CNPS 2022 Conference
ROOTING TOGETHER
EFFECTS OF A FIREBREAK ON PLANTS AND WILDLIFE

AT PINE HILL, A BIODIVERSITY HOTSPOT, EL DORADO COUNTY, CALIFORNIA

J. Mario K. Klip, Molly R. Caldwell, Debra R. Ayres, and Virginia Meyer

photo credits: ‘Coyote’ by Jerry Kirkheart via Flickr, ‘Gray Fox’ by Don Owns via Flickr, ‘Western Grey Squirrel’ by Don Loarie via Flickr, ‘Hetorothica grandiflora’ by queerbychoice via LocalWiki, ‘Pine Hill Flannelbush’ by Stickpen via Wikimedia Commons
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Study Area

- Pine Hill Ecological Reserve, El Dorado County, CA
  - Chaparral habitat in gabbro soil complex
  - Hosts endemic plant species
  - No formal wildlife surveys previously conducted

Study evaluated impacts of fire break on native vegetation and wildlife

Fire break cut along property perimeter bordering residential development

Legend:
- Treatment cameras
- Control cameras
- Vegetation plots
- Pine Hill unit boundary

0 0.3 0.6 Kilometers
Pine Hill Firebreak studies

Questions addressed:

• What are the densities and survivorship of *Ceanothus roderickii* with and without fire?

• How does the vegetation respond to clearing and clearing-plus-burning?
  • Exotic vs native species diversity and cover
  • Will one or both communities return to native chaparral?

• How does the wildlife respond to clearing – assessed by motion detection cameras?
Prior to firebreak clearing, El Dorado CNPS volunteers flagged rare plant individuals in 2017

Survey paths were cut with hand tools to allow for volunteer surveyors to access rare plant occurrences in the dense chaparral.
Following firebreak clearing, survey for additional rare plant occurrences and flagging continued.

Survey crew taking a break at the north side of the “hill”

*Galium californicum* ssp. *sierrae* – El Dorado bedstraw
BOTANICAL METHODS
Cleared perimeter on the west side of Pine Hill with intact chaparral of ? age in background

Opening in chaparral with invasive false brome (*Brachypodium distachyon*)

Plant studies began in spring, 2019
- Pine Hill cleared material burned in small piles – result is fire replicates that we used as plots

- Each burned plot paired with a same-size plot in adjacent, cleared (but NOT burned) area
  - plots size range: 4.3-12.65 m²
All species within each plot identified and percent cover assessed. Pine Hill ceanothus seedlings marked with a nail, counted and size measured

*Ceanothus roderickii* – federally endangered

Note the cotyledons on the seedling on the right!
Data collected in 2019, 2021, 2022

- West area firebreak cleared in 2017
- 5 plots burned in 2017: data collected 2, 4, and 5 years post treatment
- 3 plots burned in 2018: data collected 1, 3, and 4 years post treatment
Ceanothus roderickii demographics – Pine Hill Ceanothus

Mature shrubs not found in burned plots: mature shrubs of rare species were avoided when the firebreak was cleared and is killed by fire.

Fire is required for PH ceanothus seed germination.
Seedlings continue to germinate years 4 and 5 in the fire treatment but not in the cleared.

Seedlings continue to grow; few flowers produced as yet.

*Ceanothus roderickii* 5 year demographics and growth
Burned plot 6 in spring, 2021 (year 4)

Chart of seedling diameters in burned plot 6 in spring, 2022 (year 5)

Average: 12 cm
Range: 2-46 cm

Note many small seedlings, presumably having germinated in later years

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Total = 89 seedlings
Exotic species continue to contribute cover in both burned and cleared-only treatments.
Community Coefficient (Jaccard) 5 years

Coefficients < 50 indicate different communities

By shared species number, burned and cleared-only treatments have similar communities (share a large proportion of species).

By cover of shared species, burned and cleared-only treatments differ in community (shared species have very different cover values between treatments).
Multivariate analysis and cluster summary of treatment by year for 5 years

All species cover values used to calculate distance between treatment x year.

There is NO convergence between fire and cleared treatments.

Question: are all species equally important in separating communities?

Examine those species that respond most strongly to treatment and time = focal species
Fire kills established plants. Whiteleaf manzanita does not resprout after cut down or burned – ALL cover due to seedlings.

Creeping sage escaped chain saw in clearing but was killed by fire. All creeping sage in fire plots grew in from unburned edges vegetatively.

Seeds do not germinate in response to fire – fire injures or kills?
Whiteleaf manzanita in cleared-only plot 4, 2021 - seedlings

Creeping sage in burned plot 5, 2022 - vegetative growth
Seeds that respond to fire – fire promotes germination; fire kills plants.

Pine Hill ceanothus survived clearing as was below chain saw blade, but not fire. Regeneration by seed and branch rooting.

Rushrose killed by fire. Regeneration by seed.
Crocanthemum scoparium –
rushrose in burned plot 8
Resprout response – fire does not kill but promotes resprouts. Plants able to take advantage of additional nutrients and water.

California yerba santa plants were burned, but responded by vigorous resprouting.

Pitcher sage also responded to fire by resprouting, though not as dense in occurrence as yerba santa.
Yerba santa resprouting in burned plot 7

Pitcher sage sprouting (above) in burned plot 6, 2021 and germinating from seed (below) in a burn, 2019
*Brachypodium distachyon* – annual false brome – a fall germinating exotic annual grass that can thrive under mature chaparral canopies perhaps altering fire regimes due to the fine fuel it provides during the fire season to catch the shrubs on fire.

Cal-IPC rating: moderate
Exotic species with highest cover in both treatments
Early fire treatments

All cleared treatments

Late fire treatments

Correlation: $r = 0.98$, $p = 1$

Excellent agreement between analyses
Firebreak study extended to south slope of Pine Hill

_Fremontodendron decumbens_ – Pine Hill flannelbush – resprouts and germinates from seed in response to fire
Functional analysis: availability of palatable plant life (2019) - two years post-clearing of firebreak

Cover by Functional Grouping Intact Chaparral

- Exotic grass
- Exotic annuals
- Native grass
- Native annuals
- Bulbs
- Herb perennials
- Resprouters
- Seeders
- Unvegetated

Cover by Functional Grouping Cleared Treatment

- Exotic grass
- Exotic annuals
- Native grass
- Native annuals
- Bulbs
- Herb perennials
- Resprouters
- Seeders
- Unvegetated

Exotic grass – mostly false brome (*Brachypodium distachyon*)
Seeders – mostly whiteleaf manzanita (*Arctostaphylos viscida*) and Pine Hill ceanothus (*Ceanothus roderickii*).

Perennial herbs – mostly creeping sage (*Salvia sonomensis*) and chaparral sedge (*Carex xerophila*).
Resprouters – mostly coffee berry (*Frangula californica* ssp. *tomentella*), hollyleaf redberry (*Rhamnus illicifolia*), and Bolander’s mules ear (*Wyethia bolanderi*).
WILDLIFE METHODS
Data Collection

12 trail cameras set for 1 year

Photo subsamples reviewed for mammal detections; “unduplicated” dataset created

Model testing

3 control area cameras

9 treatment area cameras

photo credit: California Department of Fish and Wildlife
Results

2,872 unduplicated mammal detections

Most common:

- Rabbits
- Mule Deer
- Gray Fox
- Gray Squirrel
- Humans

Detection probabilities generally higher in treated areas than control sites

Photo credits: 'Western Grey Squirrel' by Don Loarie via Flickr, 'Black-tailed Jackrabbit - Lepus californicus' by Jon Nelson via Flickr, 'Cottontail Rabbit' by Eric Sonstroem via Flickr, 'Mule Deer' by Wayne Dumbleton via Flickr, 'Gray Fox' by das_miller via Flickr, humans via Microsoft
New plant growth in firebreaks may have increased forage availability for herbivores, including smaller species whose movement was less restricted by dense vegetation in untreated areas.
Increased utilization of firebreaks by herbivores may have contributed to higher predator detection rates in treated areas.
Detection rates for some meso carnivores were positively correlated with prey species, like grey squirrel:

Large carnivore detection probabilities were calculated from a small sample of black bear and mountain lion observations, resulting in positive correlation with meso carnivore and mule deer detection rates and negative correlation with human detection rate.

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<td>$p = 0.003-0.013$</td>
<td>$\beta = 5.6$</td>
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<td>Mule deer detection rate</td>
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<td>Human detection rate</td>
<td>$p = 0–0.017$</td>
<td>$\beta = -21.704$</td>
<td>$P = 0.094$</td>
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Trophic patterns persist in a changing landscape
An impression of what we saw:
Acknowledgements

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Nate McCarthy
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Field Ecology Program
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Native Plant and Pollinator Interactions at the Pine Hill Preserve

By: Landon Eldredge (BLM biological technician)
Pine Hill Preserve

- ~5,000 acres of managed lands
  - Cooperative conservation effort of 10 different agencies
- ~10% CA’s native flora
- 8 rare plants
- Gabbro soils of the Rescue series
Vegetation Management

- Habitat heterogeneity
- Public safety
Education and Outreach

Native Seed Collections

Rare Plant Monitoring
Native Bees and Flora of Pine Hill Preserve
Most native bee pollination is done by solitary reproductive females. (Not female workers or males)
What makes natives so great?

- Native veg
  - coevolution (*Fritillaria, Calystegia*)
  - ~1,600 native bees in CA
    - many are thought to be pollen specialists

- Non-native veg
  - Loss of floral diversity is the primary cause of native bee decline
Collections
(2014-2020)

Hand nets
-direct observation
-sweep netting

Blue vane traps

Malaise
## Results

- 145+ total bee species
  - 143+ native
  - 2 non-native
- 65+ plant species
  - 60+ native
  - 5 non-native

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Rare plants were visited by 68 of 145 bee species.

**WYRE**  
- 40 bee species

**FRCADE**  
- greater bee diversity than previously reported and one bee not recorded in our study

**GACASI**  
- no female bee(s) collected

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Calystegia stebbinsii
-Federally and state listed as endangered

-Growing wildfire burn-scar

-Population seems to be holding steady

-Regularly visited by *D. bituberculata* and occasional other generalist bees

Cut vegetation create openings in chaparral for forbs to grow

-Habitat Management That Helps Both the Plant and the Pollinator

*Diadasia bituberculata*
-Morning glory pollen specialist

-Nests in bare soil within the *C. stebbinsii* population

-Hairy males hang out in flowers in afternoon

-Females are seen regularly moving from flower to flower

-Only a few records of *D. bituberculata* found outside of this general area

-Burning fuels creates access to bare soil for ground nesters
How do honey bees fit in?

- Excluded from certain resources
- They have a competitive costs with native bee resources.
- Supplementing plants with additional pollination?
  - Frangula californica
- This information is considered if apiculturists seek to place honeybees on Preserve lands

Ceratina on manzanita

Apis mellifera
Poor pollinators?

- Masked bees
- Cuckoo bees
- Male bees
- Other?
- Exceptions?
Looking forward
(and back)
Blue Orchard Bee Nesting Rates on BLM Land in California

STEPHEN PETERSON PH.D.
FOOTHILL BEE RANCH
FORESTHILL, CA
Osmia lignaria

- Commonly called the blue orchard bee or the orchard mason bee
- Nests in pre-existing holes in wood or in paper tubes or reeds
- One generation per year
- Solitary (not social)
- Native to the western US
Currently being used to pollinate almonds, cherries, pears, berries

Highly efficient pollinators

Just 300 nesting females needed per acre of almonds to replace one honey bee hive

Most bees used for pollination in California come from WA, OR and UT
Nest Material Options

- Solid drilled wood
- Grooved wooden laminates
- Paper tubes
- Reeds
- Plastic
Nesting

- Holes: 6” deep, 5/16” diameter
- One pollen load usually requires 75 flower visits
- To complete one provision, about 25 trips are needed
- One cell represents 1,875 flower visits
- A female can live up to 6 weeks and lay up to 32 eggs
- Mud is used for partitions between cells and to cap the hole
BOB Nest in a Reed

- Old cocoon
- mud
- pollen
- egg
- males
Wintering

- The bees spend winter as adults inside the cocoon
- Can be held in a refrigerator
- Cocoons can be washed in a bleach solution to remove mites and fungal spores
Can blue orchard bees be propagated successfully in the Sierra foothills?

Two Study Sites on BLM property
Case Mountain: 1260-1700’
Kanaka Valley: 1100’
Case Mountain
Kanaka Valley
Blue Orchard Bees forage from a wide variety of native CA plants

- Western Redbud
- Manzanita
- Pacific madrone
- Deer Brush
- Oak, Maple, Willow
- California blackberry
- California coffeeberry
- Sierra gooseberry
- Phacelia, Nemophila, Lupinis, Collinsia, Penstemon, etc.
<table>
<thead>
<tr>
<th></th>
<th>Case Mountain 2017</th>
<th>Case Mountain 2018</th>
<th>Case Mountain 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nesting holes</td>
<td>1,645</td>
<td>4,137</td>
<td>5,090</td>
</tr>
<tr>
<td>Bees Released</td>
<td>0</td>
<td>7,724</td>
<td>6,144</td>
</tr>
<tr>
<td>Completed Nests</td>
<td>1,481</td>
<td>3,222</td>
<td>3,169</td>
</tr>
<tr>
<td>Bees Produced</td>
<td>11,878</td>
<td>24,101</td>
<td>22,341</td>
</tr>
<tr>
<td>Reproduction Rate</td>
<td>NA</td>
<td>3.12x</td>
<td>3.63x</td>
</tr>
<tr>
<td>Total Mortality</td>
<td>6.4%</td>
<td>16.3%</td>
<td>17.7%</td>
</tr>
<tr>
<td></td>
<td>Kanaka Valley 2018</td>
<td>Kanaka Valley 2019</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------------------</td>
<td>--------------------</td>
<td></td>
</tr>
<tr>
<td>Nesting holes</td>
<td>500</td>
<td>898</td>
<td></td>
</tr>
<tr>
<td>Bees Released</td>
<td>0</td>
<td>395</td>
<td></td>
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<tr>
<td>Completed Nests</td>
<td>98</td>
<td>313</td>
<td></td>
</tr>
<tr>
<td>Reproduction Rate</td>
<td>NA</td>
<td>4.76x</td>
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</tr>
<tr>
<td>Bees Produced</td>
<td>496</td>
<td>1,884</td>
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# Mortality Factors (% of cells):

<table>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollen Ball</td>
<td>2.3</td>
<td>4.0</td>
<td>7.4</td>
<td>1.1</td>
<td>3.6</td>
</tr>
<tr>
<td>Dead Larva</td>
<td>1.6</td>
<td>0.9</td>
<td>2.7</td>
<td>0.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Tricrania</td>
<td>1.0</td>
<td>10.7</td>
<td>5.8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sapyga</td>
<td>0.8</td>
<td>0.2</td>
<td>0.6</td>
<td>0.3</td>
<td>2.8</td>
</tr>
<tr>
<td>Chalkbrood</td>
<td>0.6</td>
<td>0.5</td>
<td>1.2</td>
<td>7.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Stelis</td>
<td>0.2</td>
<td>0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>
Tricrania stansburyi

Sapyga sp.

Stelis montana

Chalkbrood
## Reproduction Rates on Private Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>County</th>
<th>Elevation</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP</td>
<td>Placer</td>
<td>2500'</td>
<td>1.18</td>
<td>0.35</td>
<td>0.56</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>JP</td>
<td>El Dorado</td>
<td>1650'</td>
<td>0.49</td>
<td>2.47</td>
<td>0.88</td>
<td>1.94</td>
<td>1.75</td>
</tr>
<tr>
<td>GC</td>
<td>Fresno</td>
<td>3150'</td>
<td>3.64</td>
<td>2.63</td>
<td>0.81</td>
<td>1.10</td>
<td>0.57</td>
</tr>
<tr>
<td>SW</td>
<td>Tulare</td>
<td>1150'</td>
<td>4.21</td>
<td>1.42</td>
<td>0.84</td>
<td>1.50</td>
<td>0.96</td>
</tr>
<tr>
<td>RR</td>
<td>Tulare</td>
<td>2000'</td>
<td>7.59</td>
<td>0.22</td>
<td>2.14</td>
<td>0.50</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

- *Osmia lignaria* bees can easily be found and propagated in the Sierra foothills.
- Year-to-year propagation results are highly variable.
- Mortality factors include 3 cleptoparasitic species and a fungal disease.
CNPS 2022 Conference
Rooting Together
Keeping Mission Blue Butterflies in the Loop...inus

Chris Schwind
Creekside Science
Mission Blue Butterfly

- Federally endangered
- Largest population on San Bruno Mountain
- Utilize three lupine species as host plants
  - *Lupinus albifrons*
  - *Lupinus formosus*
  - *Lupinus variicolor*
San Bruno Mountain Lupines

-First established Habitat Conservation Plan (HCP)
San Bruno Mountain Lupines

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- Protected habitat surrounded by urban landscape
San Bruno Mountain Lupines

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San Bruno Mountain Lupines

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- Serpentine soils help make SBM a good habitat for a diversity of native plants
- Nonnative grass encroachment (Nitrogen deposition)
San Bruno Mountain Lupines

- First established Habitat Conservation Plan (HCP)
- Protected habitat surrounded by urban landscape
- Serpentine soils help make SBM a good habitat for a diversity of native plants
- Nonnative grass encroachment (Nitrogen deposition)
- Scrub encroachment
San Bruno Mountain Lupines

- First established Habitat Conservation Plan (HCP)
- Protected habitat surrounded by urban landscape
- Serpentine soils help make SBM a good habitat for a diversity of native plants
- Nonnative grass encroachment (Nitrogen deposition)
- Scrub encroachment
- Root crown fungus affects mostly L. albifrons (most common perennial lupine on SBM)
Diversifying and Amplifying Lupines on SBM

-Lots of work to plant lupines on SBM, most of it transplanting plugs
Diversifying and Amplifying Lupines on SBM

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-Works in deeper soils, but lupines can be outcompeted by grasses
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Diversifying and Amplifying Lupines on SBM

- Lots of work to plant lupines on SBM, most of it transplanting plugs
- Works in deeper soils, but lupines can be outcompeted by grasses
- Broadcast seeding usually yields low germination
- Raising lupines to maturity in nurseries has proven difficult
MBB Conservation Community

Need for more seeds, better planting practices
Disney Butterfly Conservation Initiative
Disney Butterfly Conservation Initiative

In 2017, in collaboration with the University of Florida, Creekside Science received a grant to work on these problems.
Creekside Conservation Nursery
Creekside Conservation Nursery

Location, Location, Location
Creekside Conservation Nursery

Fairy Bags!!
Creekside Conservation Nursery

-Fairy bags allow seeds to mature fully, but not be lost

-Unfortunately, they do add considerable time and labor to the process

-Since 2019, we’ve produced over 150,000 lupine seeds, providing seed to a number of agencies

-Viability is 99%+

-See Jimmy Quenelle’s poster!
Planting Techniques

-Rocky soils, road cuts, places with less competition, lupines grow well in rocks!
Planting Techniques

-Rocky soils, road cuts, places with less competition, lupines grow well in rocks!

-Shoving seeds into rock crevices or rocky soils, and covering with soil
Planting Techniques

-Rocky soils, road cuts, places with less competition, lupines grow well in rocks!

-Shoving seeds into rock crevices or rocky soils, and covering with soil

-Areas with lower insolation have proven to have better success
Randomized Block Planting Experiment

- Planted into grids with permanent markers for monitoring

- Varied insolation, area of mountain, scarification and species

- Found that lower insolation and the eastern part of the mountain were better habitat

- More on the species and scarification to come
Final Numbers of Lupines

2022 Monitoring # of LUFO by Year and Treatment

Total of 534 lupines established to date
Final Numbers of Leaves

2022 Lupine Monitoring # of Leaves by Year and Treatment

Total leaves in all cells

Experimental Year / Scarified

Coffee Y1 S U S Y2 U S Y3 U
Number of Plants By Species
MBB are using them!
Lessons Learned

• Careful direct seeding into rocky soils is an effective and cost efficient way to build lupine populations

• Scarified seed does better more quickly, but planting a combination of scarified and unscarified builds the seed bank and hedges bets against poor growing seasons

• Seeded lupines do best in low insolation, and on the east side of San Bruno Mountain
Scaling Up

-Recent money from USFWS partners will allow us to partner with SBM watch to continue our efforts

-SBM Watch is helping us to facilitate volunteer events to address laborious planting technique
Scaling Up

- Continue to provide seed to partners such as SF Rec and Parks, SFPUC, San Mateo RCD, NPS

- Ultimate goal of getting MBB populations back up to numbers where we can take a step back and responsibly downlist
Acknowledgements

A large project like this is always enhanced by more hands