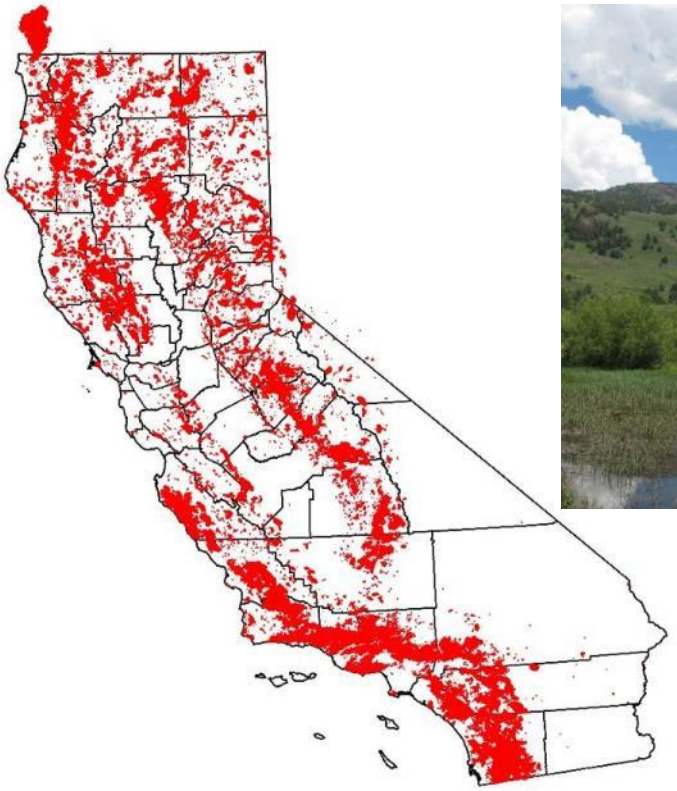
Post-Morgan Fire Plant Diversity and Succession:

A Framework for Fire Following Species and Fleeting Abundance

NOMAD ECOLOGY

by Heath Bartosh and Brian Peterson

California Climate



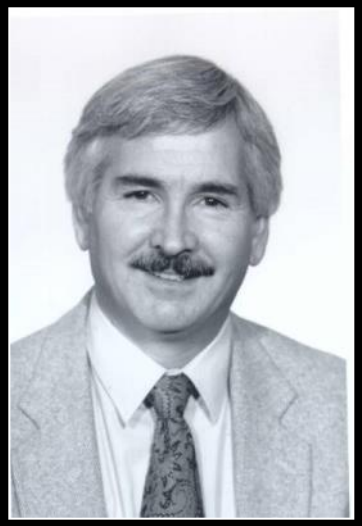
Fire Ecology

Definition: A branch of ecology that focuses on wildfire and its relationship to the environment that surrounds it, both living and non-living.

- Fuel structure
- Fire return interval
- Fire severity
- Species life history
- Species assemblages

Body of Knowledge

Harold Biswell



James Agee

Jon Keeley

Scott Stephens

Willis Jepson

Mary Bowerman

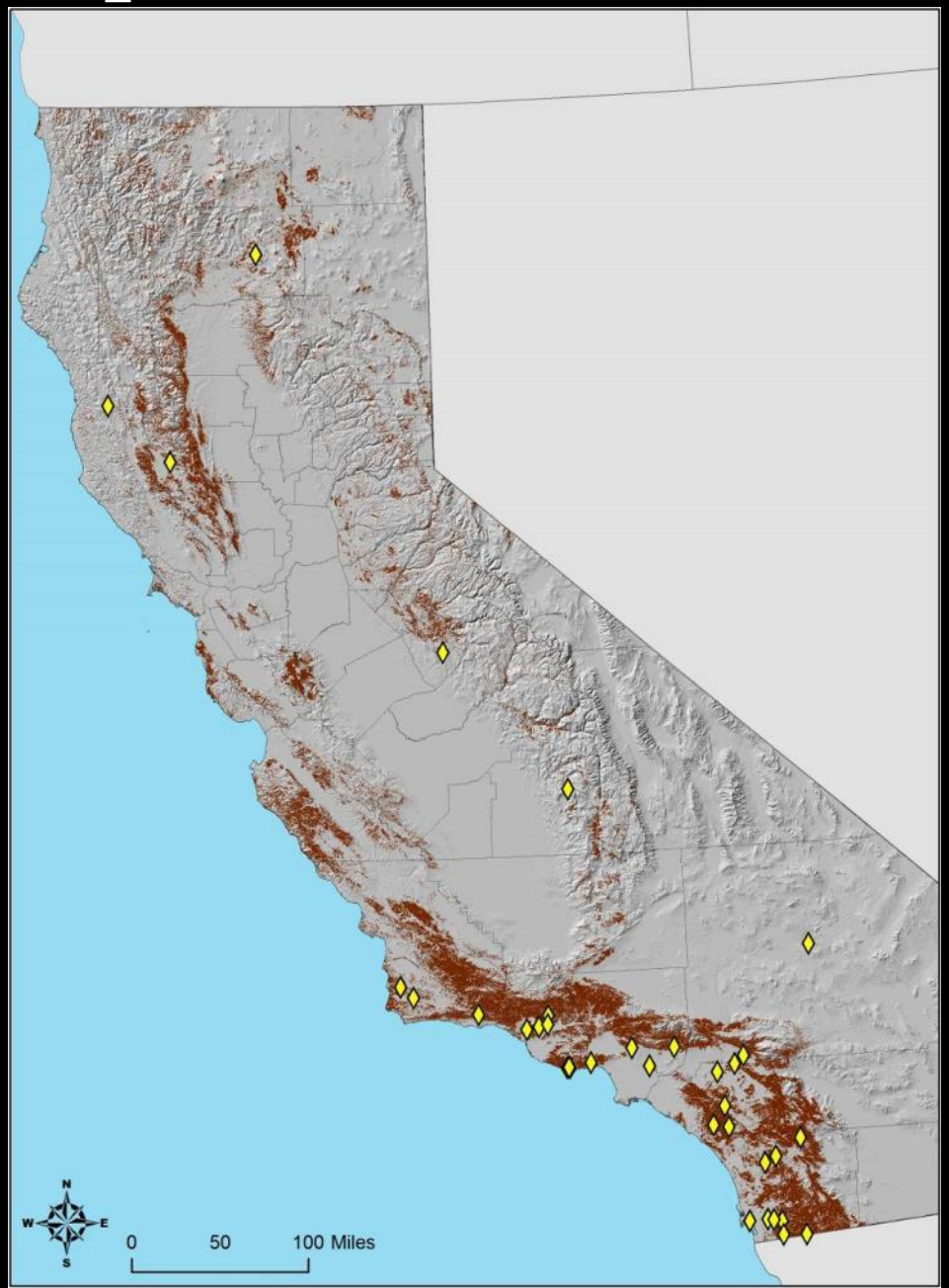
Iliamna bakeri

- Northern California Distribution
- Missing ecological info
- Incomplete habitat info
- Germination triggers?
- Life history?
- Fire severity

Clarkia biloba subsp. *australis*

- Sierra Distribution
- Missing ecological info
- Incomplete habitat info
- Germination Triggers?
- Fire severity Affects

Post-Fire Chaparral Studies



Chaparral and Fire

Chaparral Facts

- Large, low frequency wildfires is the natural condition of chaparral

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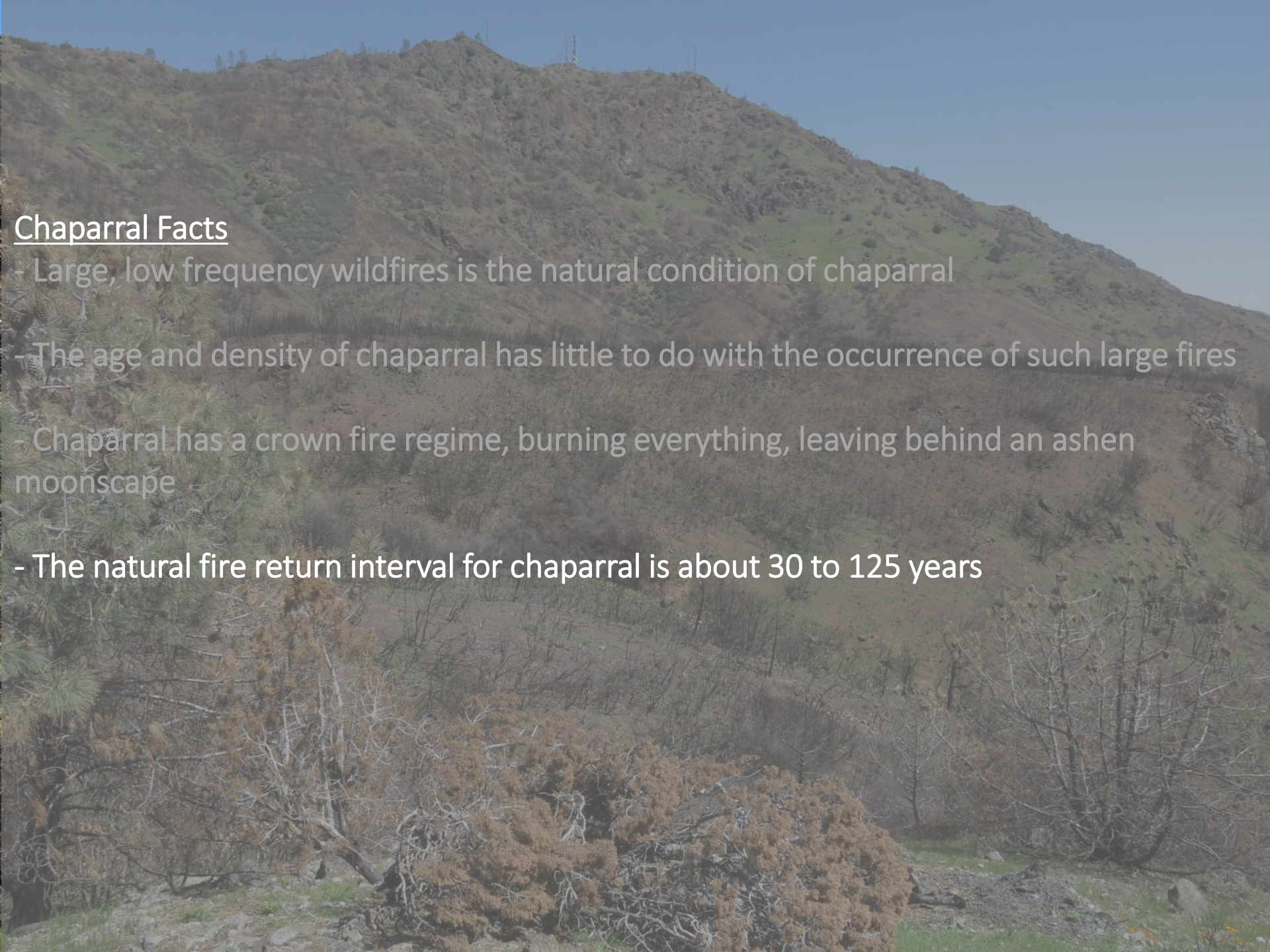
- Chaparral has a crown fire regime, burning everything, leaving behind an ashen moonscape



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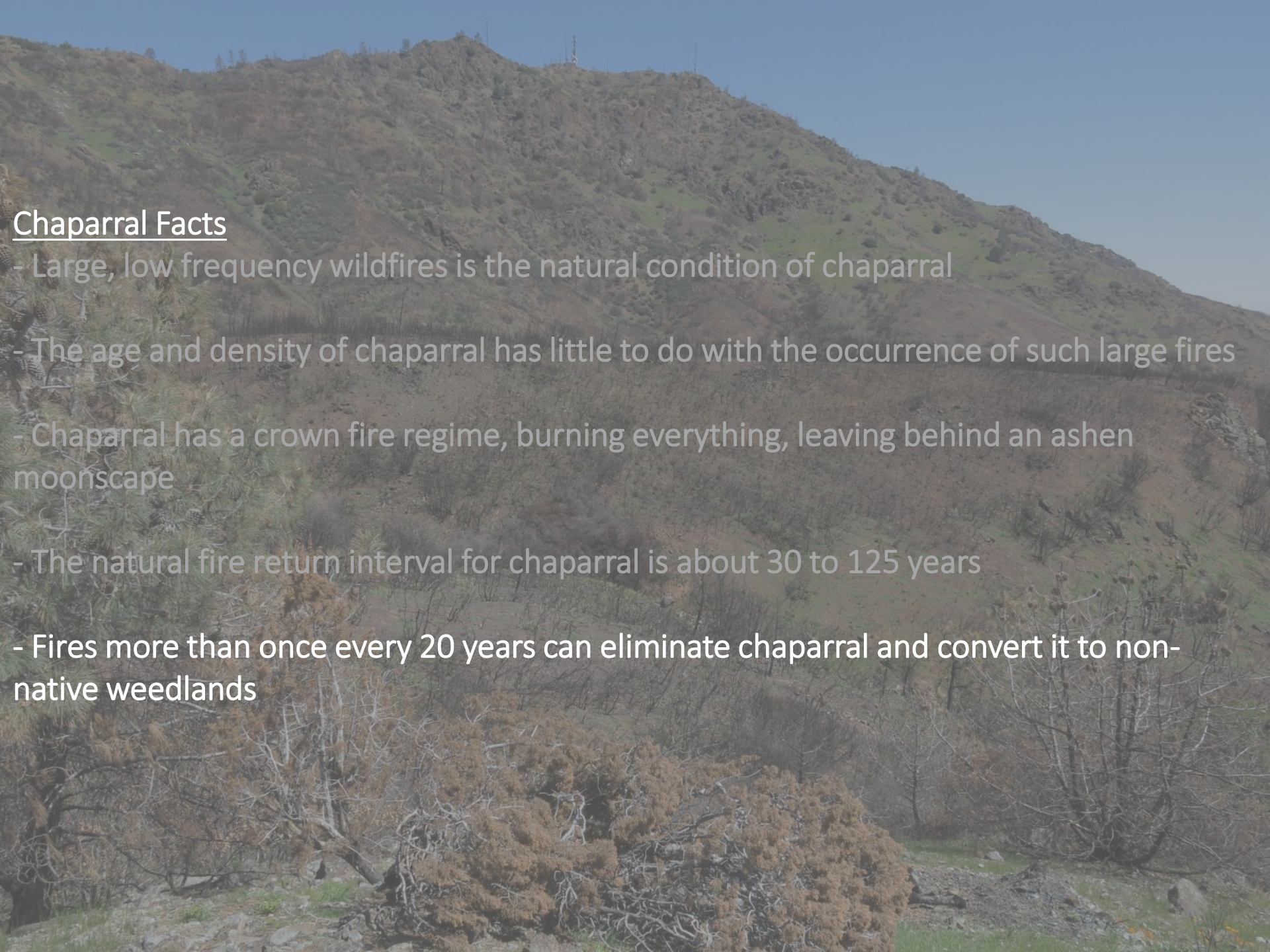

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- Fires more than once every 20 years can eliminate chaparral and convert it to non-native weedlands

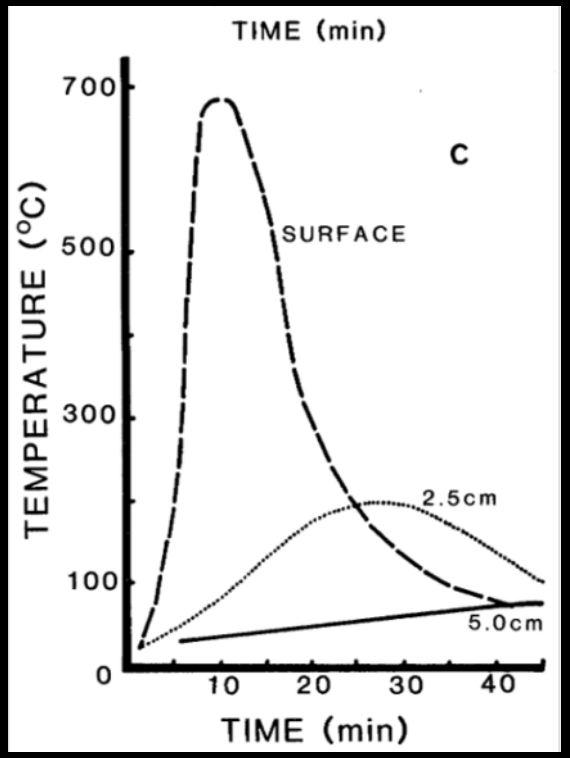
Life History Strategies: Seeders

Mount Diablo and Contra Costa manzanitas (*Arctostaphylos auriculata* & *A. manznita* subsp. *laevigata*)

Life History Strategies: Seeders

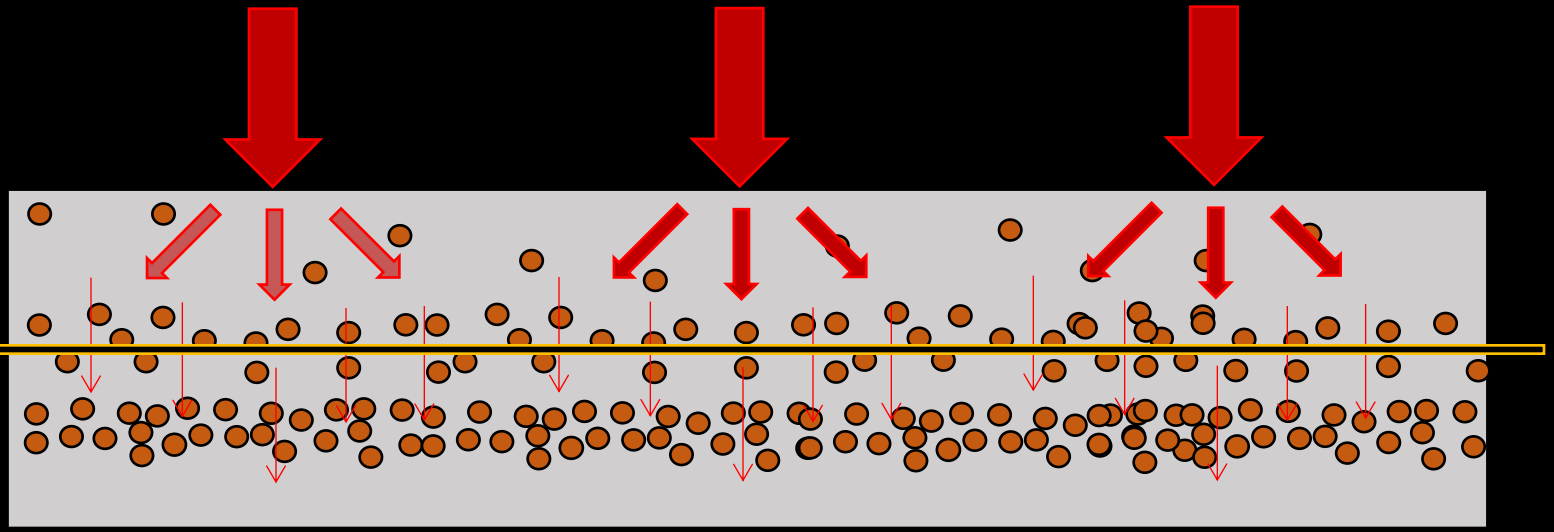
Seed Caching Rodent

Soil Heating Profile



Seed Bank Structure

Kill Zone

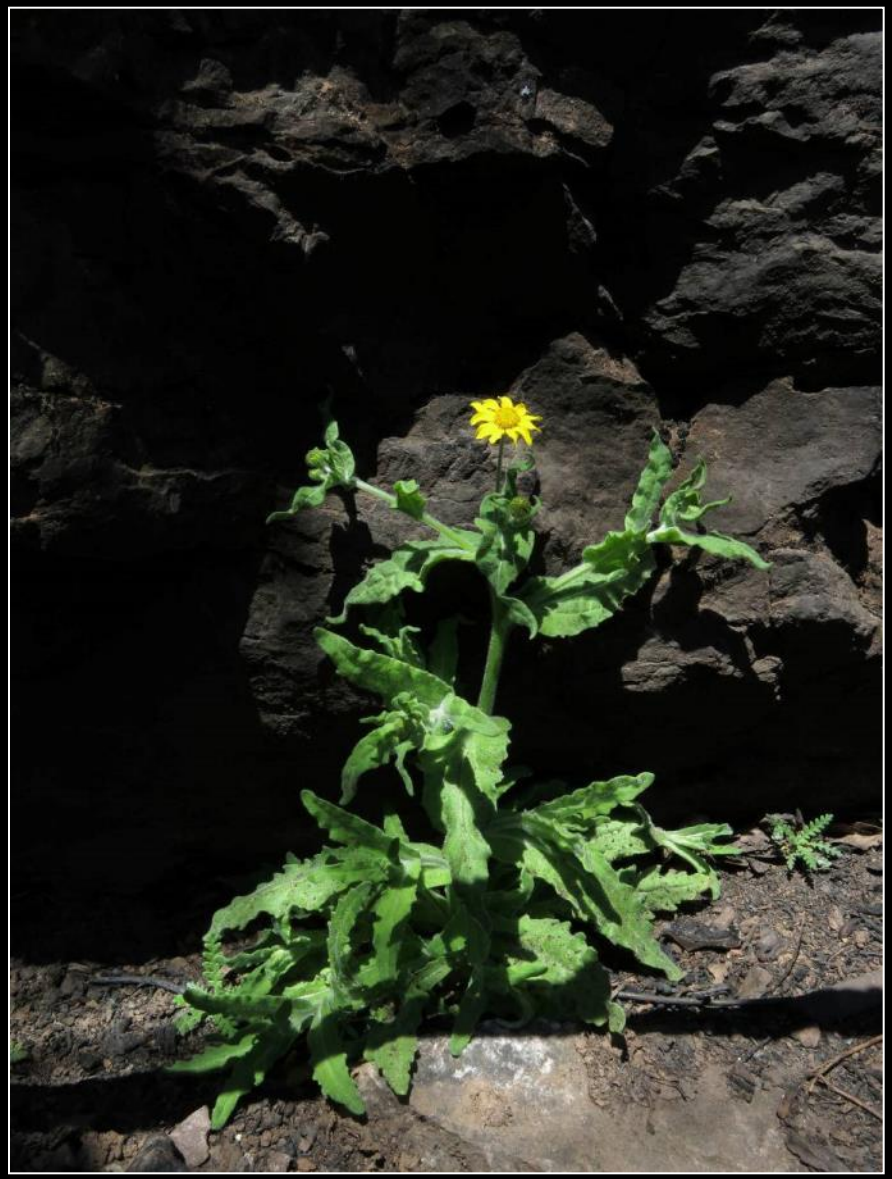


Life History Strategies: Sprouters

chamise (*Adenostoma fasciculatum* var. *fasciculatum*)

Life History Strategies: Fire Followers vs. Native Disturbed

Monolopia graciliens

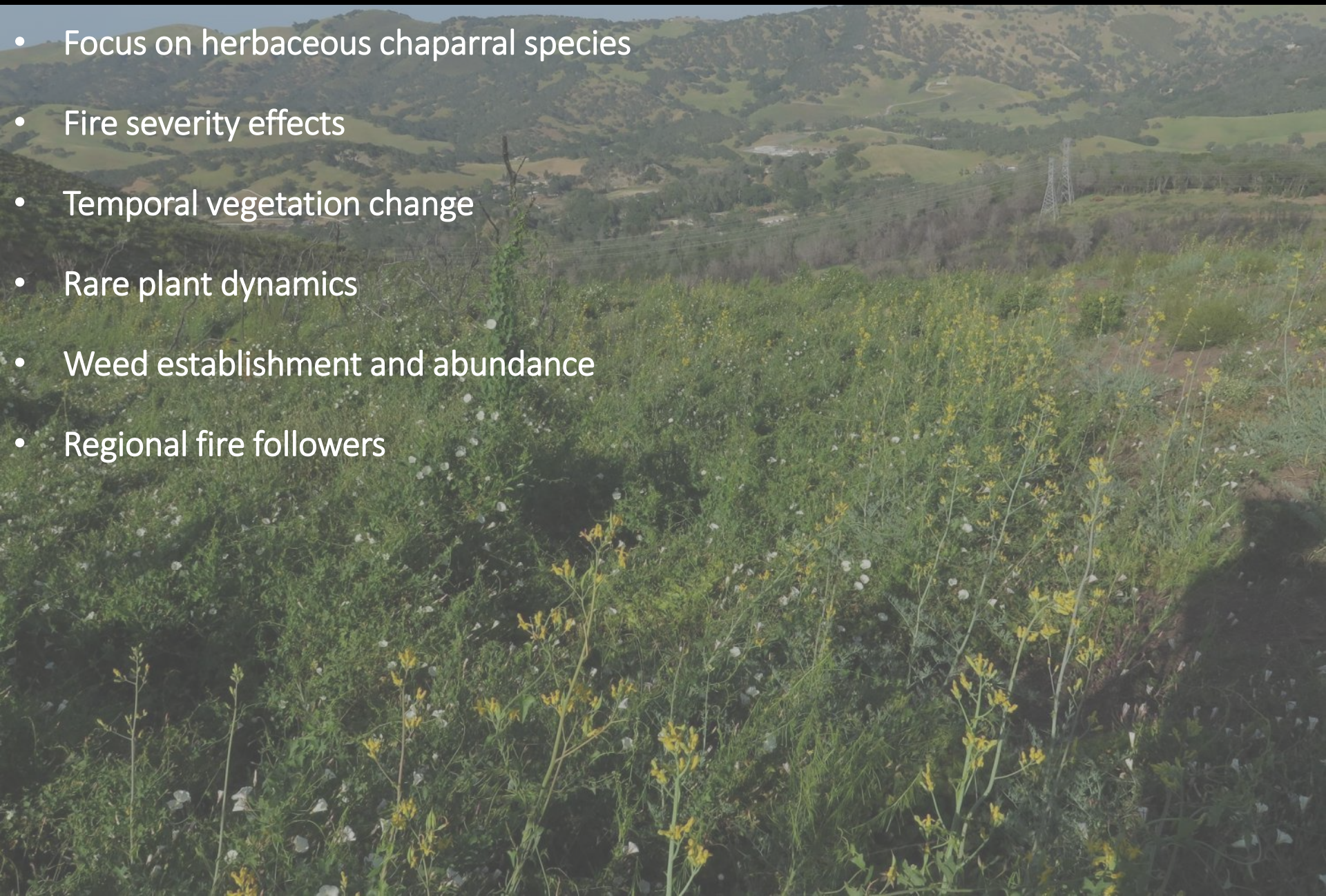


Madia gracilis

Post-Fire Research Interests

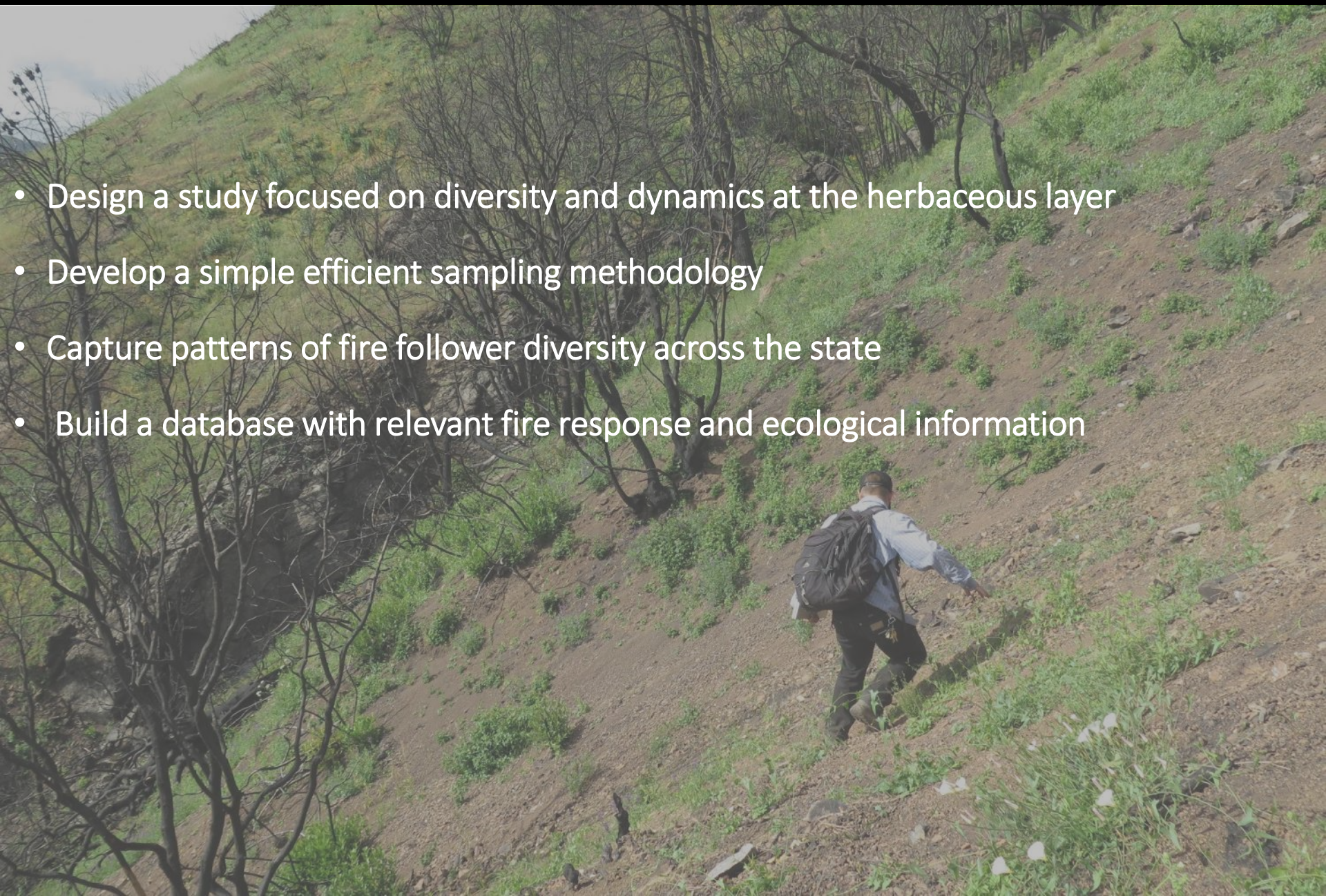
Fleeting Abundance = The dynamics of a plant species (primarily annuals) that are generally absent from the landscape, until germination is triggered by fire, and have high abundance that typically fades between a period of 1 to 3 years.

Post-Fire Research Interests



- Focus on herbaceous chaparral species
- Fire severity effects
- Temporal vegetation change
- Rare plant dynamics
- Weed establishment and abundance
- Regional fire followers

Establishing a Methodology



- Design a study focused on diversity and dynamics at the herbaceous layer
- Develop a simple efficient sampling methodology
- Capture patterns of fire follower diversity across the state
- Build a database with relevant fire response and ecological information

Morgan Fire 2013: Mount Diablo State Park


Redding
Susanville
Honey Lake
Pyramid Lake
Chico
Reno
Fallon
Ukiah
Yuba City
Carson City
Lake Tahoe
Roseville
Sacramento
Santa Rosa
Elk Grove
Vacaville
Napa
Fairfield
Vallejo
Antioch
Stockton
Concord
San Francisco
Tracy
San Leandro
Livermore
Modesto
San Mateo
Fremont
San Jose
Merced
Los Banos
Santa Cruz
Fresno
Salinas
Soledad
Visalia
Lemoore
CALIFORNIA
Coalinga
Avenal
Delano
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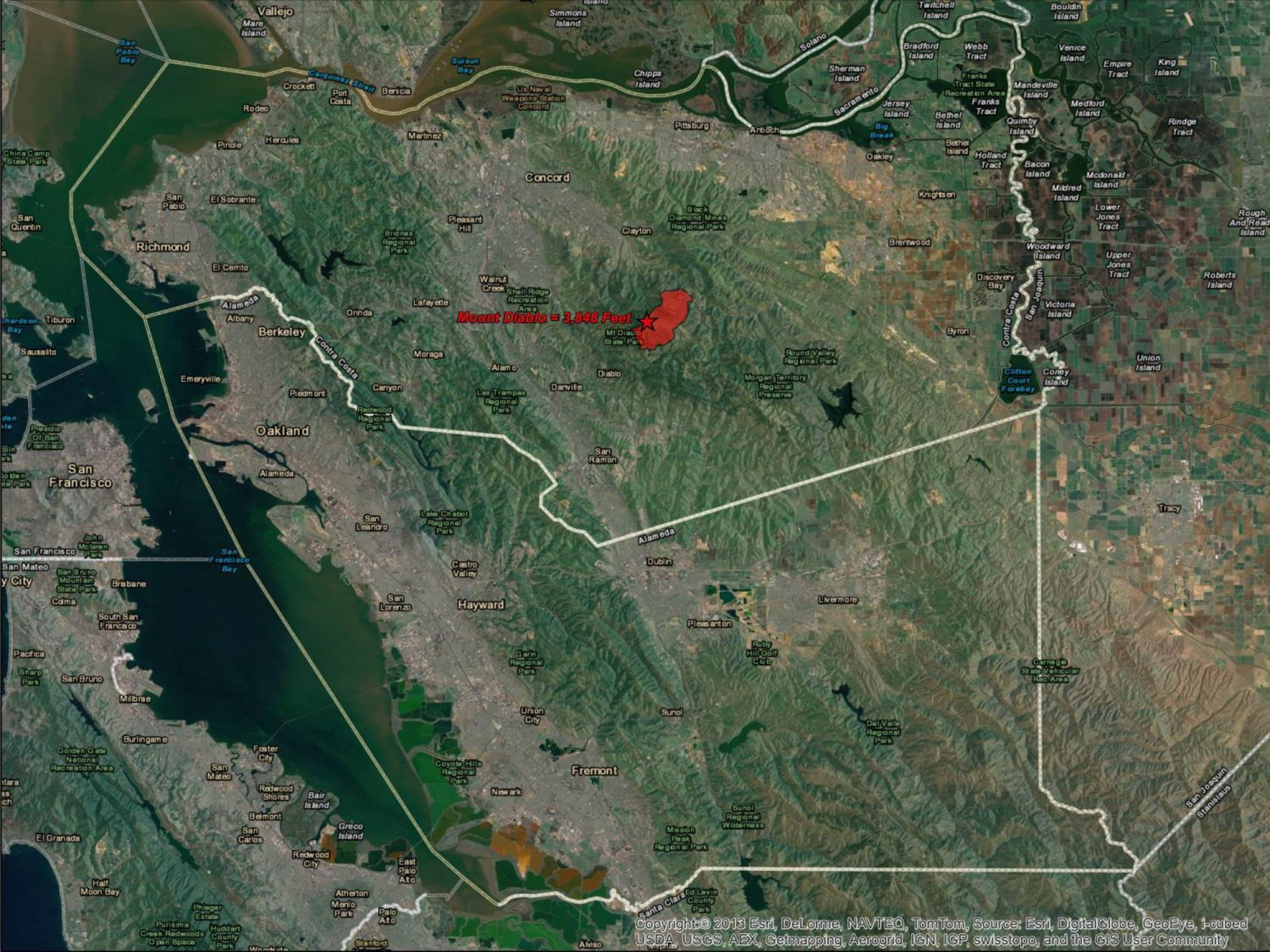
CCo
CCo
ScV
CCo
CCo
SnFrB
Mount Diablo = 3,848 Feet
SnJV
CCo
CCo
SnFrB
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP swisstopo, and the GIS User Community


Mount Diablo = 3,848 Feet
Vallejo
Mare Island
Simmons Island
Twitchell Island
Bouldin Island
San Pablo Bay
Carquinez Strait
Suisun Bay
Solano
Bradford Island
Webb Tract
Venice Island
Empire Tract
King Island
Chipps Island
Sherman Island
Crockett
Port Costa
Benicia
Rodeo
Hercules
Pinole
Martinez
Pittsburg
Antioch
Sacramento
Jersey Island
Bethel Island
Mandeville Island
Medford Island
Quimby Island
Rindge Tract
Big Break
Oakley
Holland Tract
Bacon Island
Mcdonald Island
Mildred Island
Knightsen
Concord
China Camp State Park
San Pablo
El Sobrante
San Quentin
Richmond
Pleasant Hill
Clayton
Black Diamond Mines Regional Park
Lower Jones Tract
Rough And Ready Island
Brentwood
Woodward Island
Upper Jones Tract
Roberts Island
Briones Regional Park
El Cerrito
Walnut Creek
Shell Ridge Recreation Area
Lafayette
Orinda
Alameda
Albany
Berkeley
Contra Costa
Tiburon
Sausalito
Moraga
Alamo
Diablo
Danville
Mt Diablo State Park
Discovery Bay
San Joaquin
Victoria Island
Byron
Round Valley Regional Park
Morgan Territory Regional Preserve
Clifton Court Forebay
Coney Island
Union Island
Emeryville
Piedmont
Canyon
Las Trampas Regional Park
Redwood Regional Park
Oakland
Presidio Of San Francisco
San Francisco
Alameda
San Ramon
Tracy
San Leandro
Lake Chabot Regional Park
John Mclaren Park
San Francisco Bay
Alameda
Dublin
San Mateo
San Bruno Mountain State Park
Brisbane
Cdma
Castro Valley
San Lorenzo
Hayward
Livermore
South San Francisco
Pleasanton
Pacifica
Sharp Park
Garin Regional Park
Ruby Hill Golf Club
Carnegie State Vehicular Rec Area
San Bruno
Millbrae
Union City
Sunol
Burlingame
Golden Gate National Recreation Area
Foster City
Del Valle Regional Park
San Mateo
Coyote Hills Regional Park
Fremont
Redwood Shores
Bair Island
Newark
Belmont
Sunol Regional Wilderness
San Carlos
Greco Island
Mission Peak Regional Park
El Granada
Redwood City
East Palo Alto
Half Moon Bay
Atherton
Menlo Park
Palo Alto
Santa Clara Ed Levin County Park
Phleger Estate
Purisima Creek Redwoods Open Space
Huddart County Park
Stanford
Alviso
San Joaquin
Stanislaus
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Mount Diablo Floristics

Total Taxa in California

~7,600 (6,500 Native / 1,100 Non-native)

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Total Taxa in East Bay

~1,635 (1,261 Native / 374 Non-native)

East Bay = 22% of the California Flora

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Total Taxa in California
~7,600 (6,500 Native / 1,100 Non-native)

Total Taxa in East Bay
~1,635 (1,261 Native / 374 Non-native)

East Bay = 22% of the California Flora

Total Taxa on Mount Diablo
~841 (653 Native / 188 Non-native)

Mount Diablo = 10% of the California Flora

Morgan Fire 2013: Statistics

Started: September 8, 2013

Cause: Target Shooting

Declared 100% contained: September 15, 2013

Total area burned: 3,111 ac.

Suppression cost: $4.5 Million


Chaparral Springs
Clayton Ranch Land Bank
Game Refuge 3-F
Mount Diablo State Park
Wright Property
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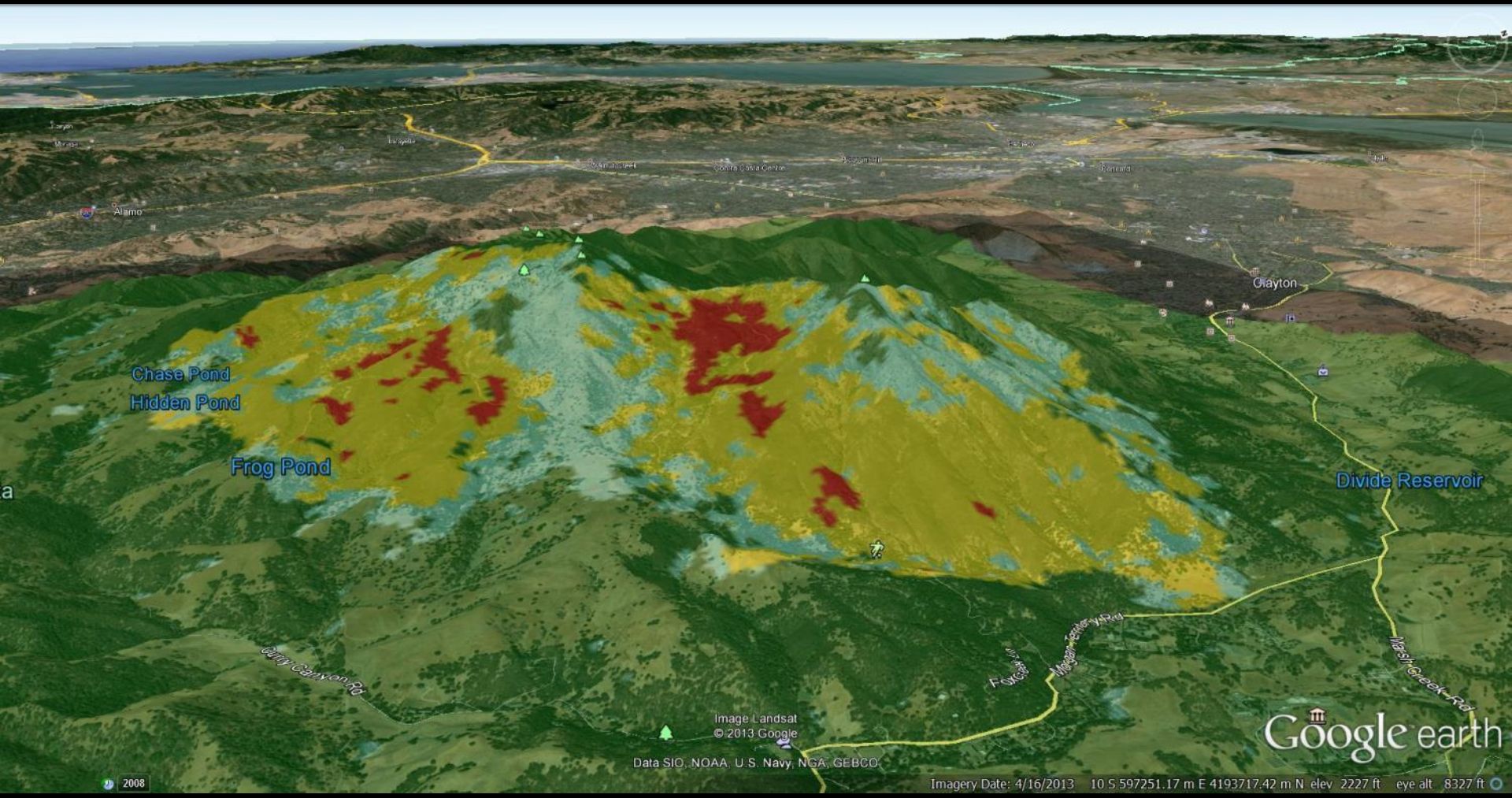
Morgan Fire 2013: Severity



Morgan Fire 2013: Severity

Morgan Fire 2013: Severity

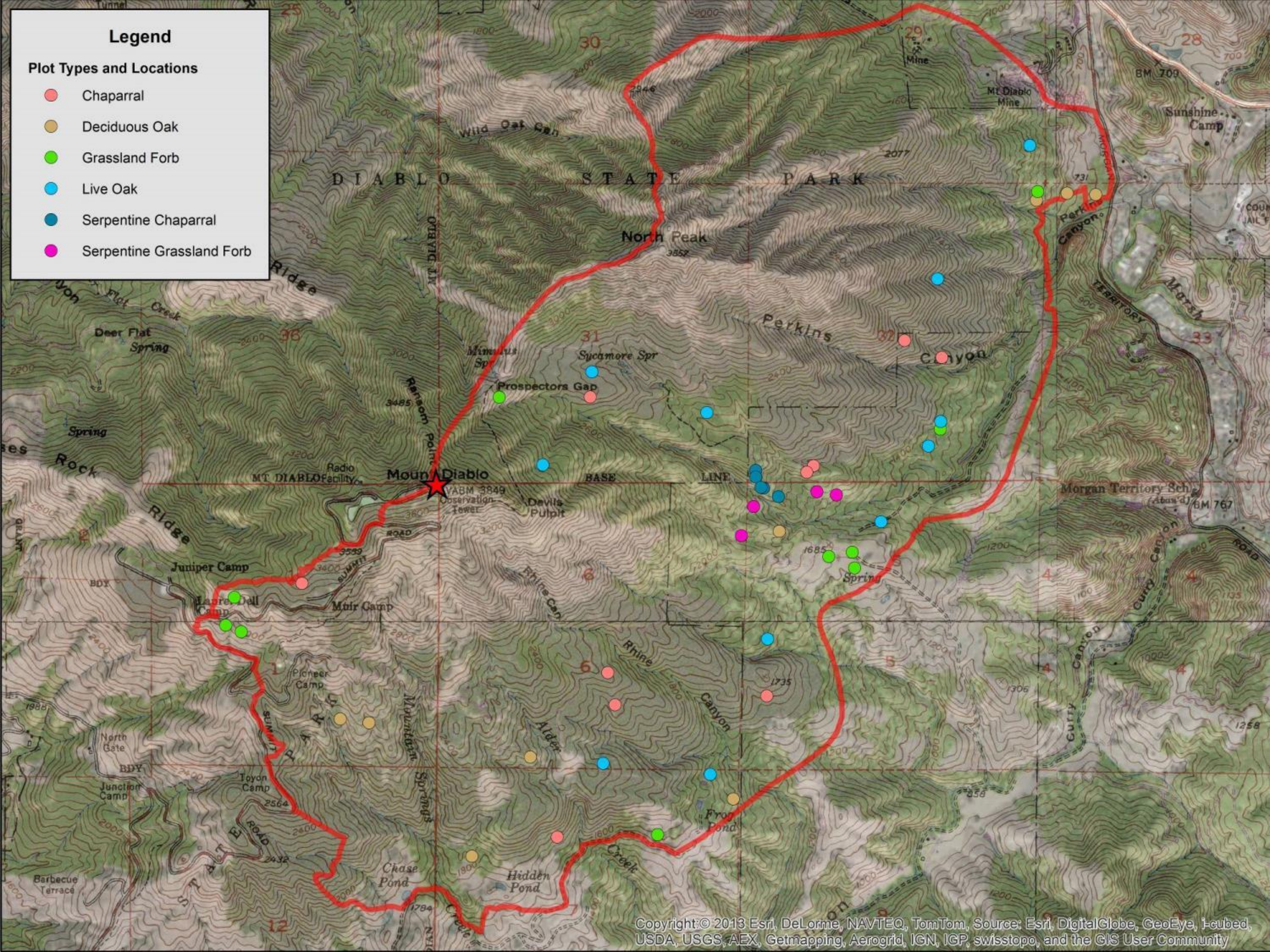
Study Objectives

- Abundance and distribution differences within 3 years
- Variables affecting post-fire vegetation composition
- Local level species responses
- Post-fire weed drivers
- Fire severity affects on plant diversity

Study Design

Stratified random sampling in 6 vegetation types

- Chaparral – 10 plots
- Deciduous Oak – 9 plots
- Live Oak – 11 plots
- Grassland and Forb – 10 plots
- Serpentine Chaparral – 5 plots
- Serpentine Grassland – 5 plots


Legend
Plot Types and Locations
Chaparral
Deciduous Oak
Grassland Forb
Live Oak
Serpentine Chaparral
Serpentine Grassland Forb
DIABLO STATE PARK
North Peak
Mount Diablo
Prospectors Gap
Sycamore Spr
Perkins Canyon
Wild Oat Can
Devils Pulpit
Juniper Camp
Muir Camp
Deer Flat Spring
Rock Ridge
Rhine Canyon
Alder
Mountain Springs
Chase Pond
Hidden Pond
Frog Pond
Toyon Camp
Junction Camp
North Gate
Barbecue Terrace
Pioneer Camp
Mt Diablo Mine
Sunshine Camp
Morgan Territory Sch
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Study Design

Belt Transects

- 50 meters long
- 1 meter X 1 meter quads at 1 meter intervals
- 25 quads per transect (1,250 quads per year)
- Collected percent cover data
- Recorded fire severity data at two scales

Stats Summary: Year 1

Stats Summary: Year 1

- Species Richness = 223 taxa
- Fire followers = 17 taxa
  - 14 of these are locally rare
- Native Disturbed species = 28
- CNPS Inventory Species = 6
  - 3 of these are fire followers)
- Locally Rare Plants = 58 taxa
- 27% of Species found on Mount Diablo

Plot Summary: Year 1

Fire Followers

Total 17

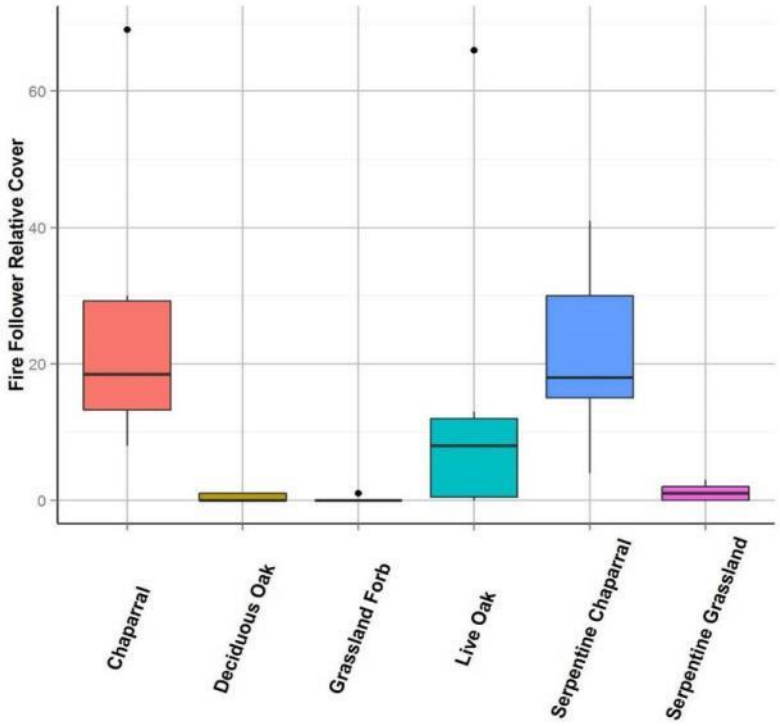
Species

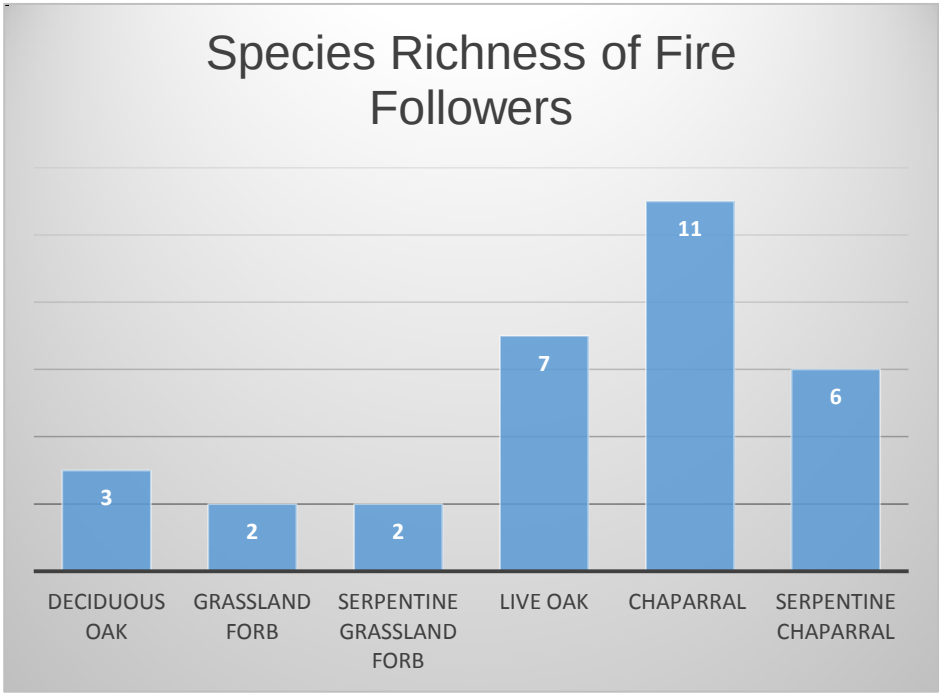
- *Antirrhinum kelloggii* – absent for 80 years
- *Calandrinia breweri*
- *Camissoniopsis intermedia*
- *Crocanthemum scoparium var. scoparium*
- *Ehrendorferia chrysantha*
- *Emmenanthe penduliflora* var. *penduliflora* – high abundance
- *Githopsis diffusa* subsp. *robusta*
- *Logfia gallica*
- *Malacothrix floccifera* – serpentine fire follower
- *Mentzelia micrantha*
- *Monolopia gracilens*
- *Papaver californicum* – low abundance
- *Phacelia nemoralis* var. *nemoralis*
- *Phacelia phacelioides*
- *Psilocarphus tenellus*
- *Rafinesquia californica*
- *Scutellaria tuberosa*

Fire Followers

Fire Followers

Relative Cover of Fire Following Species





Native Disturbed

Total 28
Species

- *Acmispon americanus* var. *americanus*
- *Acmispon parviflorus*
- *Acmispon wrangelianus*
- *Antirrhinum vexillocalyculatum* subsp. *vexillocalyculatum*
- *Caulanthus lasiophyllus*
- *Cirsium occidentale* var. *venustum*
- *Claytonia parviflora* subsp. *parviflora*
- *Claytonia perfoliata* subsp. *perfoliata*
- *Croton setiger*
- *Festuca microstachys*
- *Hosackia crassifolia* var. *crassifolia*
- *Lupinus bicolor*
- *Lupinus pachylobus* – seldom seen
- *Madia gracilis*
- *Micropus californicus* var. *californicus*
- *Mimulus aurantiacus* var. *aurantiacus*
- *Osmorhiza berteroi*
- *Rubus ursinus*
- *Salvia columbariae*
- *Stellaria nitens*
- *Trifolium albopurpureum*
- *Trifolium ciliolatum*
- *Trifolium gracilentum*
- *Trifolium microcephalum*
- *Trifolium microdon*
- *Trifolium willdenovii*
- *Triodanis biflora*
- *Vicia americana* subsp. *americana*

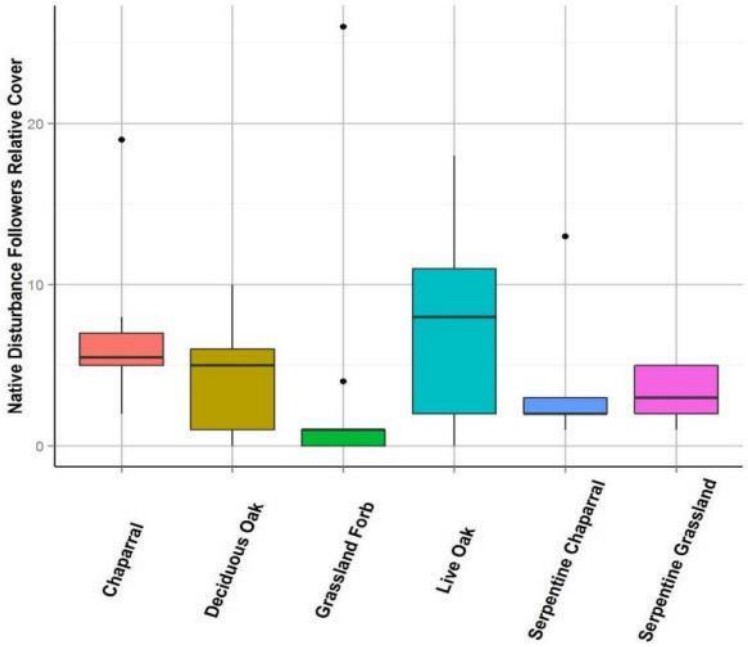
Native Disturbed

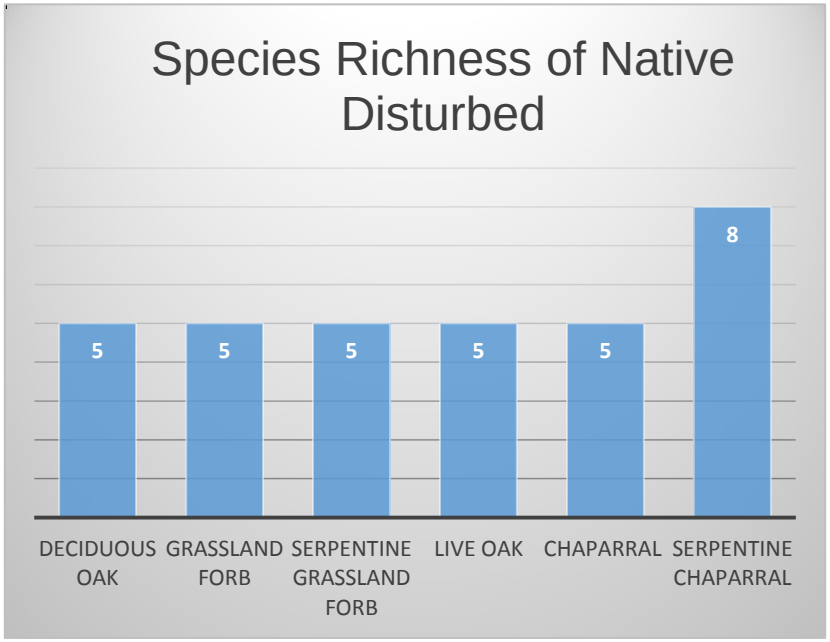
Caulanthus lasiophylla

Lupinus pachylobus

Native Disturbance Followers

Relative Cover of Native Disturbed Species





Locally Rare in the East Bay

EBCNPS

A1

- *Hosackia crassifolia* var. *crassifolia*
- *Mentzelia micrantha*

A1x

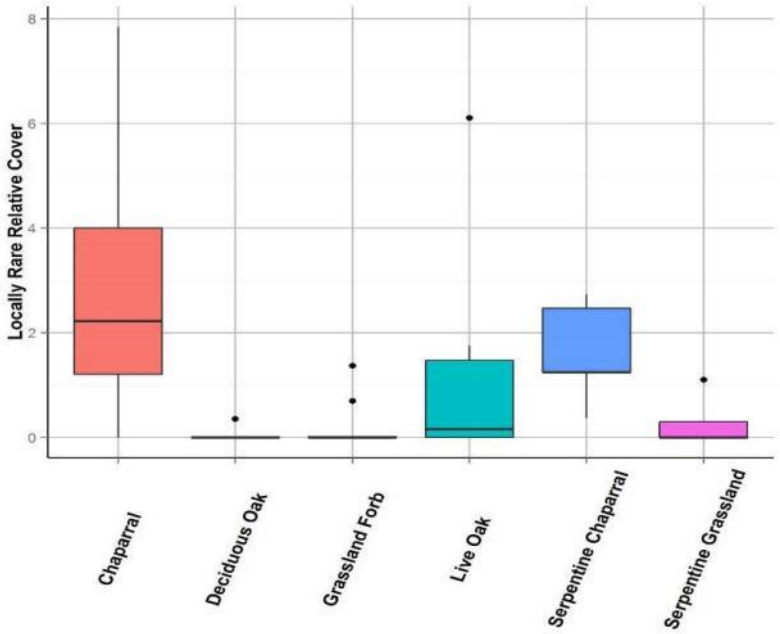
- *Antirrhinum kelloggii*

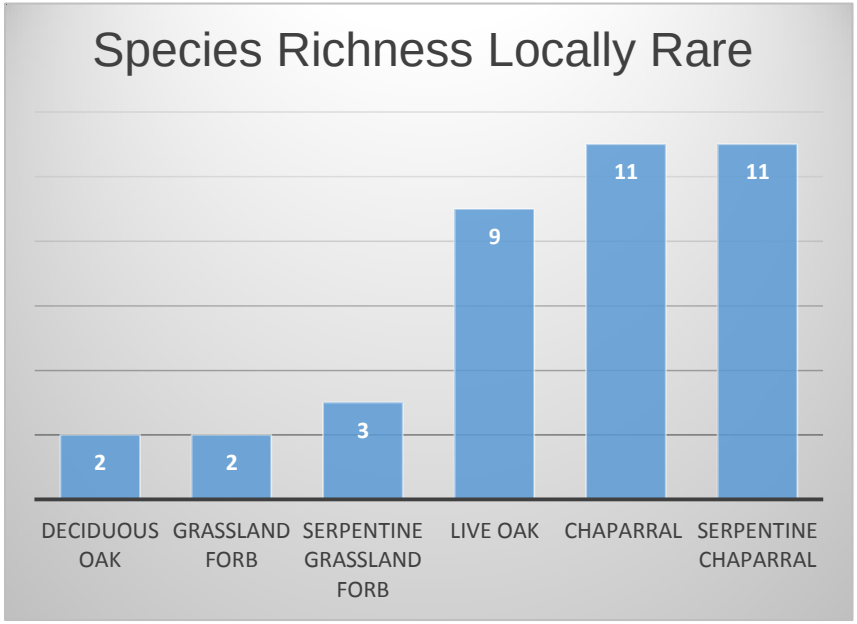
A2

- *Allophyllum divaricatum*
- *Apiastrum angustifolium* – narrowly abundant
- *Camissoniopsis intermedia*
- *Chorizanthe membranacea*
- *Cryptantha muricata* var. *muricata* – narrowly abundant
- *Ehrendorferia chrysantha*
- *Eriogonum luteolum* var. *luteolum*
- *Fraxinus dipetala*
- *Githopsis diffusa* subsp. *robusta*
- *Malacothrix floccifera*
- *Orobanche bulbosa*
- *Papaver californicum*
- *Streptanthus albidus* subsp. *peramoenus*
- *Viola purpurea* subsp. *quercetorum*

Locally Rare: A Rank Species

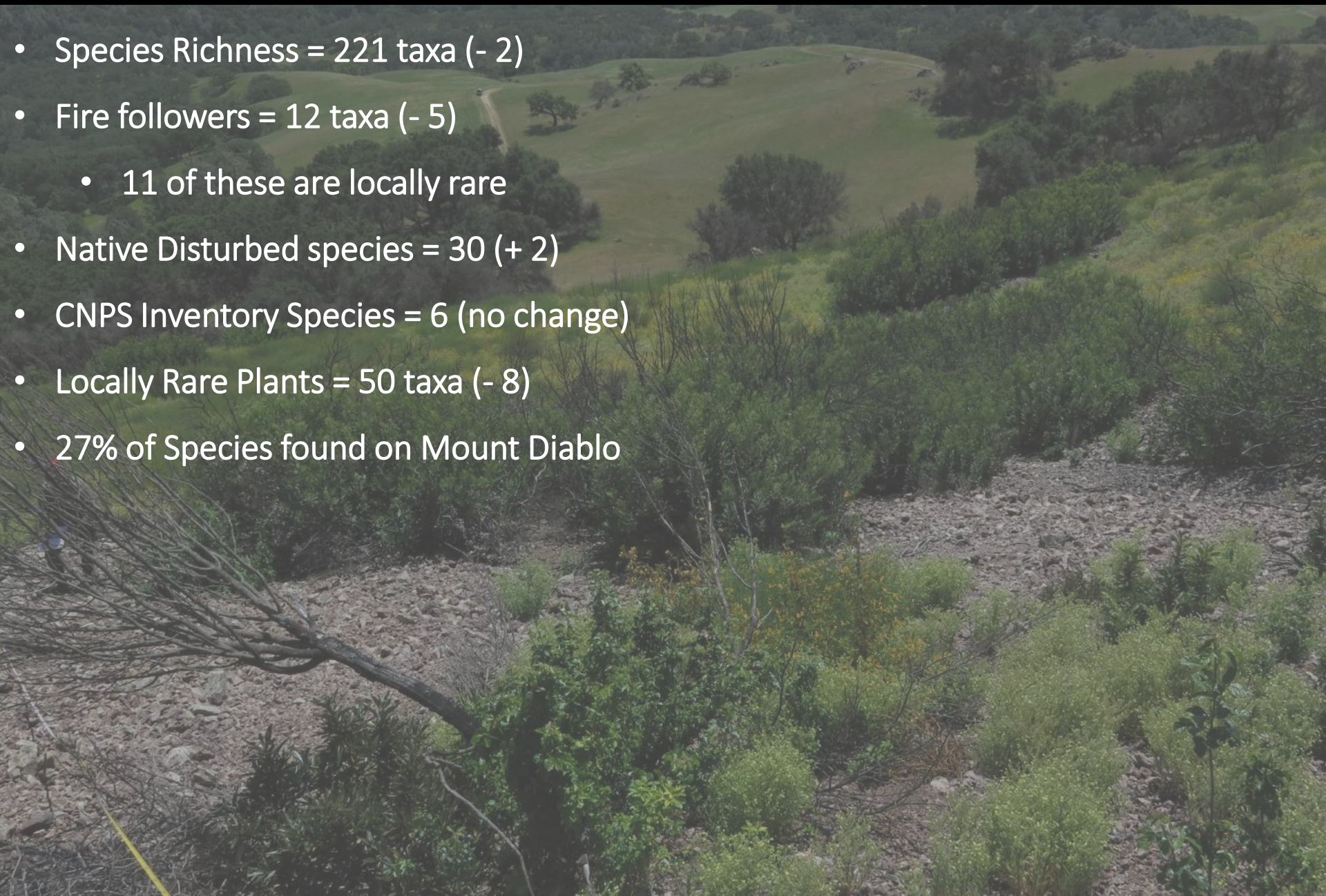
Relative Cover of Locally Rare Species





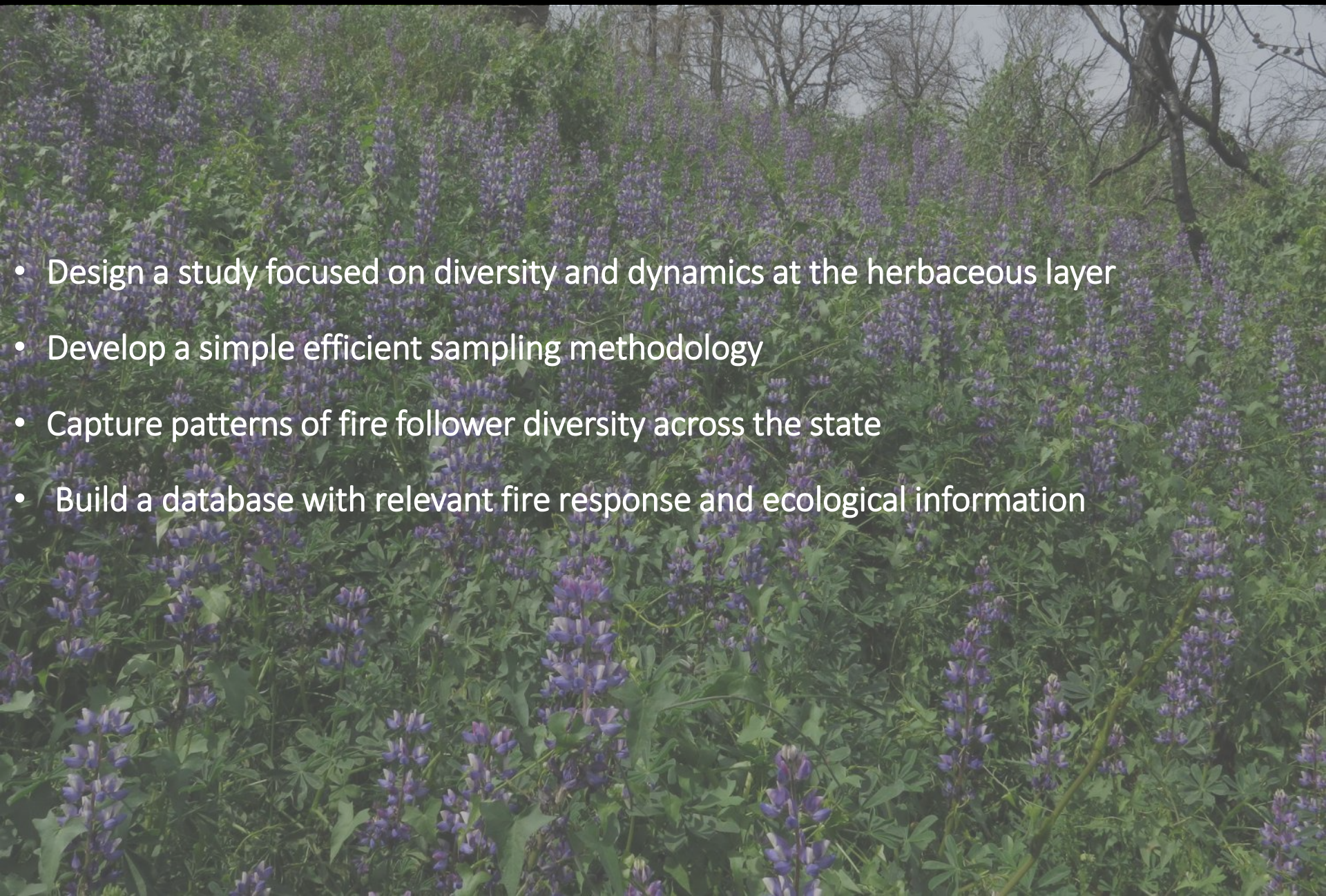
Stats Summary: Year 2

- Species Richness = 221 taxa (- 2)
- Fire followers = 12 taxa (- 5)
  - 11 of these are locally rare
- Native Disturbed species = 30 (+ 2)
- CNPS Inventory Species = 6 (no change)
- Locally Rare Plants = 50 taxa (- 8)
- 27% of Species found on Mount Diablo



Expectations: Year 3

Expanding the Methodology



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Expanding the Methodology

Berryessa Snow Mountain NM

Tesla Fire