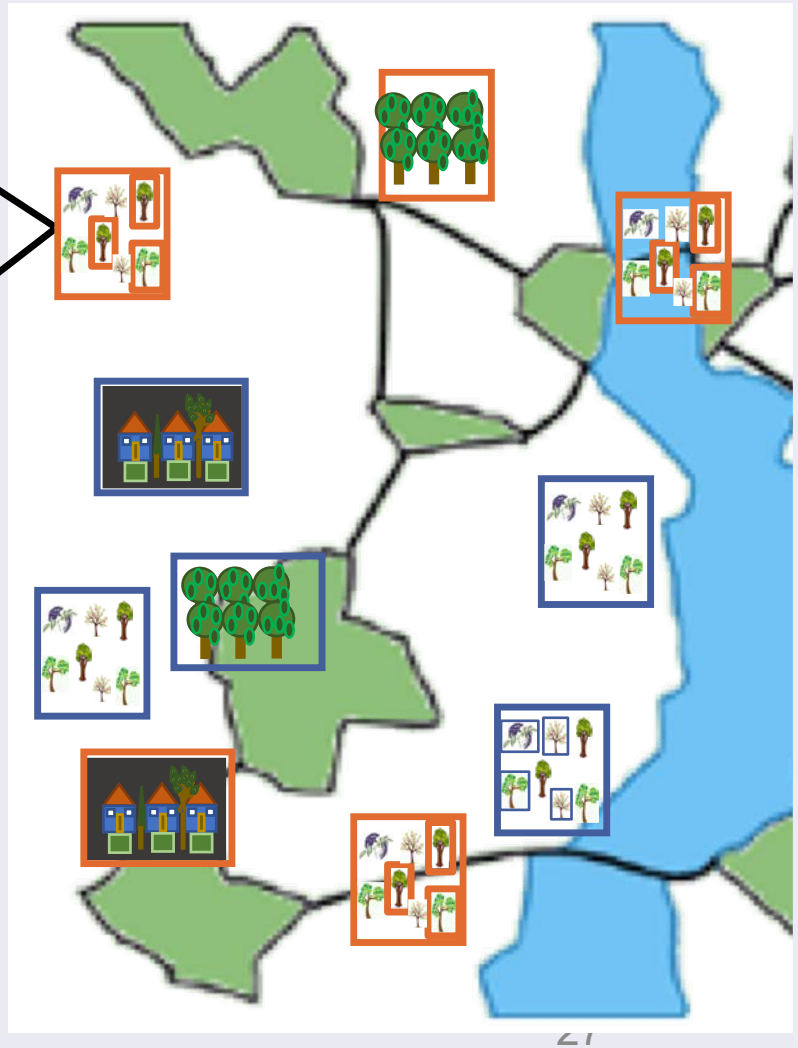
Under Investigation

- Statewide predictions over time
- Landscape considerations

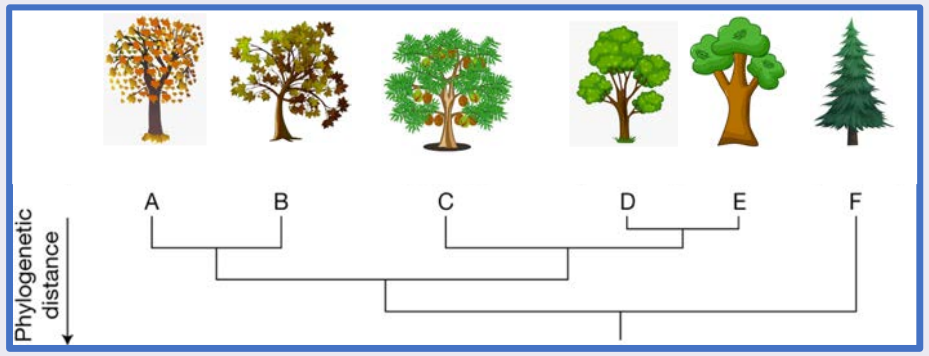
Landscape Considerations

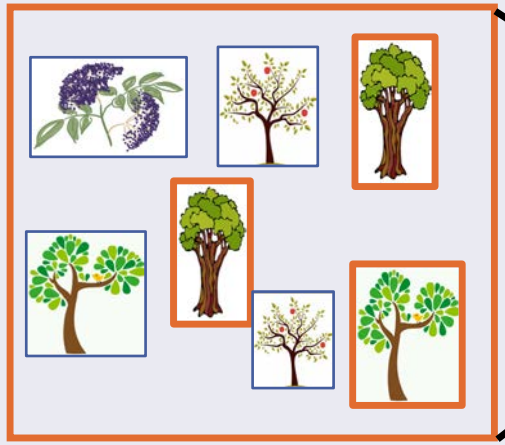


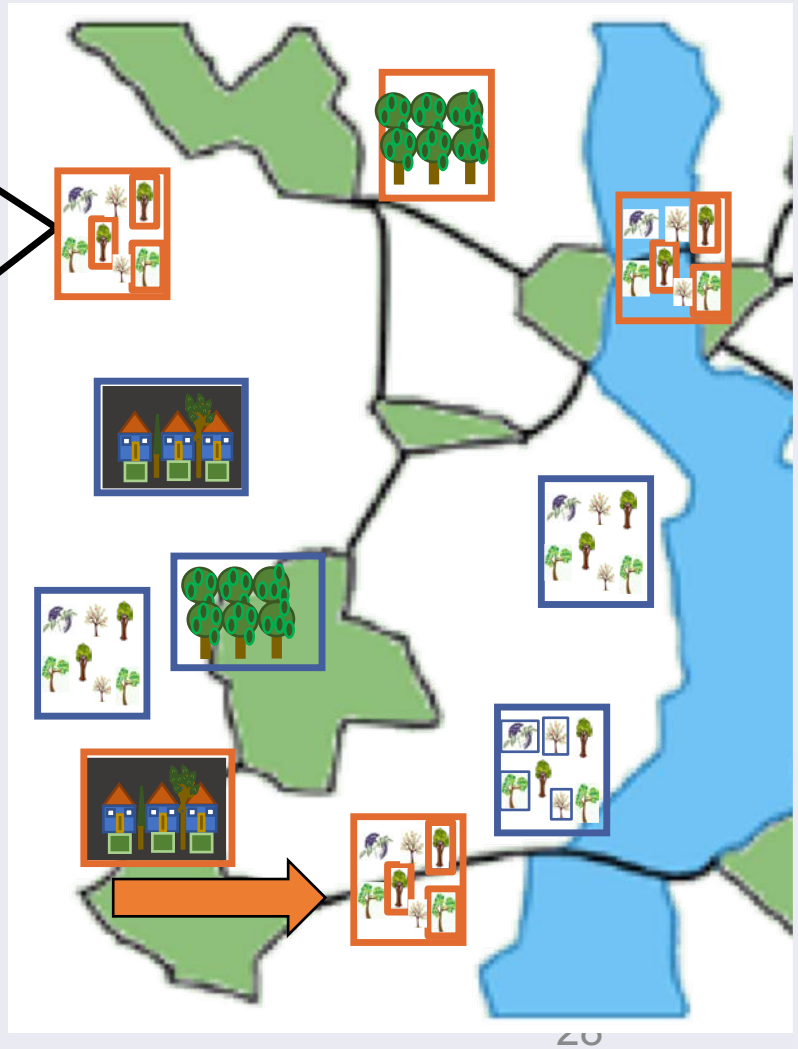




Landscape Considerations







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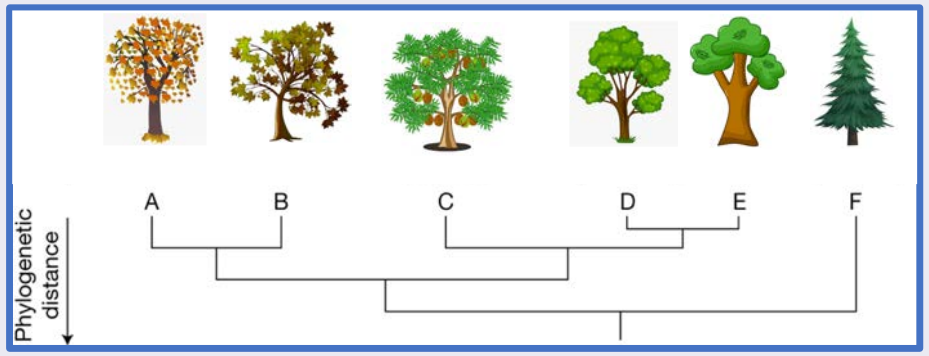
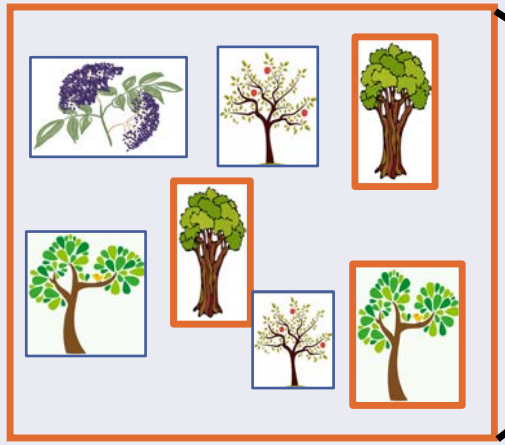
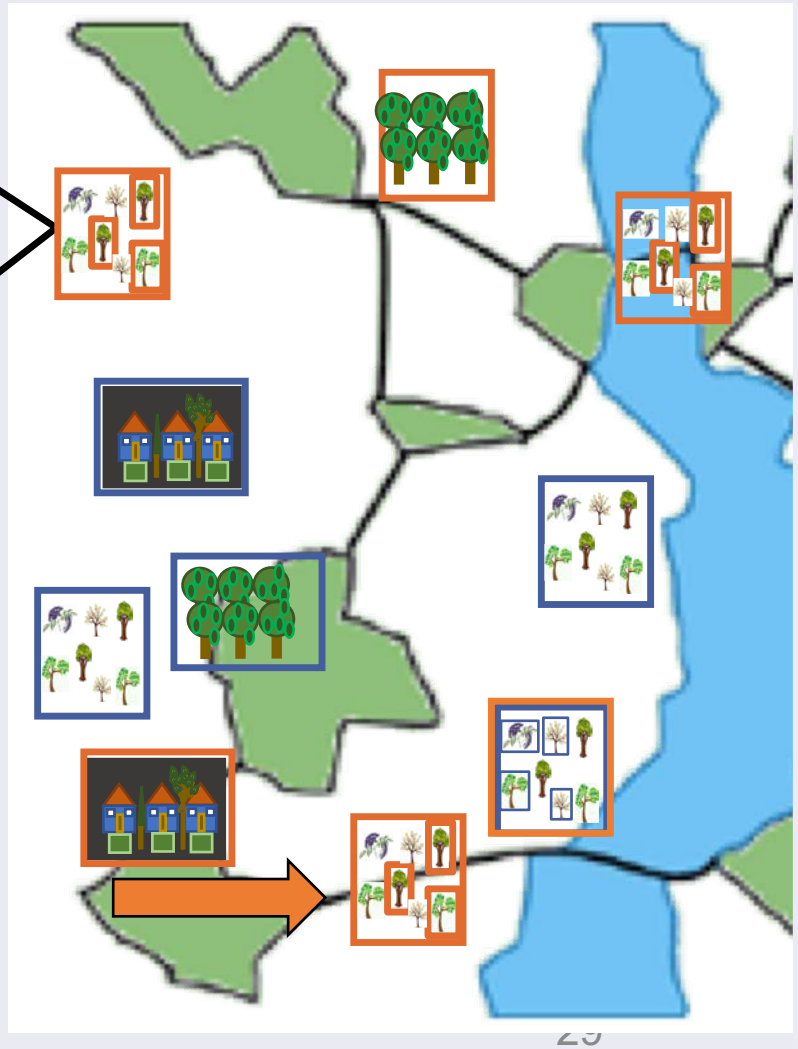
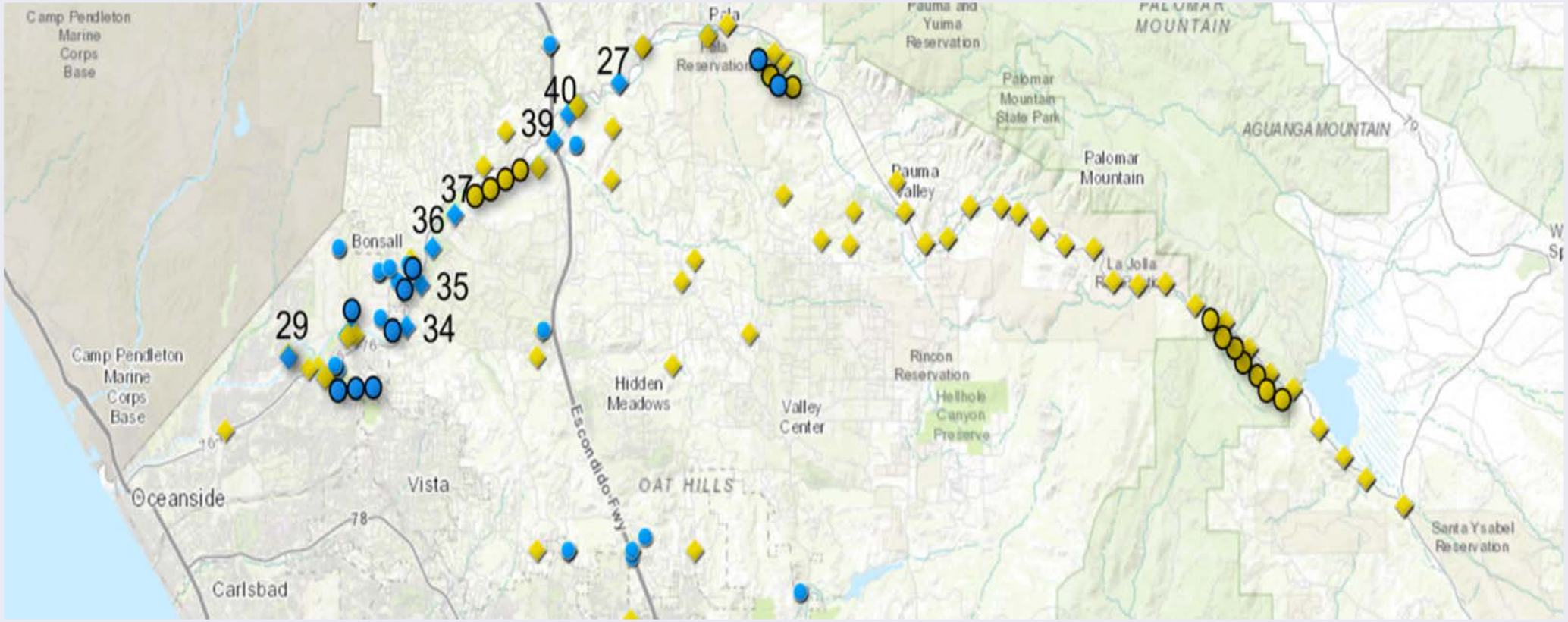






Monitoring beetle population in San Luis Rey River



San Luis Rey monitoring traps and permanent plot locations. Blue circles are KSHB positive traps, yellow diamonds are negative monitoring traps. The red circle is recent findings

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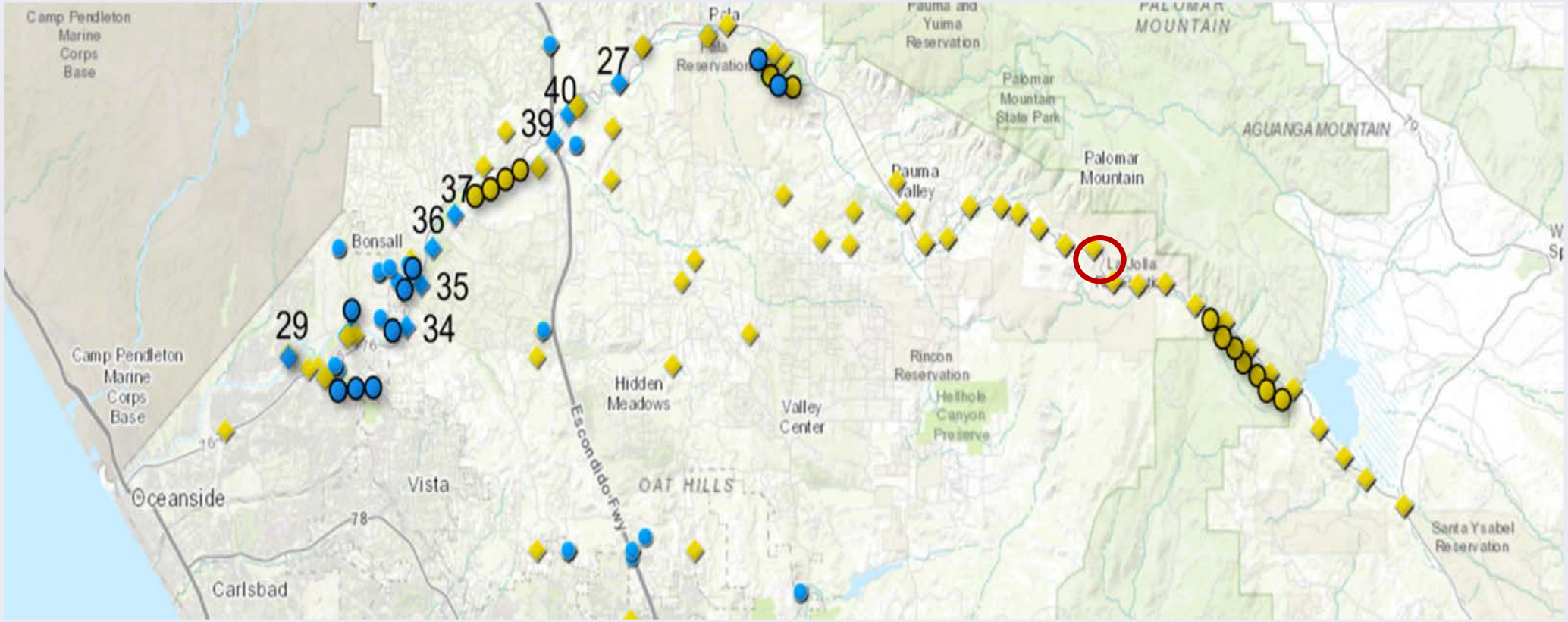
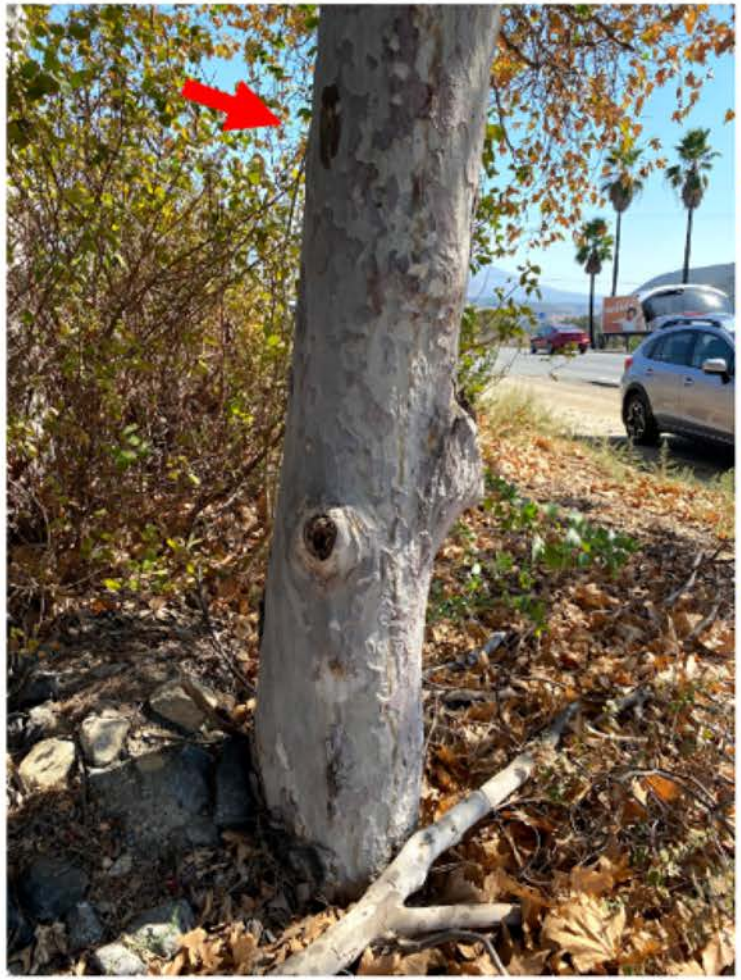


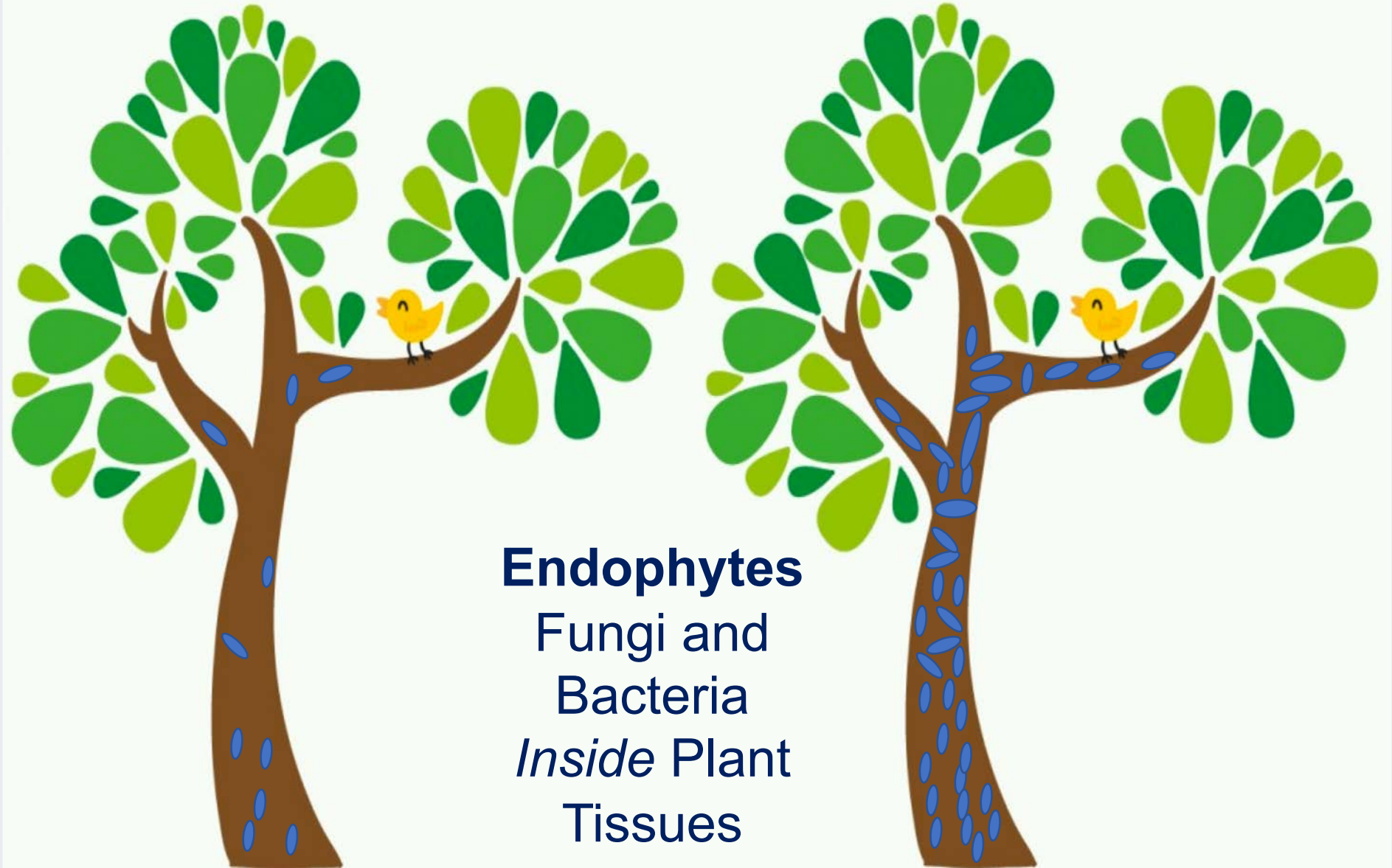
San Luis Rey monitoring traps and permanent plot locations. Blue circles are KSHB positive traps, yellow diamonds are negative monitoring traps. The red circle is recent findings

New KSHB infestation on a sycamore (*Platanus racemosa*) along SLR near Lilac Rd.
No new infestation was observed on any willows and cottonwoods in the area.



New PSHB infestation on a sycamore (*Platanus racemosa*) along SLR near Oak Knoll Campground

Host Microbiome and Disease Dynamics



Endophytes
Fungi and
Bacteria
Inside Plant
Tissues

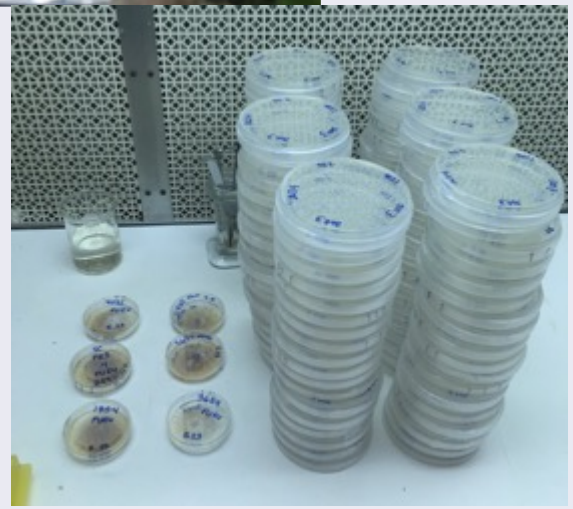
Non-Infested Sycamore in a Disease Hot-Spot

March 2016

November 2016

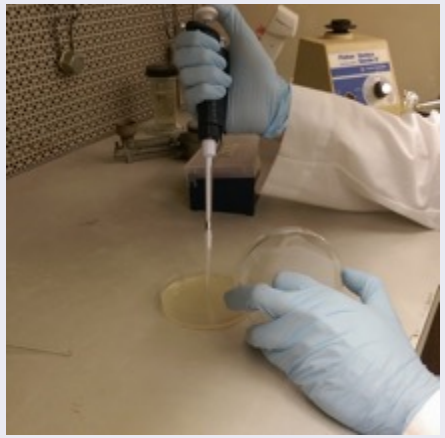
Endophyte Sampling

- **Willows**
- **Cottonwood**
- **Oak**
- **Sycamore**

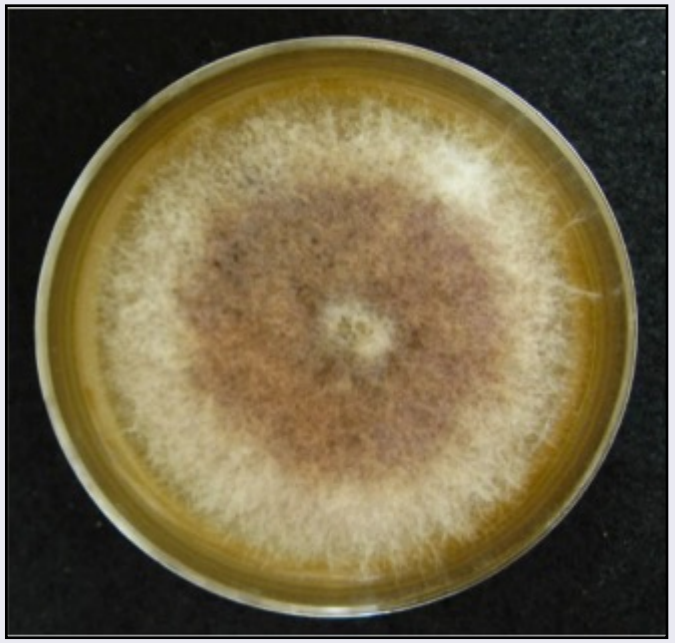


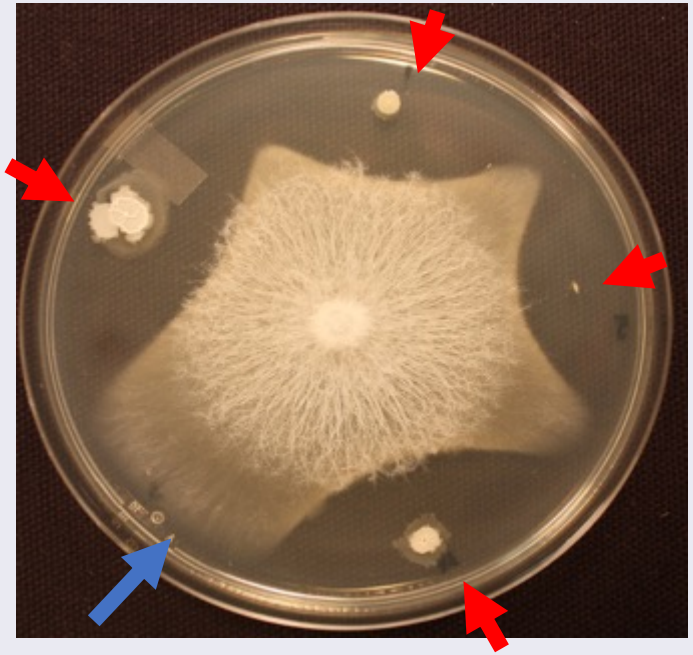
Total 606 samples were collected in San Diego

Preliminary Endophyte Screening



In vitro Inhibition Bioassays





Control

Treatment

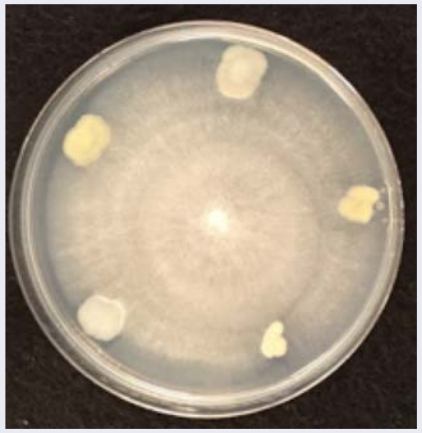
- No Inhibition
- Inhibition

Microbes Exhibiting Inhibition of *Fusarium* growth

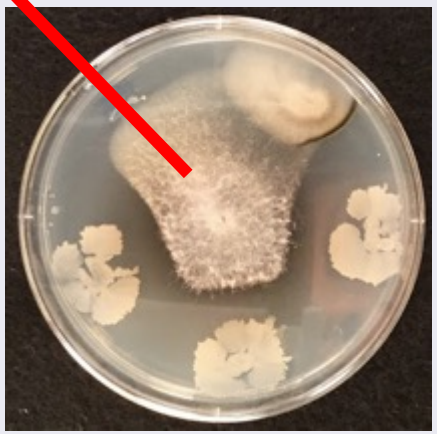
Bacterial Inhibition	Fungal Inhibition
Pseudomonas sp.	*Aureobasidium pullulans**
Pantoea sp.	*Pithomyces chartarum*
Variovorax sp.	*Acremonium* sp.
Bacillus spp.	*Alternaria alternate*
	Epicocoum nigrum

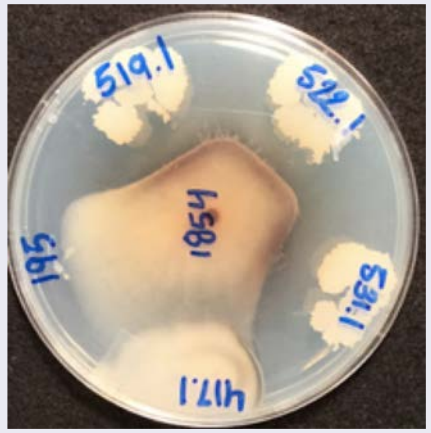
Endophyte Sampling

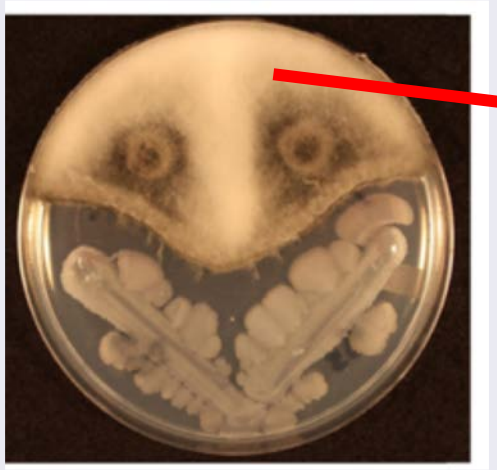
Fusarium kuroshium



Control

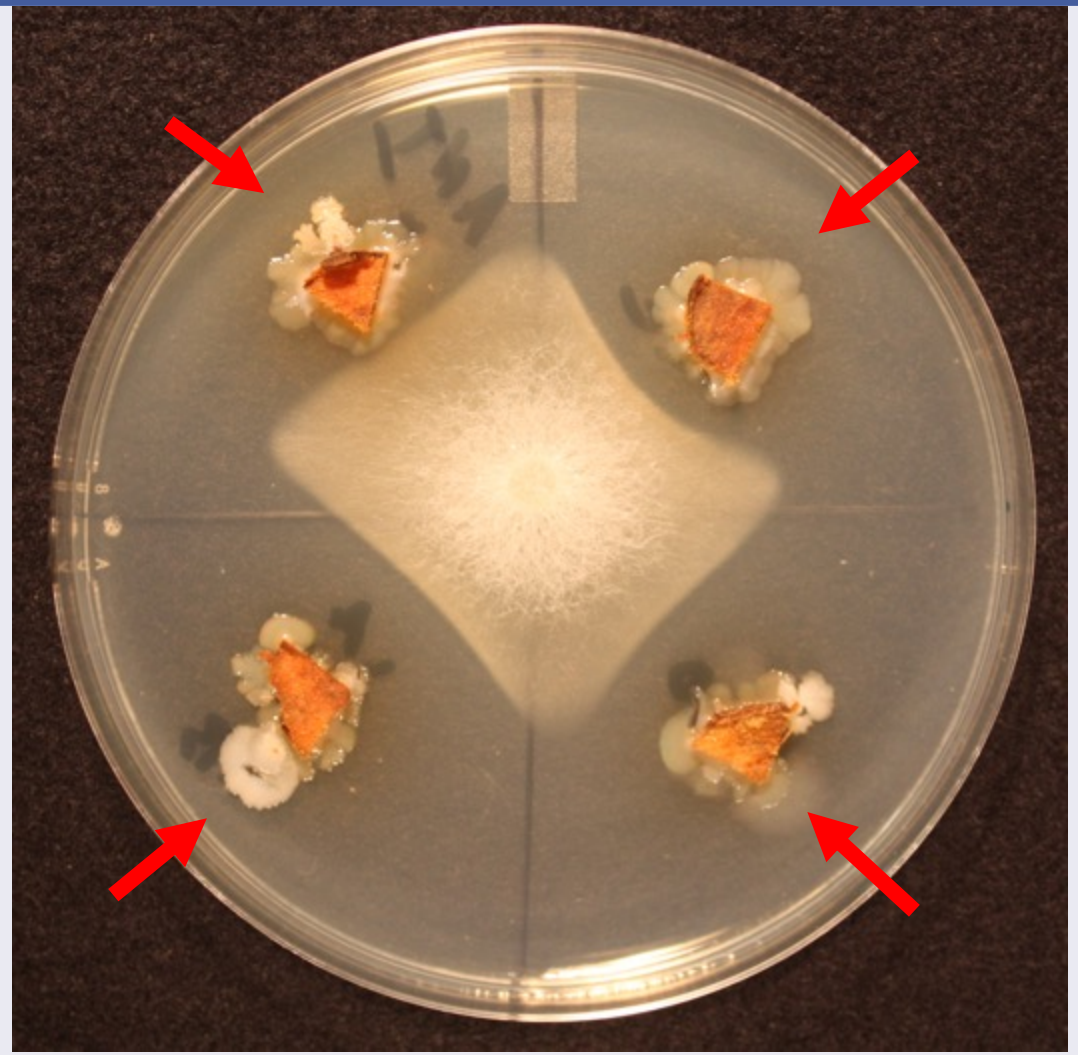






Botryosphaeria sp.

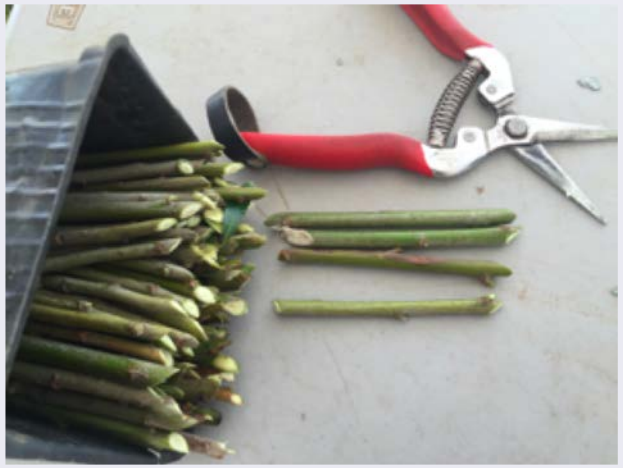
Inhibition Bioassays



In planta

No Inhibition Inhibition

Restoration with Biocontrol

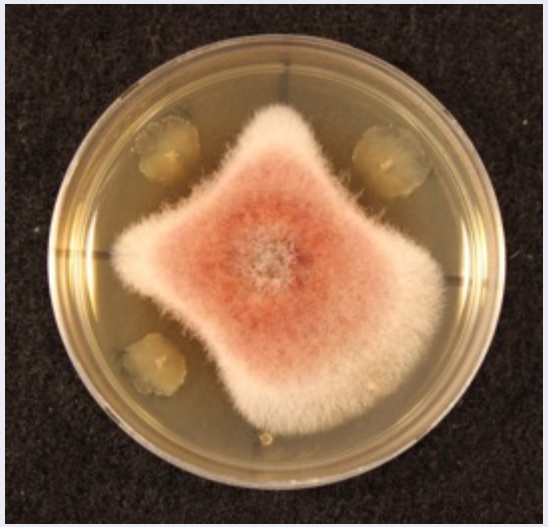


Willow cutting for propogation

Infiltrate

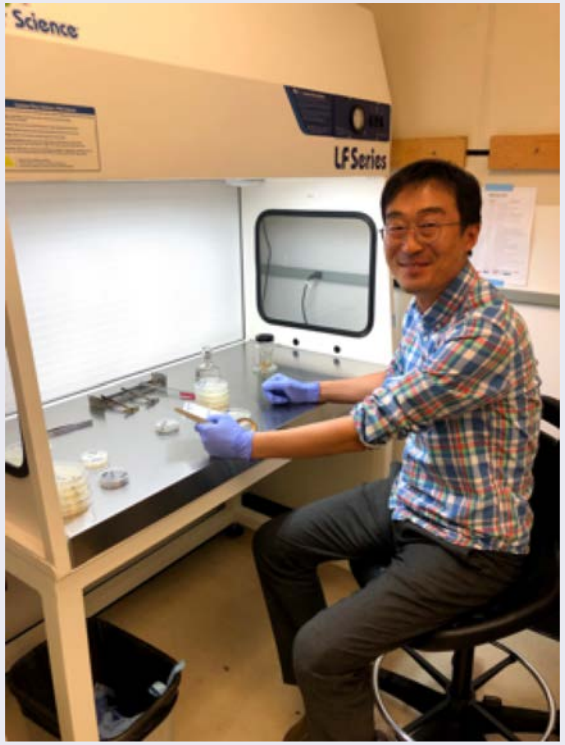
Propagate

Restore



Recover

Fermentation of endophytic bacteria in large scale



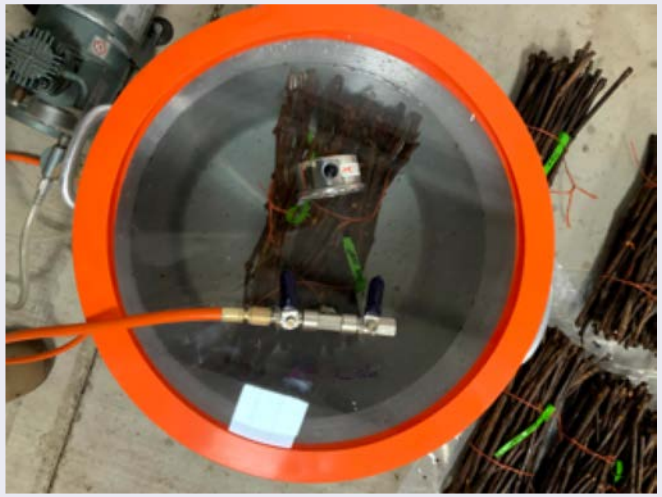
In vitro isolation and culturing

In vitro fermentation

Large scale fermentation

Collaboration with a group of scientists from the University of Chonnam from South Korea on fermentation of endophytic bacteria that could be applied in large scale.

Delivering endophytes into propagation cuttings via vacuum infiltration



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OCparks

The Nature Conservancy

SANDAG

LOS ANGELES CENTER FOR URBAN NATURAL RESOURCES SUSTAINABILITY

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

IRVINE RANCH CONSERVANCY

California AVOCADO COMMISSION

cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

SOUTHERN CALIFORNIA BOTANISTS FOUNDED 1927

CNPS California Native Plant Society

Sea & Sage Audubon Society
An Orange County Chapter of the National Audubon Society

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