

Regional Occupancy and Post-fire Recovery of California Gnatcatchers in Southern California

Barbara Kus
Kristine Preston
Alexandra Houston

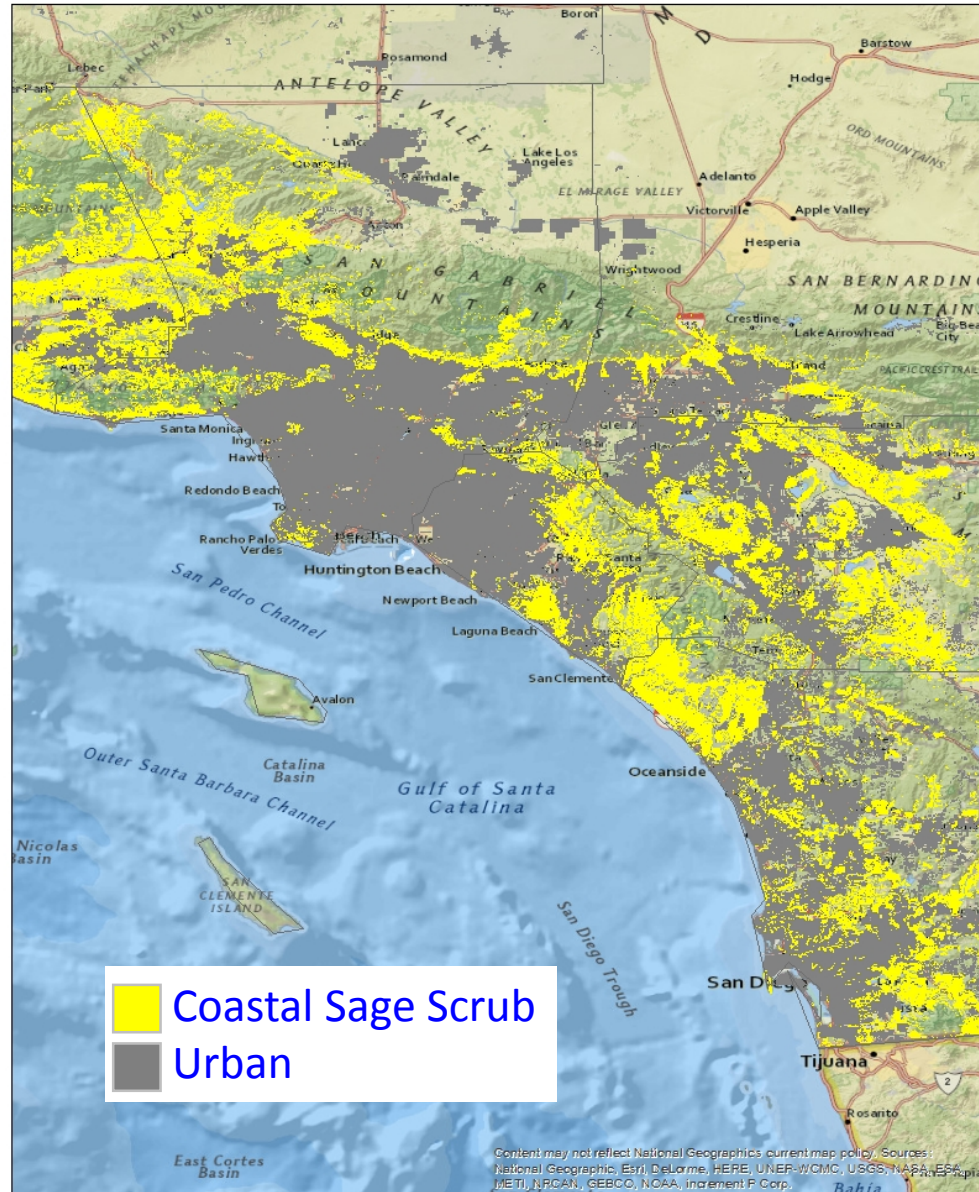
Western Ecological Research Center
San Diego Field Station



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Threats:

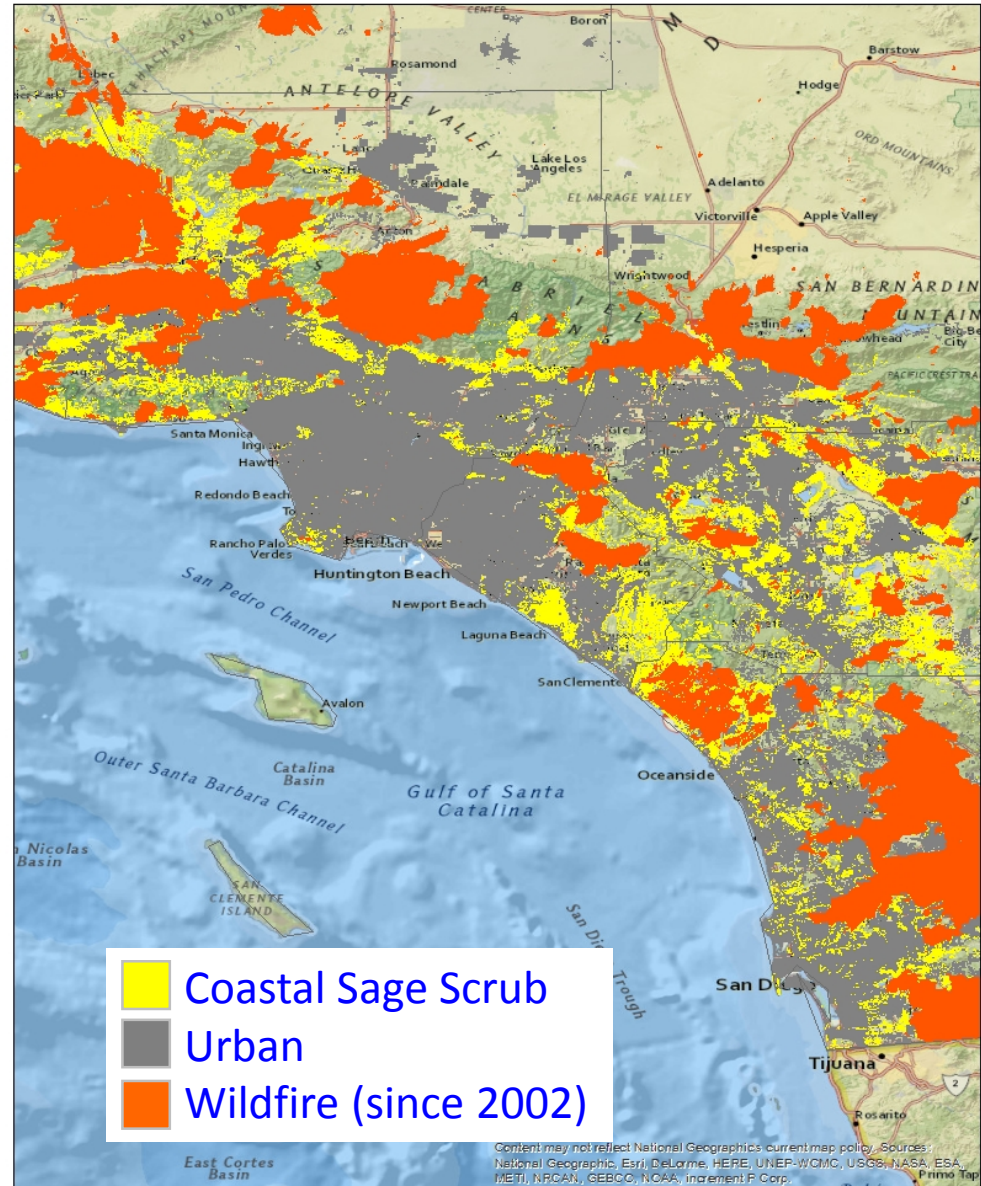
- Habitat fragmentation
- Urbanization



Preliminary Information-Subject to Revision.
Not for Citation

Threats:

- Habitat fragmentation
- Urbanization
- Wildfire



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Outline of Presentation

- Brief history of project
- Methods
- Results
 - Gnatcatcher occupancy
 - Post-fire
 - Regional, subregional
 - Vegetation influences
- Summary and applications



Technical Workshop

Research and Monitoring Priorities for the California Gnatcatcher in the San Diego MSCP

July 18, 2013
San Diego, CA

Participants

Barbara Kus	USGS
Kristine Preston	SDMMP
Ron Rempel	SDMMP
Jon Atwood	Antioch University
Clark Winchell	USFWS
Paul Doherty	Colorado State Univ.

GOALS:

- Review findings of past studies
- Identify future research and monitoring priorities



Research Priorities

Primary Stressors:

- Fire: temporary loss of habitat
- Habitat degradation/conversion

Focus research on:

- Effect of fire on habitat and birds, with the goal of informing management before, during, and after fire
- How and where to rehabilitate CSS
- How to predict and detect response of CAGN to climate change

Workshop Recommendations

- Design a post-fire study to address habitat and CAGN recovery

- Continue occupancy monitoring -> **Regional**

- Improve habitat suitability model by integrating vegetation variables

- Improve efficiency of survey methods



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New Tool:
Revised
model

- Improve efficiency of survey methods



New Tool

New CAGN Habitat Suitability Model (Kris Preston, SDMMP)

Need: Existing model worked well for San Diego County, but not for other counties and more inland areas

- Partitioned Mahalanobis D2 statistical model for southern California
- Created in GIS using PRISM environmental (climate, topography) covariate data and the most recent available vegetation and land use layers and CAGN presence data (1,063 calibration points; USGS)
- 150 x 150m spatial scale
- Validated with 3,195 USFWS gnatcatcher locations
- Includes burn perimeters and attributes (time since fire, etc.) to guide post-fire monitoring at regional scale



Workshop Recommendations

- Design a post-fire study to address habitat and CAGN recovery



USGS,
SDMMP

- Continue occupancy monitoring -> **Regional**

- Improve habitat suitability model by integrating vegetation variables



New Tool:
Revised
model

- Improve efficiency of survey methods



USGS,
SDMMP,
FWS, NCC



Post-fire Study

Goals:

- Evaluate recovery of CAGN and CSS habitat as a function of time since fire (2003, 2007, 2014)
- Relate CAGN occurrence to vegetation structure and composition
- Relate recovery of vegetation structure and composition to time since burn, previous land use, geographic location, and environmental conditions

Workshop Recommendations

- Design a post-fire study to address habitat and CAGN recovery

USGS,
SDMMP

- Continue occupancy monitoring -> **Regional**

Workshop:
Interest in
Regional
Monitoring
(July 2014)

- Improve habitat suitability model by integrating vegetation variables

New Tool:
Revised
model

- Improve efficiency of survey methods

USGS,
SDMMP,
FWS, NCC



Workshop Recommendations

- Design a post-fire study to address habitat and CAGN recovery

USGS,
SDMMP

- Continue occupancy monitoring -> **Regional**

Workshop:
Interest in
Regional
Monitoring
(July 2014)

Workshop:
Results of
July 2014
workshop
(Dec 2014)

- Improve habitat suitability model by integrating vegetation variables

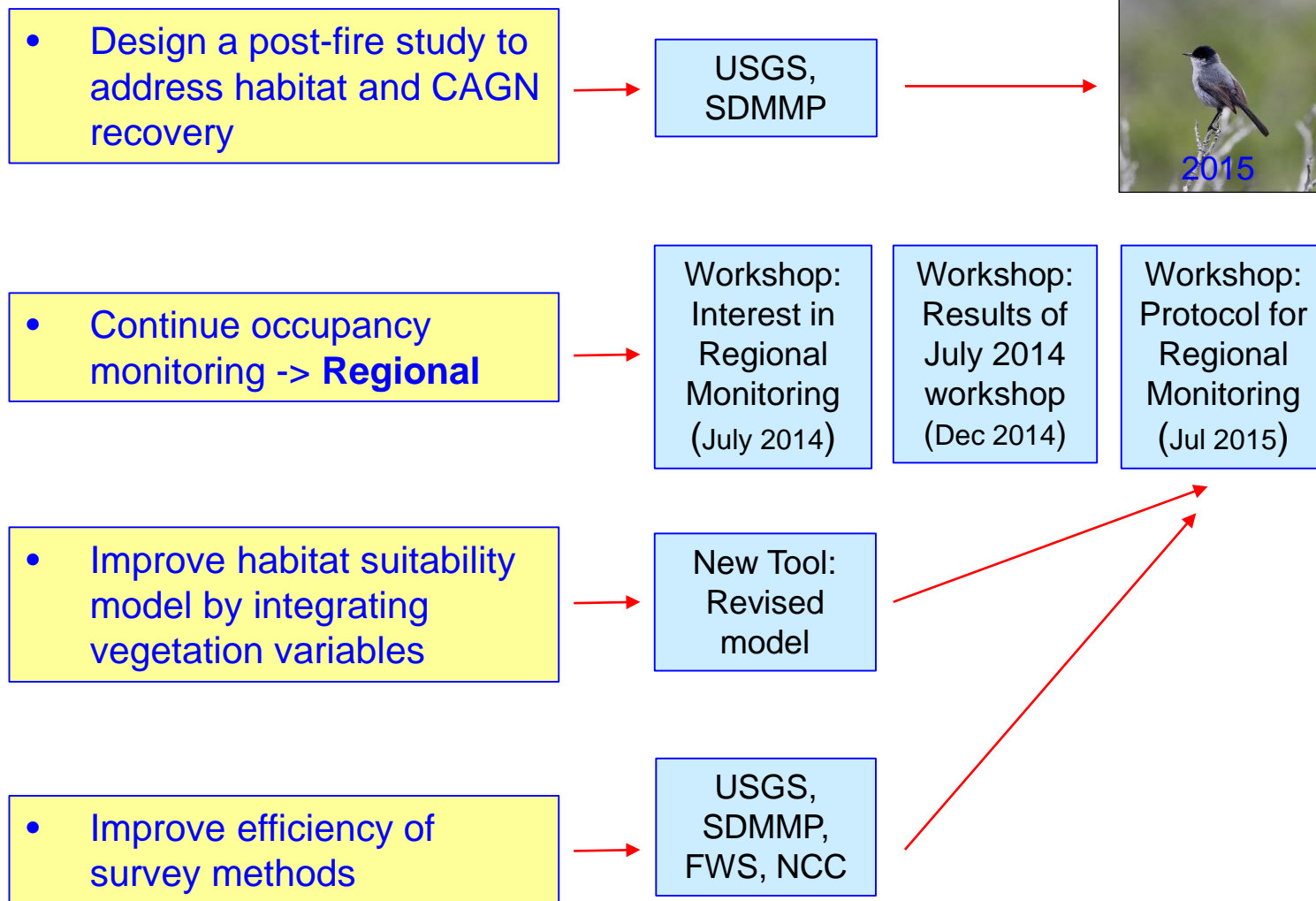
New Tool:
Revised
model

- Improve efficiency of survey methods

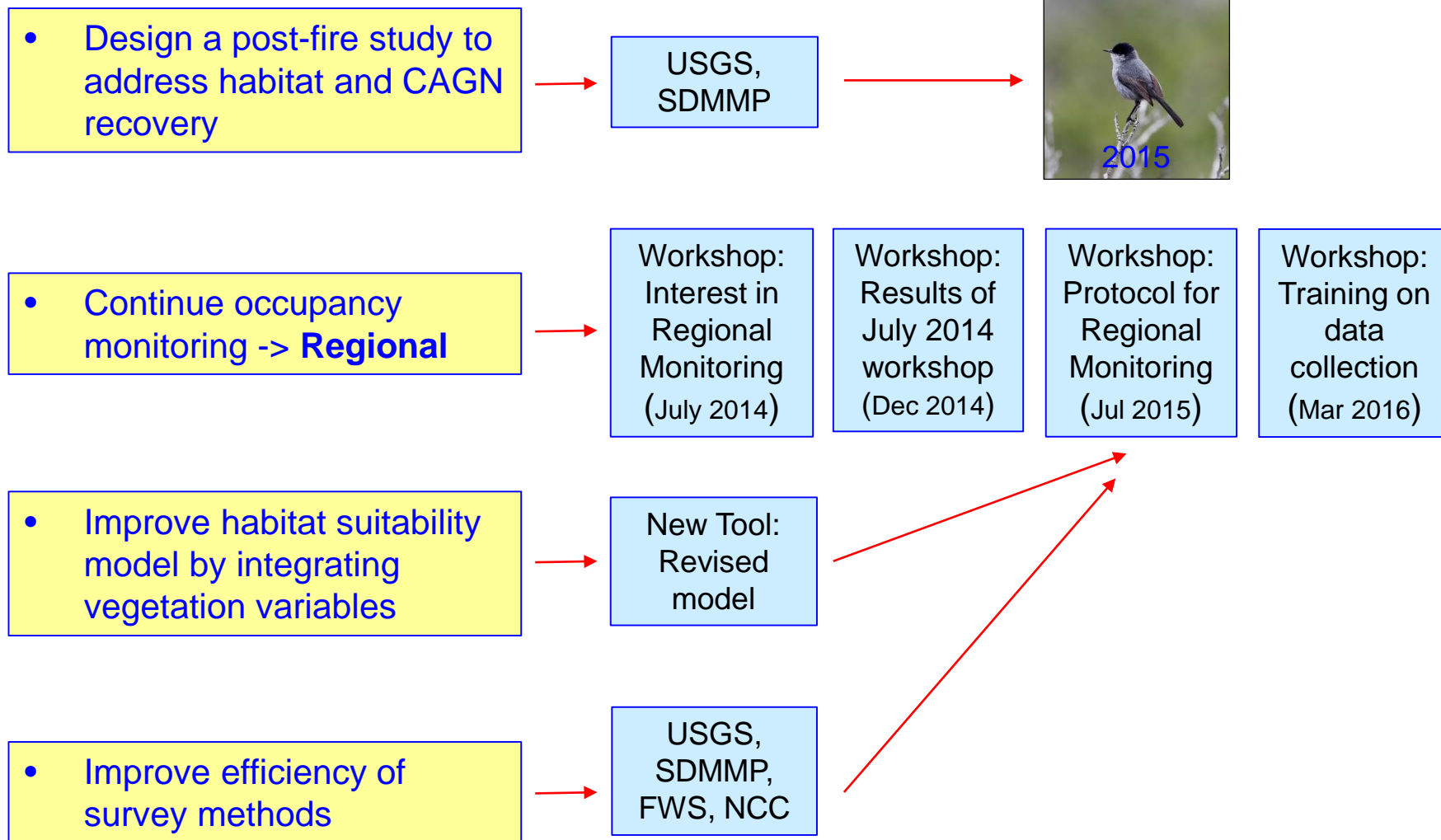
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FWS, NCC



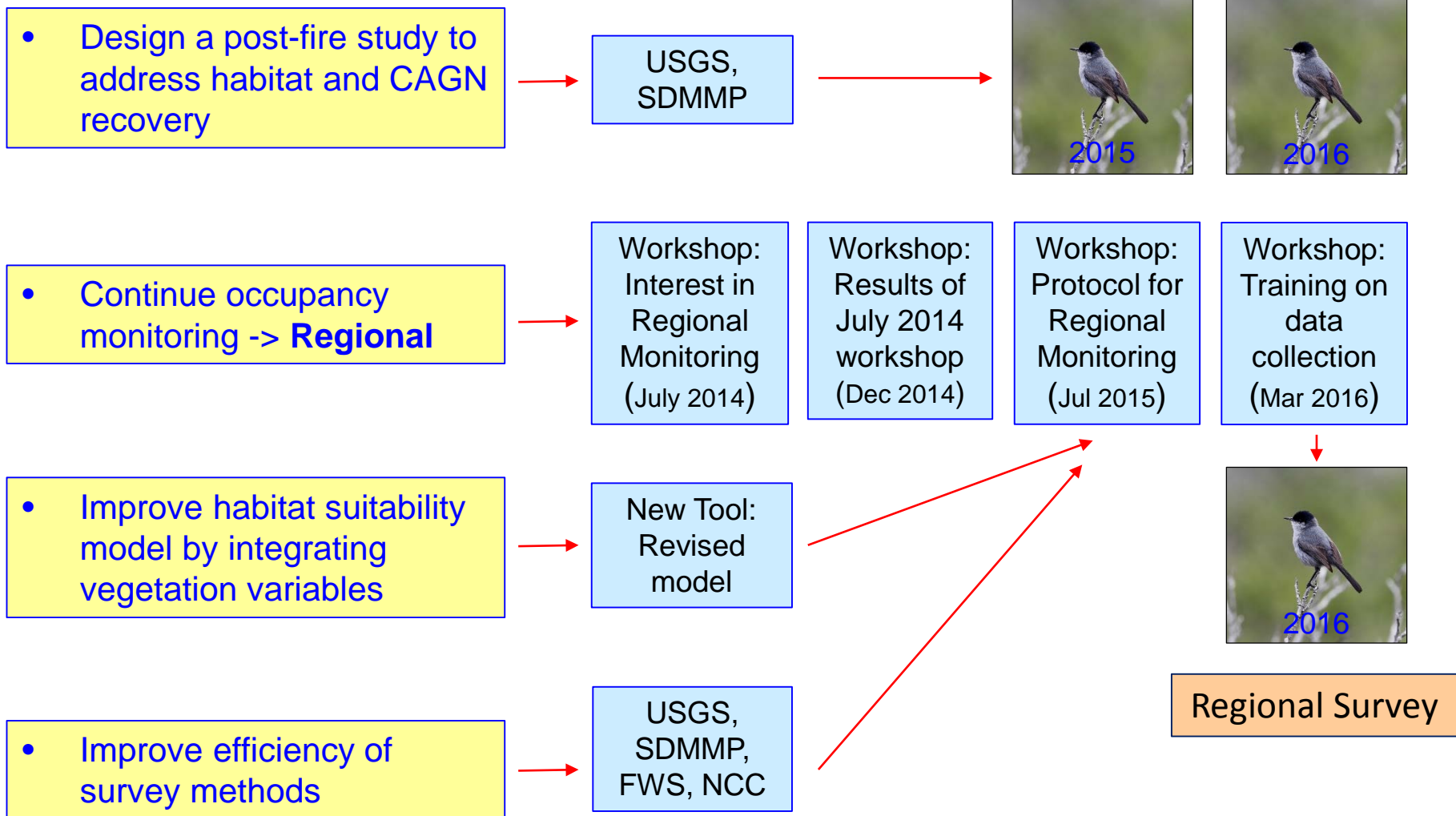
Workshop Recommendations



Workshop Recommendations



Workshop Recommendations



Partners

4-S Ranch HOA
Angeles National Forest
Audubon California Starr Ranch
California Department of Fish and Wildlife
California Department of Parks and Recreation
Caltrans
Center for Natural Lands Management (CNLM)
City of Anaheim
City of Carlsbad
City of Chino Hills
City of Chula Vista
City of Escondido
City of Irvine
City of Laguna Niguel
City of Oceanside
City of Poway
City of San Diego - Parks Department
City of San Diego - Public Utilities
City of Thousand Oaks
City of Vista
City of Whittier
Conejo Open Space Conservation Agency
County of Los Angeles
County of Orange
County of San Diego
Endangered Habitats Conservancy
Fallbrook Land Conservancy

Fallbrook Public Utility
FED
Fond Land Preservation Foundation
Helix Water District
HG Fenton Environmental Lands LLC
Irvine Ranch Water District
Lakeview at Highlands Ranch HOA
Manzanita Partners LLC
Matt Witman
Mountains Recreation & Conservation Authority
Native Habitat Preservation Authority
Nature Reserves of Orange County (NCC)
Olivenhain Municipal Water District
Orange County Transportation Authority
Otay Ranch POM
Otay Water District
Palos Verdes NCCP
Ramona Municipal Water District
Rancho Mission Viejo
Rancho Santa Fe Lakes HOA
Rancho Simi Recreation and Park District
Riverside County Habitat Conservation Agency
Riverside County Parks
San Dieguito River Park
Sanitation Districts of Los Angeles County
Santa Monica Mountains Conservancy

Sweetwater Authority
The Environmental Trust
The Nature Conservancy
UC San Diego
US Bureau of Land Management
US Department of Defense
US National Park Service
US Forest Service
US Fish and Wildlife Service
US Geological Survey
Vallecitos Water District
WashPlan HCP Property
Western Riverside Co. Regional Conservation Authority
Western Riverside Co. Multi-Species Reserve



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Partners

4-S Ranch HOA
 Angeles National Forest

Fallbrook Public Utility
 FED

Sweetwater Authority
 The Environmental Trust

Funding:

San Diego Association of Governments (Sandag)
 California Department of Fish and Wildlife
 U.S. Fish and Wildlife Service
 Natural Communities Coalition

Conservancy
 Land Management
 ent of Defense
 Park Service
 rvice
 Wildlife Service
 l Survey
 ater District
 CP Property

Audubon
 California
 California
 Caltrans
 Center for
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 City of Irvine
 City of Laguna Niguel
 City of Oceanside
 City of Poway
 City of San Diego - Parks Department
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 City of Thousand Oaks
 City of Vista
 City of Whittier
 Conejo Open Space Conservation Agency
 County of Los Angeles
 County of Orange
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 Rancho Santa Fe Lakes HOA
 Rancho Simi Recreation and Park District
 Riverside County Habitat Conservation Agency
 Riverside County Parks
 San Dieguito River Park
 Sanitation Districts of Los Angeles County
 Santa Monica Mountains Conservancy

Western Riverside Co. Regional Conservation Authority
 Western Riverside Co. Multi-Species Reserve



Alex Houston



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Methods

Point Selection:

- Based on revised CAGN habitat suitability model
- Number of points based on analysis of sample sizes needed to detect change in occupancy (30%)
- Located on conserved and military lands
- Spatially balanced design
- Survey plots 150 x 150m
- Plots at least 600m apart (regional); 450 m (fire)

Methods

Number of Points:

Fire Study (San Diego County)

	Fire Category				
	2003-2006	2007-2010	2011-2014	<2002 “unburned”	Total
2015	106	111	107		324
2016	107	111	106	103	427

Regional Occupancy Monitoring

	County						
	SD	OC	RV	LA	SB	VN	Total
2016	177	77	38	17	8	21	338



Methods

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Fire Study (San Diego County)

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2015	106	111	107		324
2016	107	111	106	103	427

Regional Occupancy Monitoring

	County						Total
	SD	OC	RV	LA	SB	VN	
2016	177	77	38	17	8	21	338

180

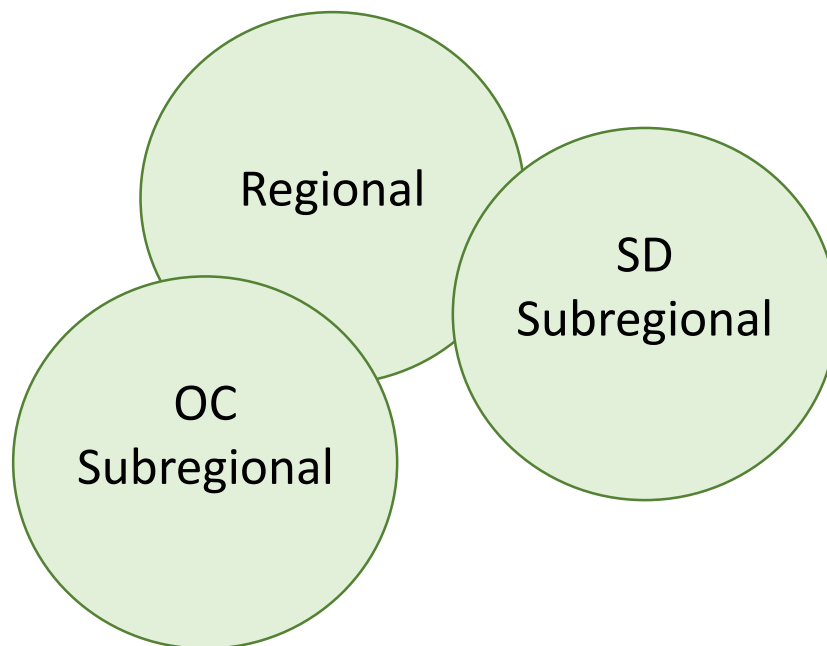
179

Sub-regional Occupancy Monitoring

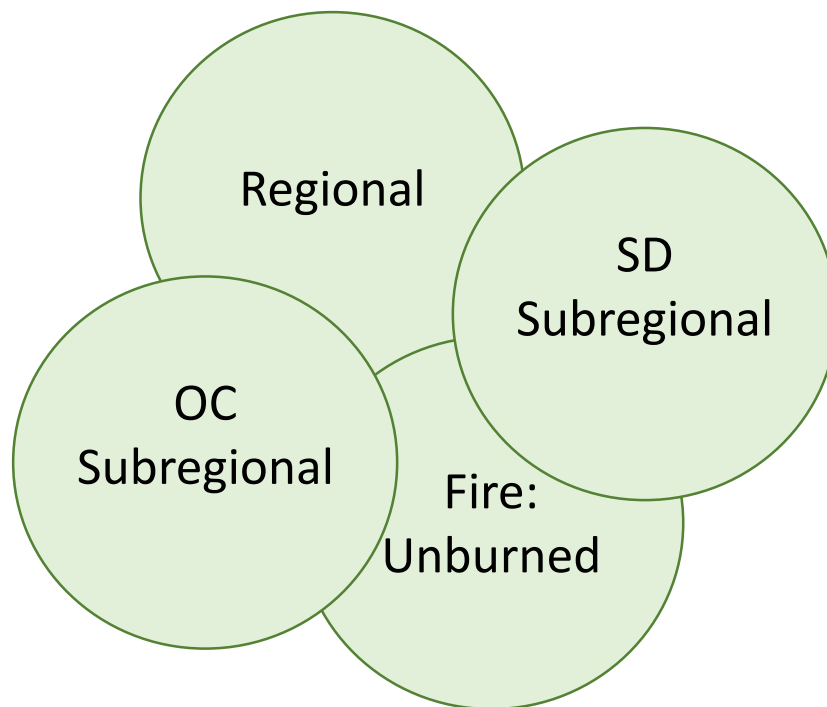


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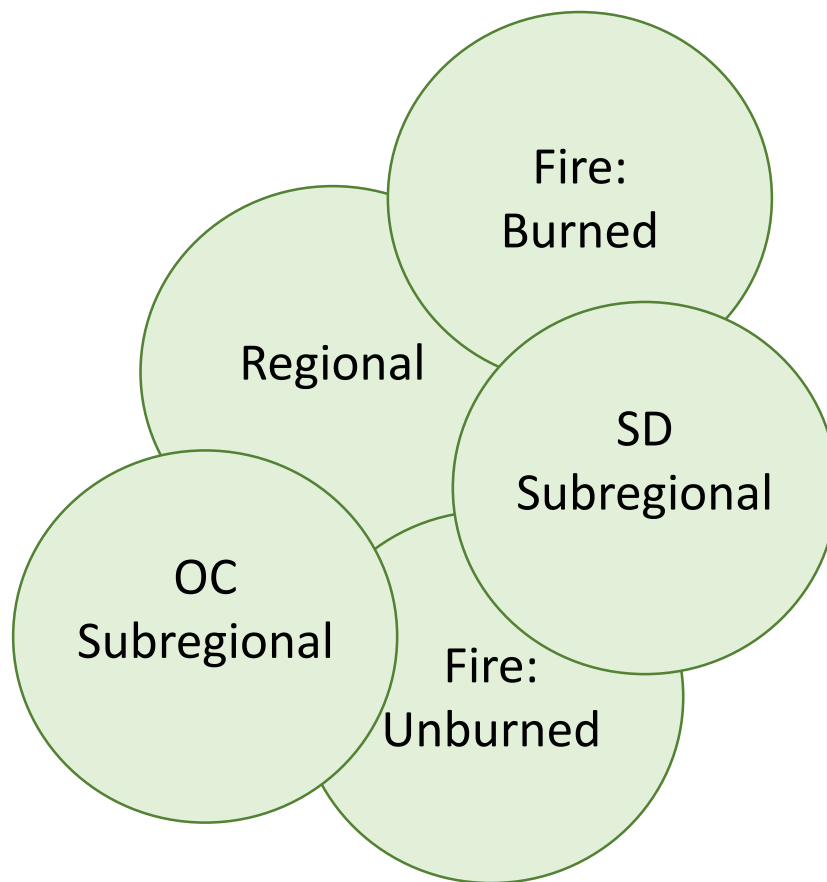
Methods



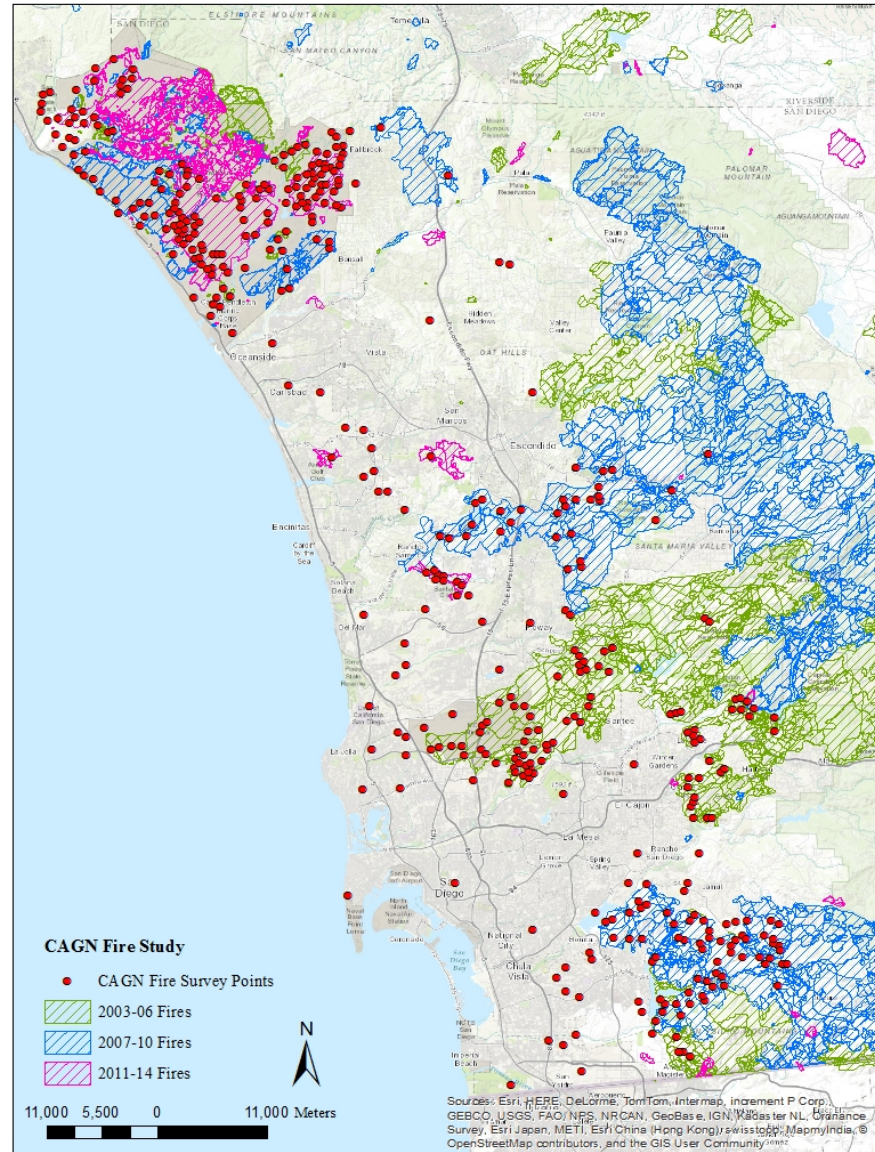
Methods



Methods

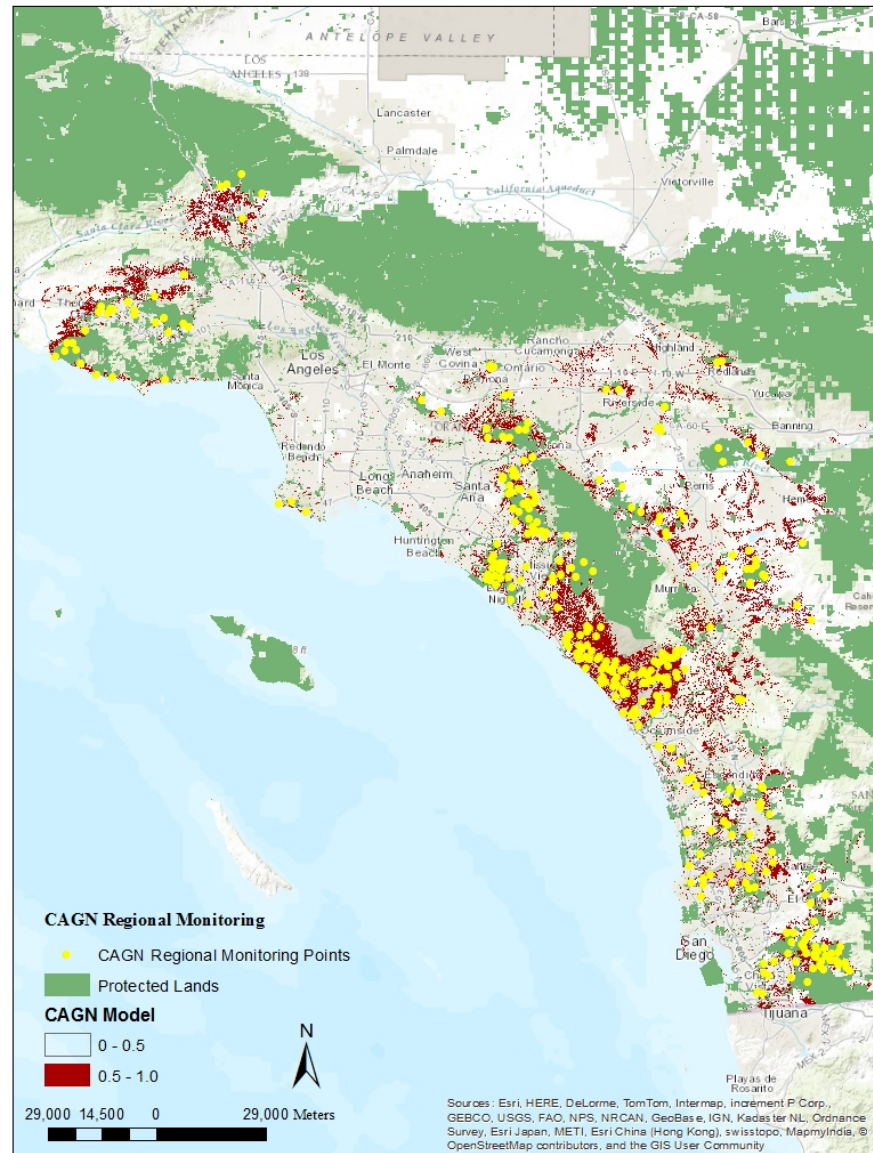


Post-fire Points



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Regional Points

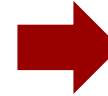


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Overall Objectives

Use occupancy framework to calculate:

- Percent area occupied (PAO)
- Extinction rates
- Colonization rates



Bird Survey
Protocol

Analyze effect of covariates:

- Vegetation variables
- Others



Vegetation
Sampling
Protocol

Standardized

Bird Survey Protocol

Timing and number of visits:

- 3 visits to each point
- Survey periods:
 - 15 – 31 March
 - 1-15 April
 - 16-30 April

Survey method:

- Area searches
- Broadcast CAGN song
- Survey length up to 45 minutes



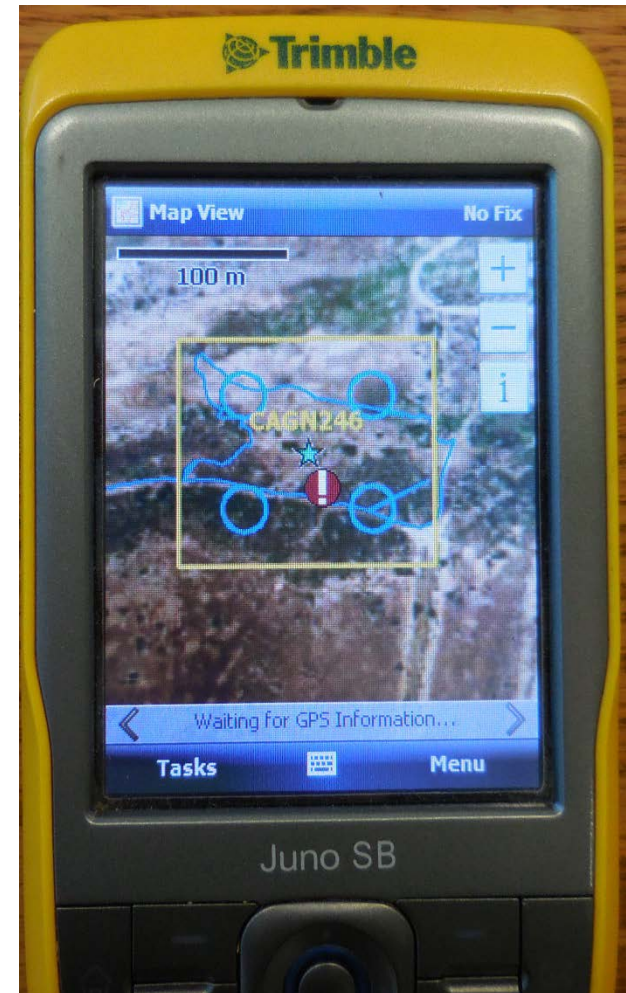
Vegetation Sampling Protocol

Timing:

- One visit per plot
- 1 May – 15 June

Sampling:

- Veg sampled in each of 4 circular plots
- Point-intercept method
- Hits at 2-m intervals along 2 30-m transects
- 32 points/circle x 4 =
- 128 points/plot



Vegetation Species

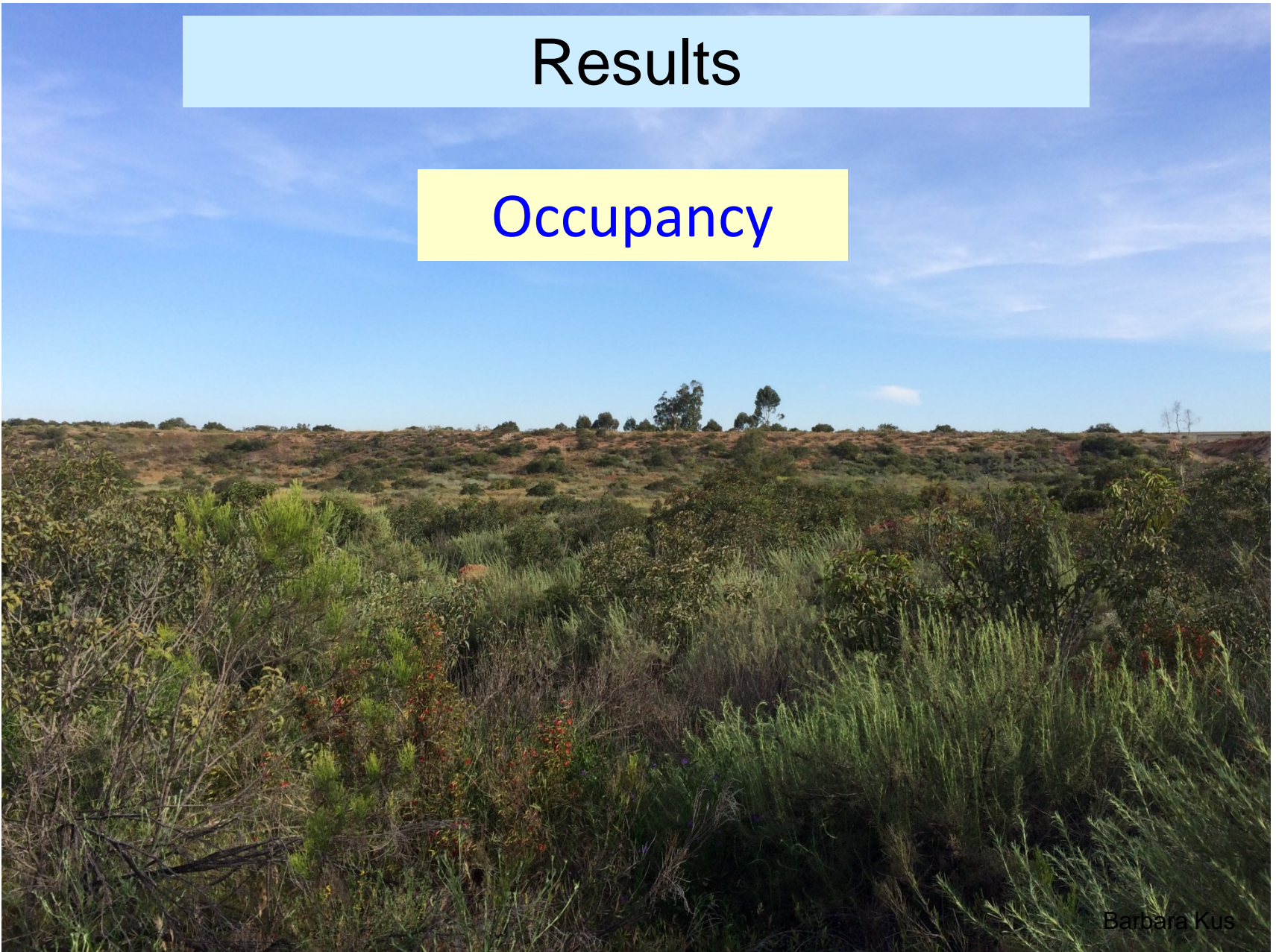
QUER	<i>Quercus spp.</i> (Oak species)
MALA	<i>Malosma laurina</i> – Laurel sumac
SAMX	<i>Sambucus mexicana</i> - Elderberry
RHIN	<i>Rhus integrifolia</i> – Lemonadeberry
CEAN	<i>Ceanothus spp</i> – Lilac species
ARCA	<i>Artemisia California</i> – California sagebrush
ERFA	<i>Eriogonum fasciculatum</i> – California buckwheat
ENCA	<i>Encelia californica</i> – Bush sunflower or California Encelia
ENFA	<i>Encelia farinosa</i> – Brittlebush
BALA	<i>Bahiopsis laciniata</i> - San Diego Sunflower
MAFA	<i>Malacothamnus fasciculatus</i> – Bushmallow
OPUN	<i>Opuntia/Cylindropuntia spp.</i> – Prickly pear/Cholla cactus species
SAAP	<i>Salvia apiana</i> – White sage
SAME	<i>Salvia mellifera</i> – Black sage
BAPI	<i>Baccharis pilularis</i> – Coyote bush
ACGL	<i>Acmispon glaber</i> – Deerweed
YUCC	<i>Hesperoyucca whipplei</i> – Our Lord’s Candle – or <i>Yucca spp.</i>
DEAD	Dead shrub – entire shrub is dead
BRNI	<i>Brassica nigra</i> – Black mustard
CEME	<i>Centaurea melitensis</i> – Tocalote
CYCA	<i>Cynara cardunculus</i> – Artichoke thistle
FOVU	<i>Foeniculum vulgare</i> – Fennel
Grass	Non-native grasses
OTHER	Other species not on list

TREE: ≥ 2 m tall
SHRUB: < 2 m tall



Results

Occupancy



Barbara Kus

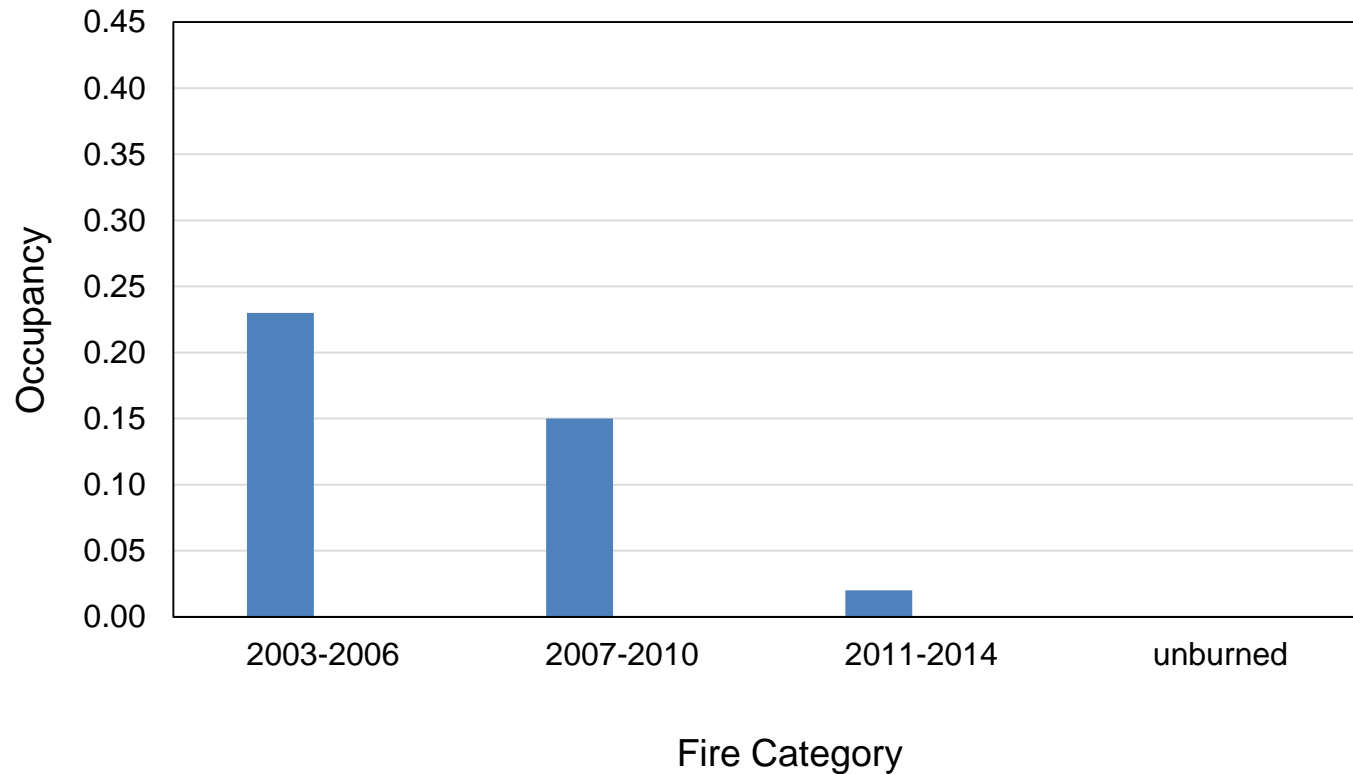


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Post-fire Occupancy 2015

2015:

- Detectability = 0.66
- Occupancy = 0.14



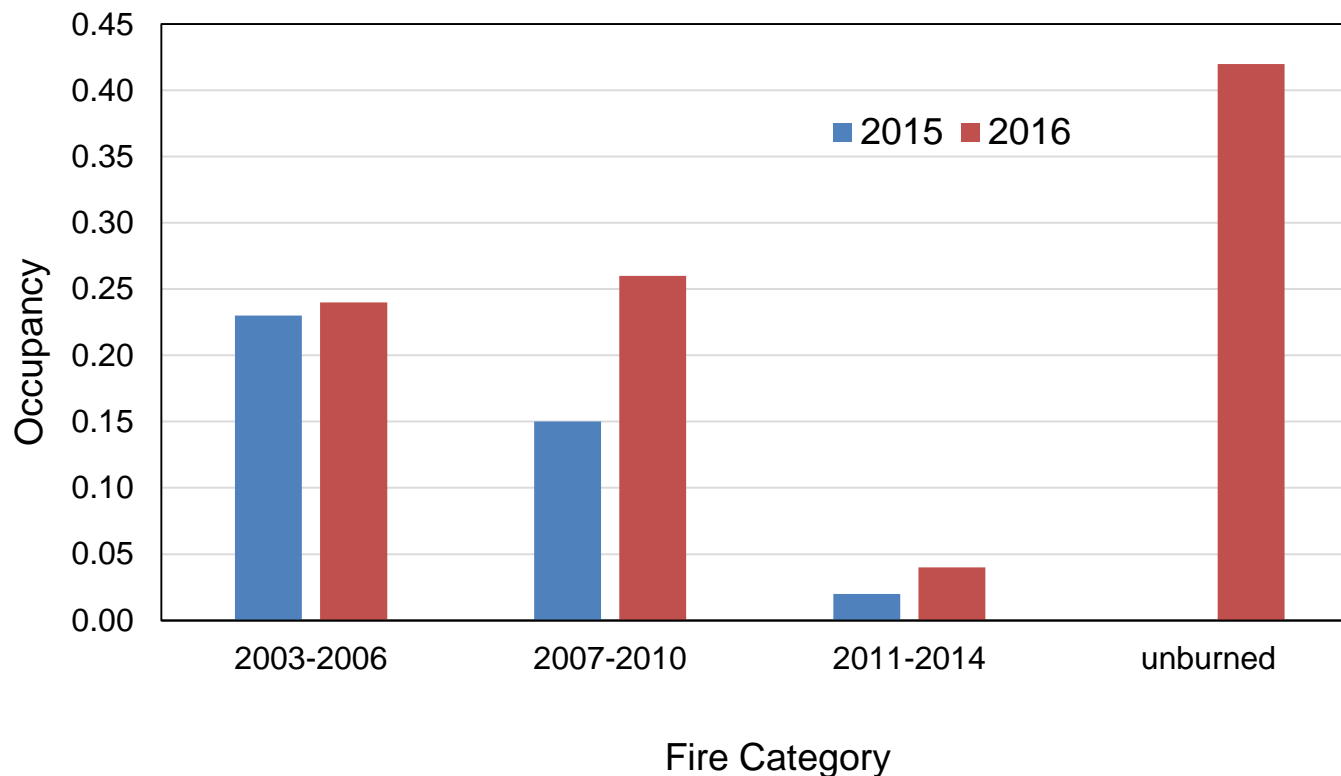
Post-fire Occupancy 2015-2016

2015:

- Detectability = 0.66
- Occupancy = 0.14

2016:

- Detectability = 0.71
- Occupancy = 0.24



Overall Occupancy 2016

Regional

- Detectability = 0.66
- Occupancy = 0.23

Overall Occupancy 2016

Regional

- Detectability = 0.66
- Occupancy = 0.23

SD Subregional

- Detectability = 0.66
- Occupancy = 0.20

Overall Occupancy 2016

Regional

- Detectability = 0.66
- Occupancy = 0.23

SD Subregional

- Detectability = 0.66
- Occupancy = 0.20

OC Subregional

- Detectability = 0.69
- Occupancy = 0.30

Overall Occupancy 2016

Regional

- Detectability = 0.66
- Occupancy = 0.23

SD Subregional

- Detectability = 0.66
- Occupancy = 0.20

OC Subregional

- Detectability = 0.69
- Occupancy = 0.30

What factors influence occupancy?

Results

Vegetation

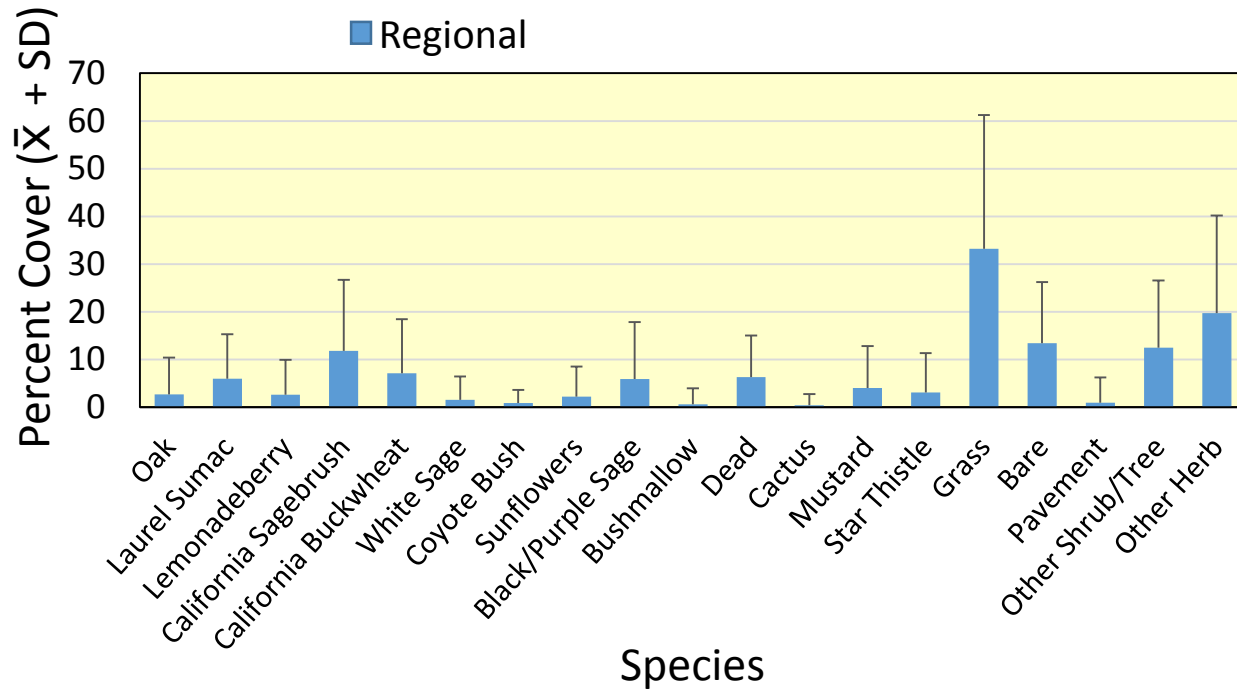


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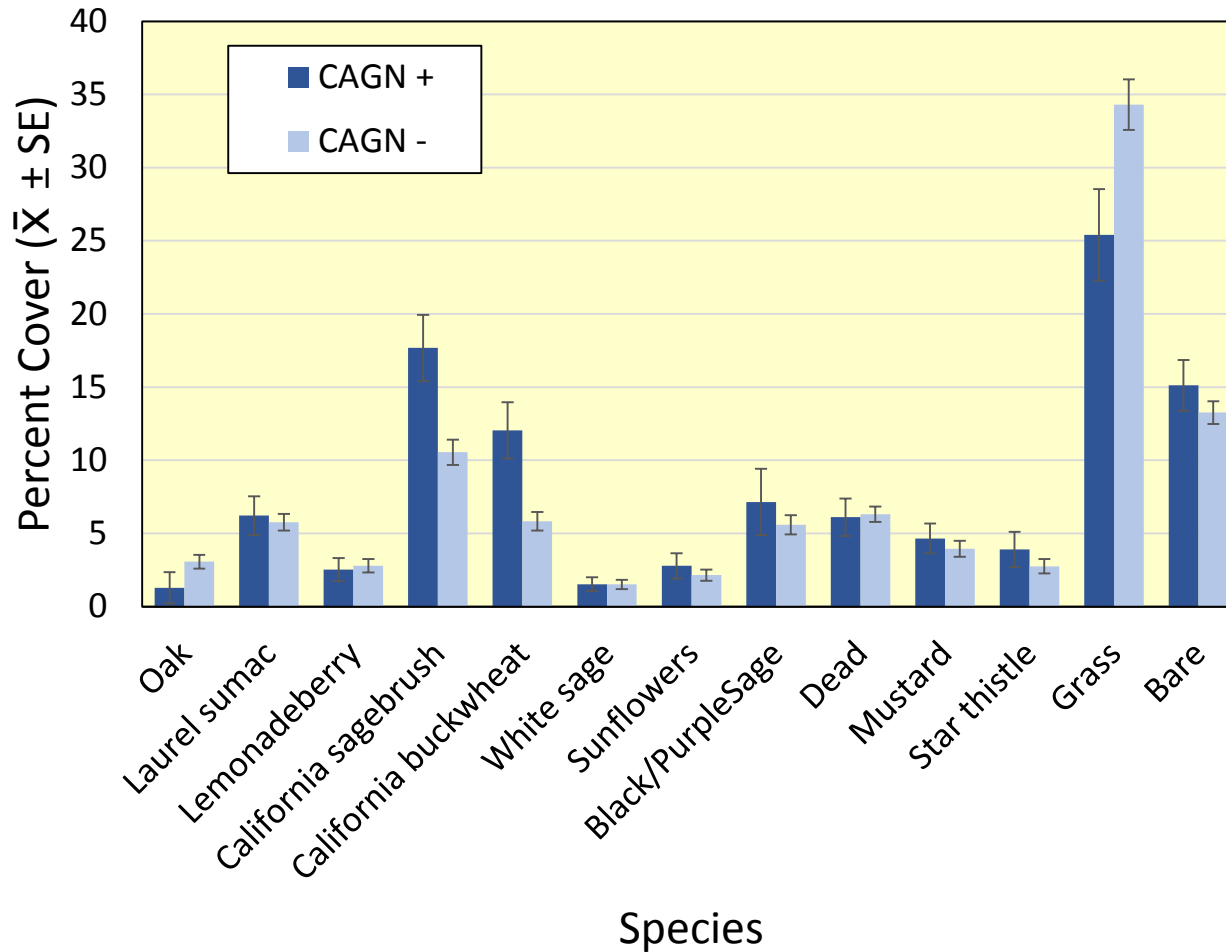
Vegetation Composition



12 variables:
cover ≤ 0.01

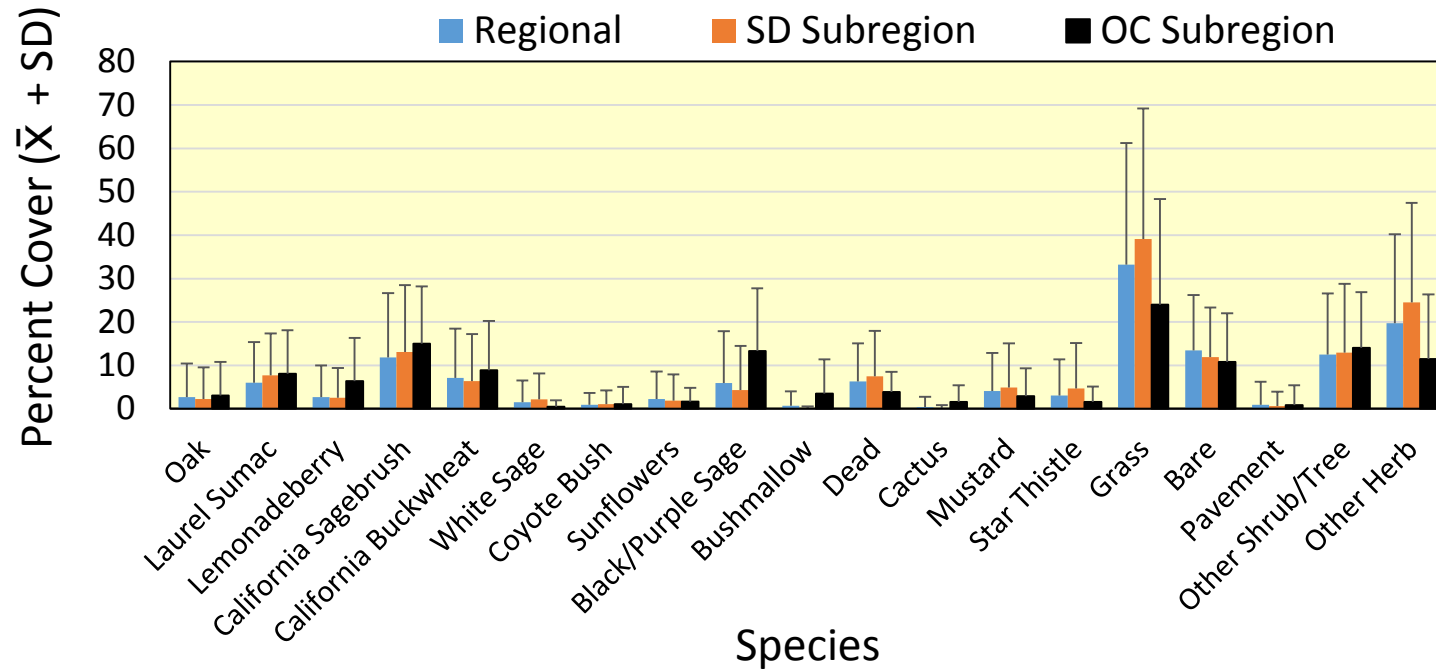
17 variables:
cover > 0.01

Vegetation Composition



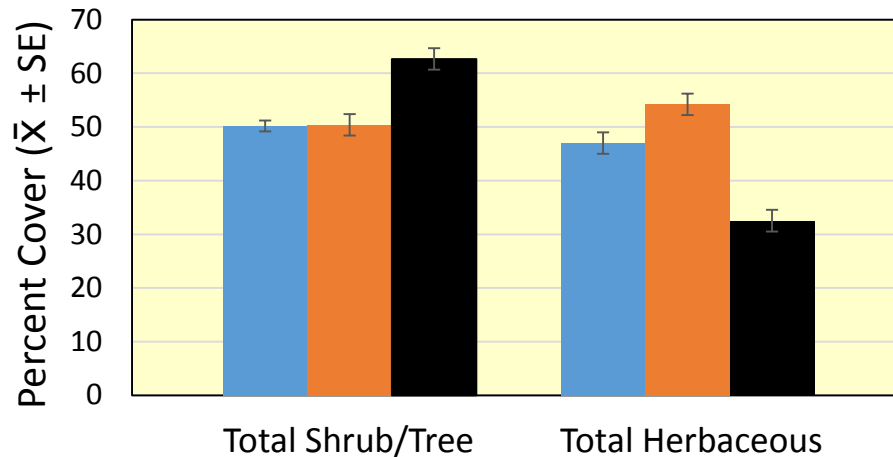
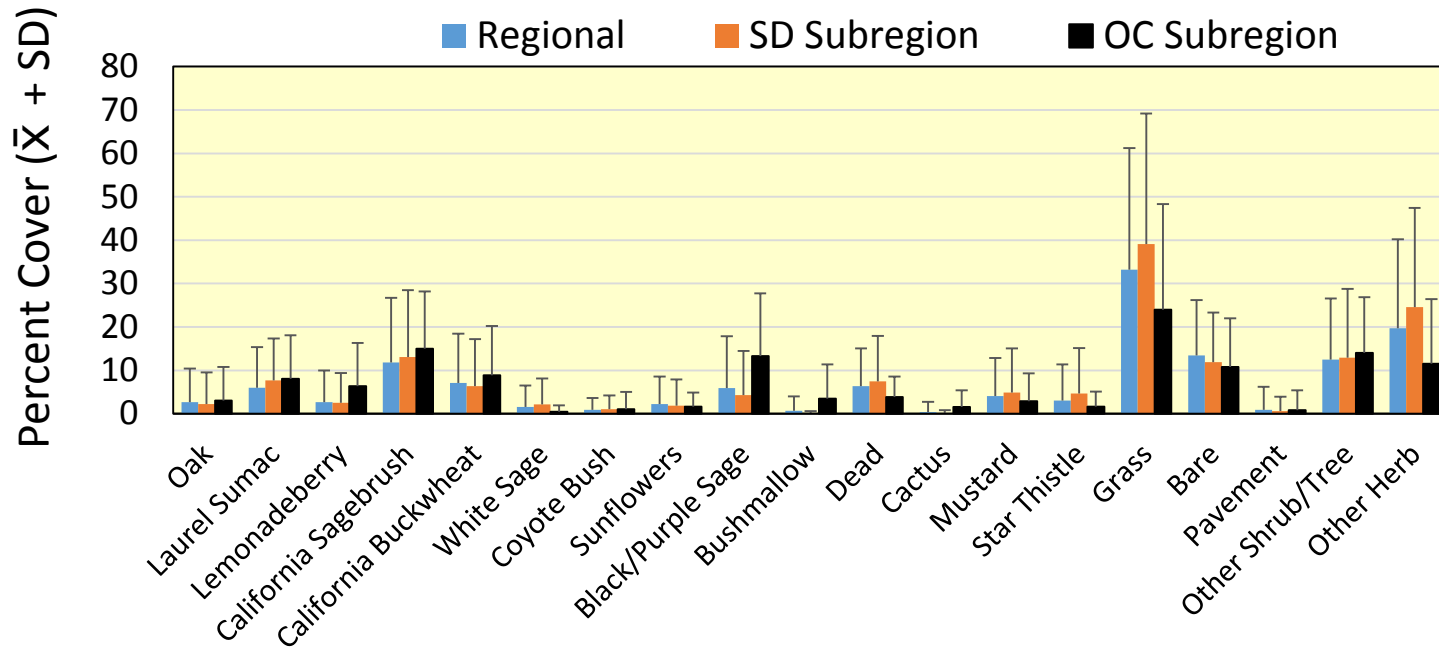
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Vegetation Composition

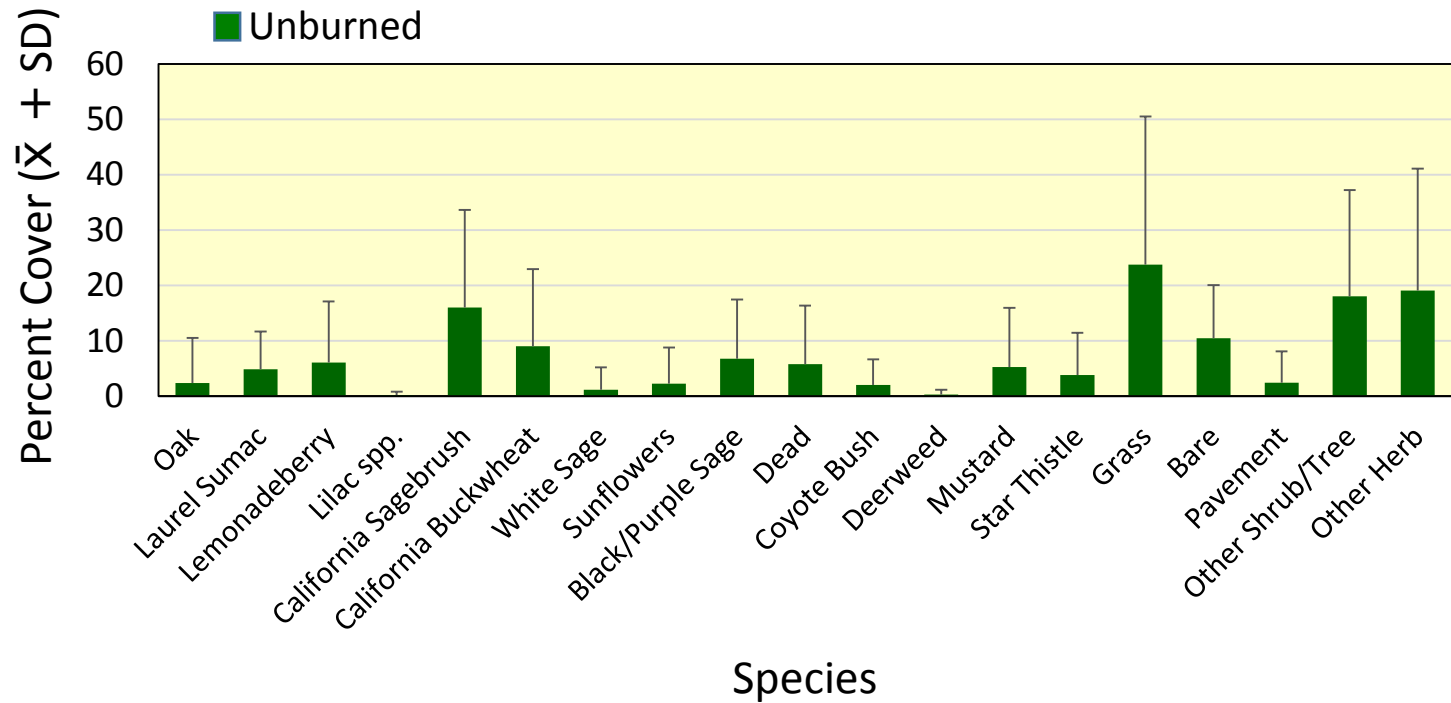


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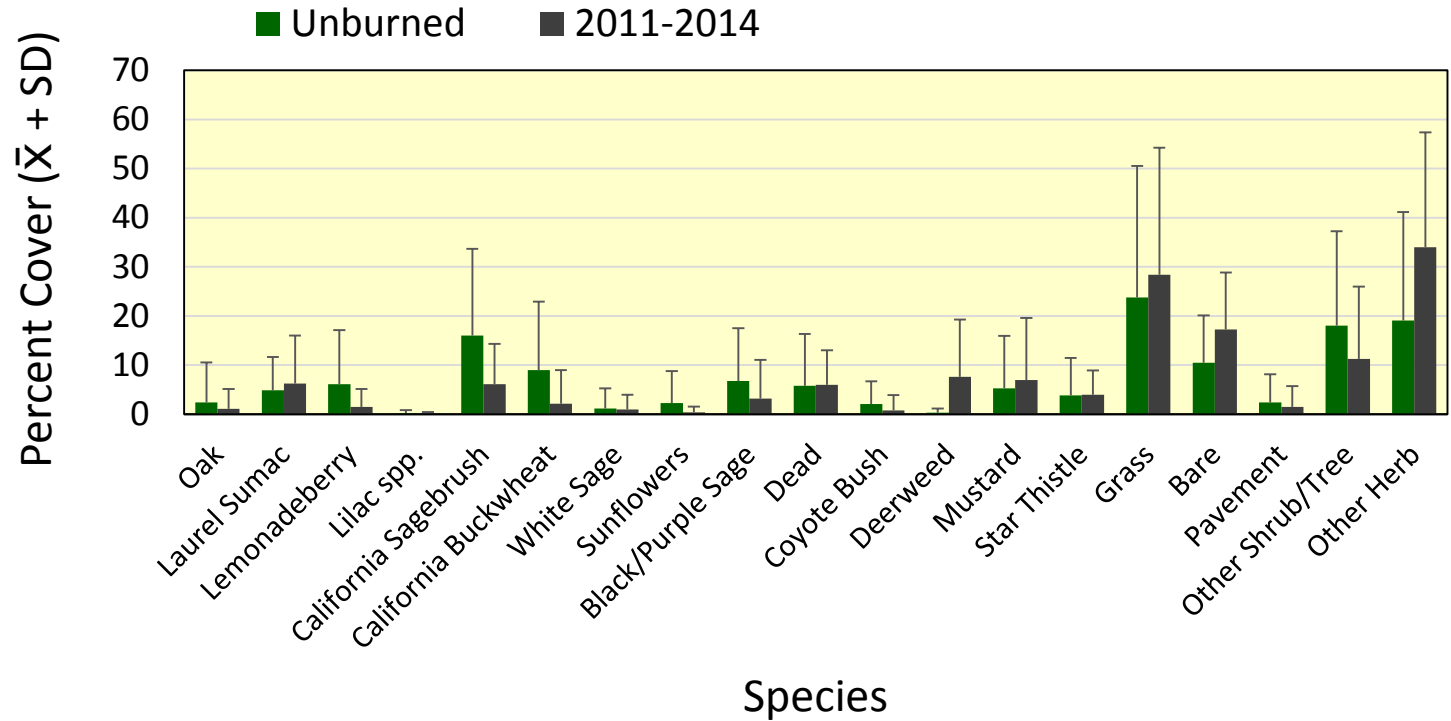
Vegetation Composition



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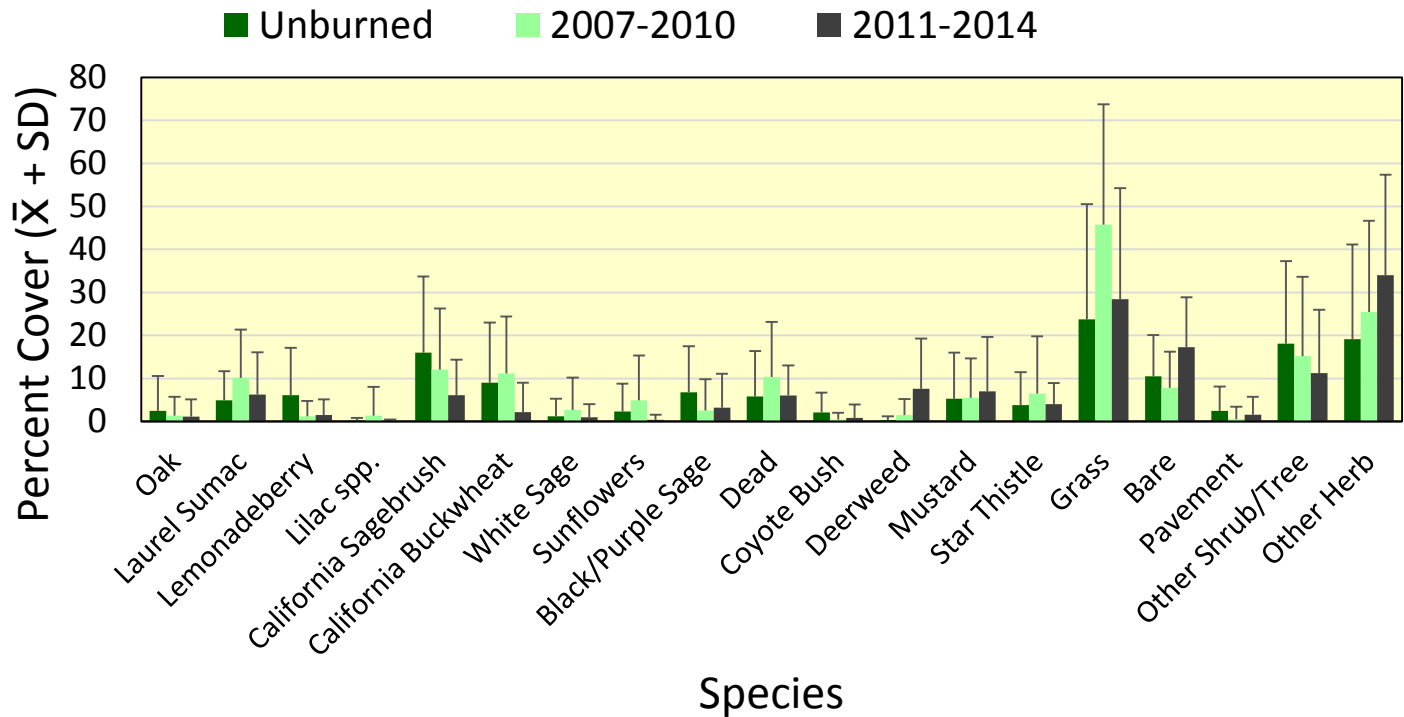


Vegetation Composition



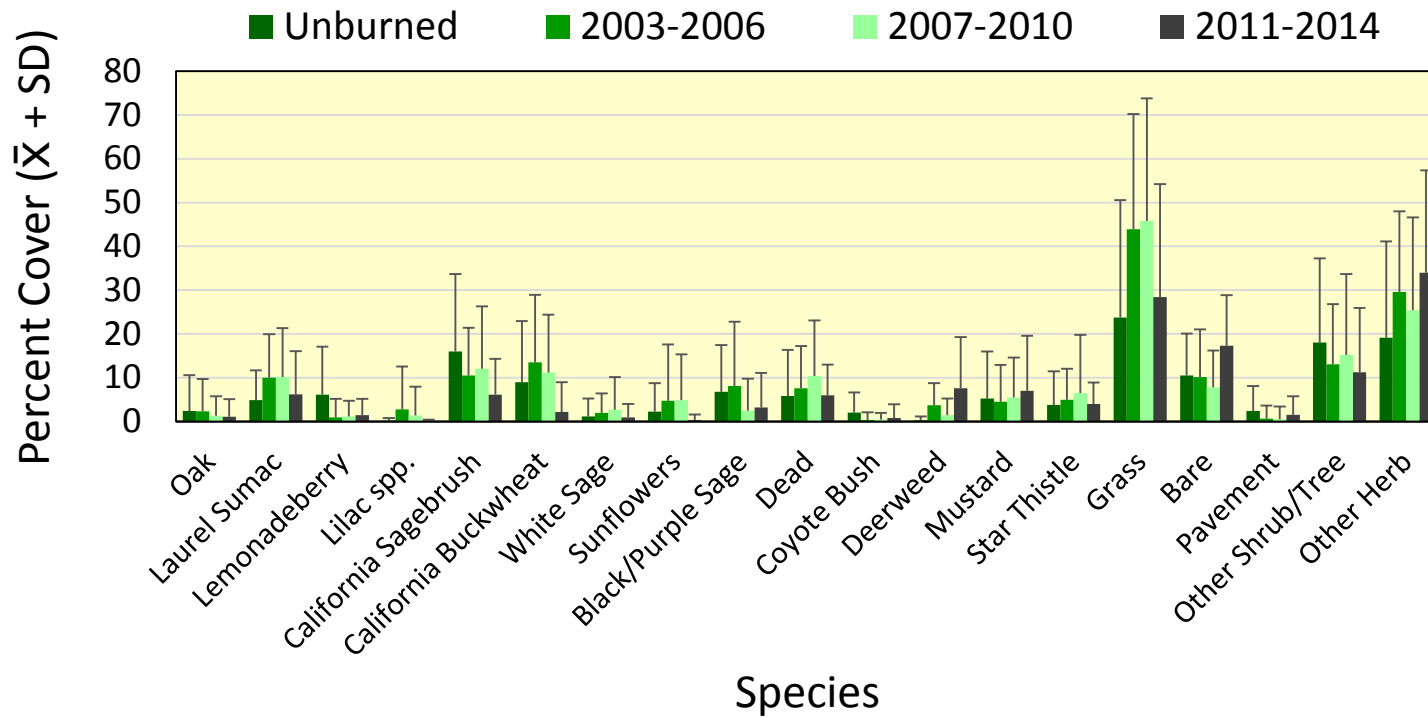
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Vegetation Composition



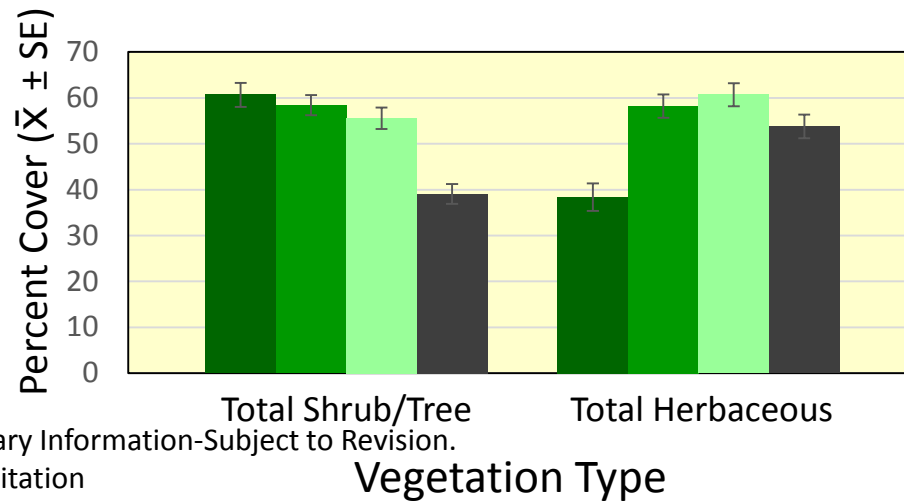
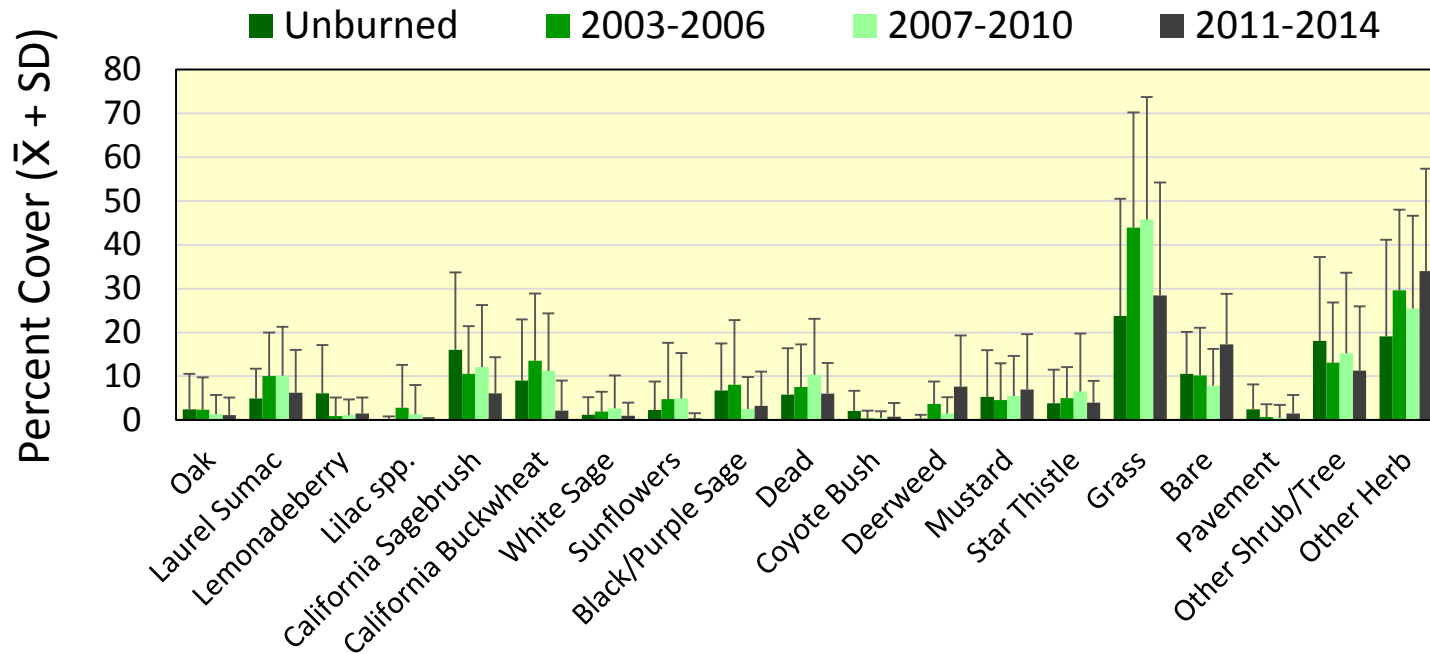
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Vegetation Composition



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Not for Citation

Vegetation Composition



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Not for Citation

Vegetation Type

Principal Components Analysis

	RC1	RC2	RC3	RC4	RC5
Deerweed	-0.17	0.03	0.10	0.20	0.35
Chamise	0.02	0.04	0.06	-0.15	0.41
California sagebrush	0.23	0.25	0.41	0.37	-0.07
San Diego sunflower	-0.15	0.00	0.02	0.78	-0.13
Coyote bush	0.01	0.33	-0.20	-0.04	-0.22
Bare	0.09	-0.45	-0.39	-0.12	0.4
Sage spp.	0.85	0.00	0.04	-0.09	-0.10
Boulder	0.01	-0.32	-0.29	0.14	0.22
Mustard spp.	-0.24	0.07	-0.07	-0.06	-0.09
Cactus	0.05	0.12	0.07	0.02	0.04
Lilac spp.	0.06	-0.04	0.51	-0.08	0.22
Star thistle	-0.12	-0.08	0.64	0.03	0.00
Artichoke thistle	-0.14	0.06	-0.07	-0.10	-0.18
Dead	-0.15	0.12	0.15	0.48	0.28
California sunflower	0.27	-0.08	-0.08	0.10	-0.04
Brittlebush	0.01	-0.42	-0.37	0.32	0.27
California buckwheat	0.23	-0.05	0.19	0.54	-0.13
Fennel	-0.14	-0.02	0.05	-0.09	-0.33
Goldenbush	0.04	-0.01	0.06	-0.08	0.29
Non-native grasses	-0.61	-0.17	0.38	-0.03	-0.42
Bushmallow	0.25	0.07	0.10	-0.04	0.12
Laurel sumac	0.23	0.16	0.46	0.35	-0.04
Other Herb	-0.49	-0.17	0.21	0.06	-0.34
Other Tree/Shrub	0.08	0.62	0.02	-0.04	0.32
Pavement	-0.02	0.12	-0.24	-0.07	-0.07
Oak spp.	-0.08	0.50	-0.10	-0.08	0.20
Lemonadeberry	0.33	0.24	-0.11	0.03	-0.09
White sage	-0.07	-0.04	0.63	0.03	0.16
Purple sage	0.21	-0.04	0.08	-0.06	-0.06
Black sage	0.82	0.02	0.02	-0.07	-0.08
Mexican elderberry	-0.03	0.39	-0.18	0.11	-0.11
Shrub Height	0.36	0.48	0.12	0.12	0.01
Sunflowers	-0.01	-0.33	-0.26	0.79	0.11
Total Herb	-0.75	-0.19	0.30	-0.05	-0.44
Total Tree/Shrub	0.56	0.55	0.26	0.44	0.23
Tree Height	-0.11	0.60	-0.19	-0.17	0.06
Yucca spp.	-0.09	0.06	0.08	0.04	0.53
Variance	0.10	0.07	0.07	0.07	0.06



Variance

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37%

Principal Components Analysis



Principal Components Analysis

RC1	RC2	RC3	RC4	RC5
+ black sage	+ oak			
+ total shrub/tree	+ Mexican elderberry			
- grass	+ tree			
- total herb	+ total shrub/tree			
tall shrubs	tall shrub			
	tall tree			
	- California sunflower			
	- bare			

Principal Components Analysis

RC1	RC2	RC3	RC4	RC5
+ black sage	+ oak	+ California sagebrush		
+ total shrub/tree	+ Mexican elderberry	+ lilac spp.		
- grass	+ tree	+ star thistle		
- total herb	+ total shrub/tree	+ laurel sumac		
tall shrubs	tall shrub	+ white sage		
	tall tree	+ grass		
	- California sunflower	- brittlebush		
	- bare	- bare		

Principal Components Analysis

RC1	RC2	RC3	RC4	RC5
+ black sage	+ oak	+ California sagebrush	+ California sagebrush	
+ total shrub/tree	+ Mexican elderberry	+ lilac spp.	+ California buckwheat	
- grass	+ tree	+ star thistle	+ laurel sumac	
- total herb	+ total shrub/tree	+ laurel sumac	+ sunflower spp.	
tall shrubs	tall shrub	+ white sage	+ dead	
	tall tree	+ grass	+ total shrub/tree	
	- California sunflower	- brittlebush		
	- bare	- bare		

Principal Components Analysis

RC1	RC2	RC3	RC4	RC5
+ black sage	+ oak	+ California sagebrush	+ California sagebrush	+ chamise
+ total shrub/tree	+ Mexican elderberry	+ lilac spp.	+ California buckwheat	+ deerweed
- grass	+ tree	+ star thistle	+ laurel sumac	+ yucca spp.
- total herb	+ total shrub/tree	+ laurel sumac	+ sunflower spp.	+ bare
tall shrubs	tall shrub	+ white sage	+ dead	- grass
	tall tree	+ grass	+ total shrub/tree	- total herb
	- California sunflower	- brittlebush		
	- bare	- bare		

Physical Variables

- Distance to coast
- Elevation
- Slope
- Last fire

AIC Model Selection

Model	AICc	Delta AICc	AICc Weights	Model Likelihood	Number Parameters	Deviance
{psi(ERFA+ARCA+TOTTRE2+TOTHRB+LASTFIRE2) p(.)}	550.4821	0	0.2673	1	9	531.9071
{psi(ERFA+ARCA+SHRBHT+TOTTRE2+TOTHRB+LASTFIRE2) p(.)}	551.0877	0.6056	0.19747	0.7387	10	530.3826
{psi(BARE+ERFA+ARCA+TOTTRE2+TOTHRB+LASTFIRE2) p(.)}	551.2566	0.7745	0.18148	0.6789	10	530.5515
{psi(ERFA+ARCA+SHRBHT+TOTTRE+TOTHRB+LASTFIRE) p(.)}	553.5233	3.0412	0.05843	0.2186	8	537.0647
{psi(ERFA+SUNFL+ARCA+SHRBHT+TOTTRE+TOTHRB+LASTFIRE) p(.)}	553.7216	3.2395	0.05291	0.1979	9	535.1465
{psi(BARE+ERFA+ARCA+SHRBHT+TOTTRE+TOTHRB+LASTFIRE) p(.)}	553.759	3.2769	0.05193	0.1943	9	535.1839
{psi(ERFA+ARCA+SHRBHT+TOTTRE+TOTHRB+LASTFIRE2) p(.)}	553.8357	3.3536	0.04998	0.187	9	535.2606
{psi(BARE+ERFA+ARCA+TOTTRE+TOTHRB+LASTFIRE2) p(.)}	554.2454	3.7633	0.04072	0.1523	9	535.6704
{psi(ERFA+ARCA+SHRBHT+TOTTRE+TOTHRB+SLOPE+LASTFIRE) p(.)}	554.4533	3.9712	0.0367	0.1373	9	535.8782
{psi(ERFA+ARCA+SHRBHT+TOTTRE+TOTHRB+ELEV+LASTFIRE) p(.)}	555.5742	5.0921	0.02095	0.0784	9	536.9991
[Plus 47 more models]						



AIC Model Selection

Regional

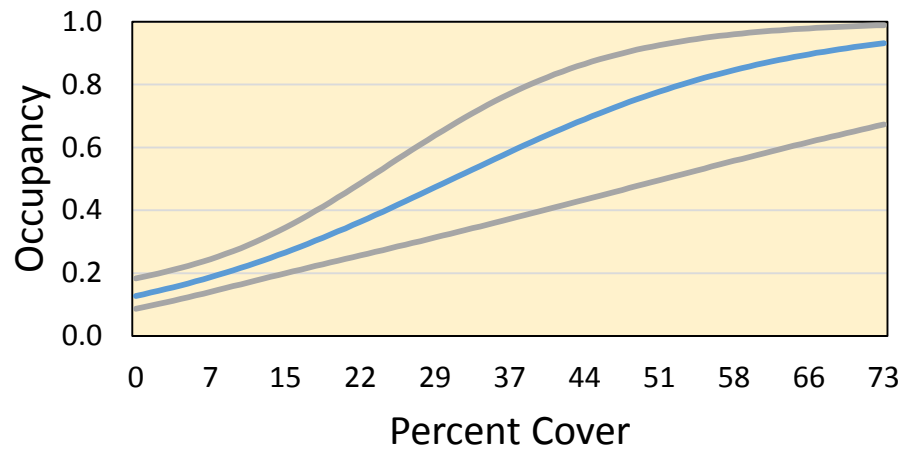
Model	AICc	Delta AICc	AICc Weights	Model Likelihood	Number Parameters	Deviance
{psi(ERFA+ARCA+TOTTRE2+TOTHRB+LASTFIRE2) p(.)}	550.4821	0	0.2673	1	9	531.9071
{psi(ERFA+ARCA+SHRBHT+TOTTRE2+TOTHRB+LASTFIRE2) p(.)}	551.0877	0.6056	0.19747	0.7387	10	530.3826
{psi(BARE+ERFA+ARCA+TOTTRE2+TOTHRB+LASTFIRE2) p(.)}	551.2566	0.7745	0.18148	0.6789	10	530.5515
{psi(ERFA+ARCA+SHRBHT+TOTTRE+TOTHRB+LASTFIRE) p(.)}	553.5233	3.0412	0.05843	0.2186	8	537.0647
{psi(ERFA+SUNFL+ARCA+SHRBHT+TOTTRE+TOTHRB+LASTFIRE) p(.)}	553.7216	3.2395	0.05291	0.1979	9	535.1465
{psi(BARE+ERFA+ARCA+SHRBHT+TOTTRE+TOTHRB+LASTFIRE) p(.)}	553.759	3.2769	0.05193	0.1943	9	535.1839
{psi(ERFA+ARCA+SHRBHT+TOTTRE+TOTHRB+LASTFIRE2) p(.)}	553.8357	3.3536	0.04998	0.187	9	535.2606
{psi(BARE+ERFA+ARCA+TOTTRE+TOTHRB+LASTFIRE2) p(.)}	554.2454	3.7633	0.04072	0.1523	9	535.6704
{psi(ERFA+ARCA+SHRBHT+TOTTRE+TOTHRB+SLOPE+LASTFIRE) p(.)}	554.4533	3.9712	0.0367	0.1373	9	535.8782
{psi(ERFA+ARCA+SHRBHT+TOTTRE+TOTHRB+ELEV+LASTFIRE) p(.)}	555.5742	5.0921	0.02095	0.0784	9	536.9991
[Plus 47 more models]						

Occupancy a function of:

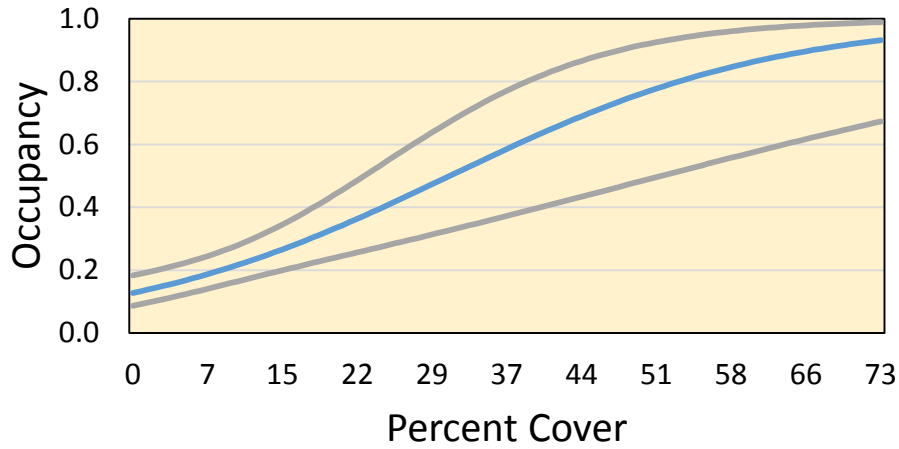
- California sagebrush (+)
- California buckwheat (+)
- Total herbaceous (-)
- Total shrub/tree (+)
- Shrub height (+)
- Bare (+)
- Time since last fire (+)



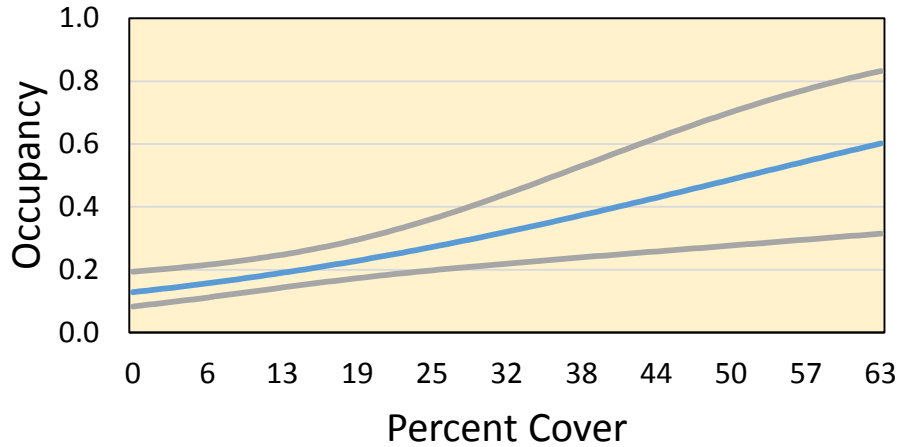
California Buckwheat



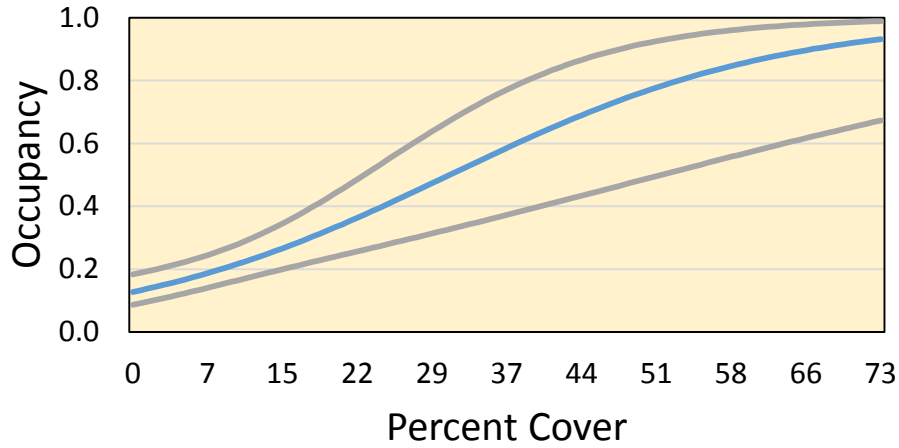
California Buckwheat



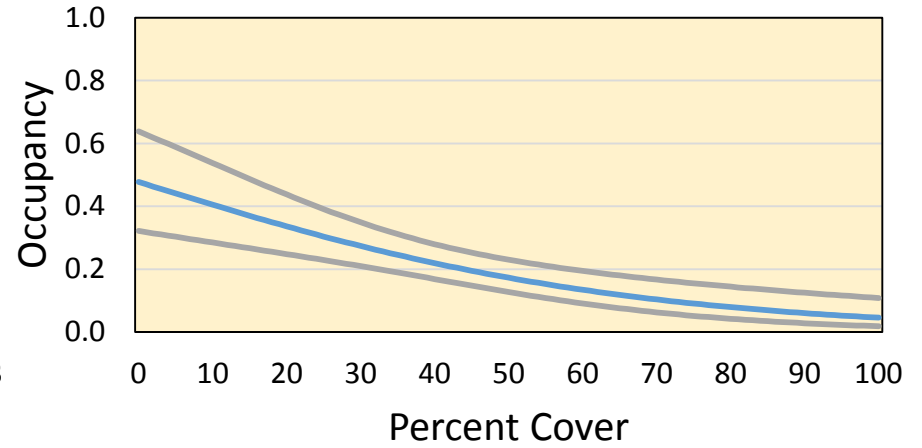
California Sagebrush



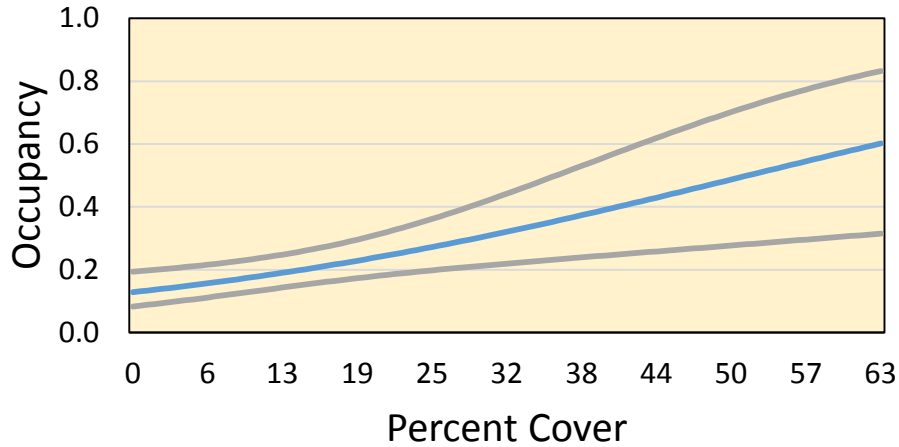
California Buckwheat



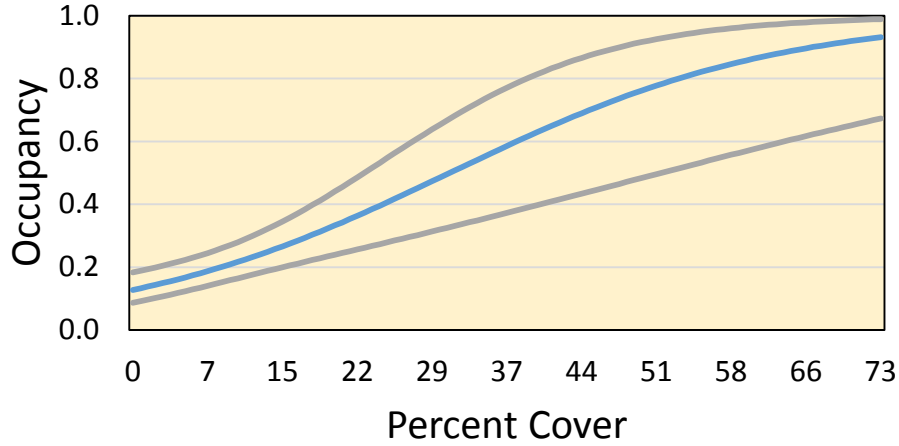
Total Herbaceous



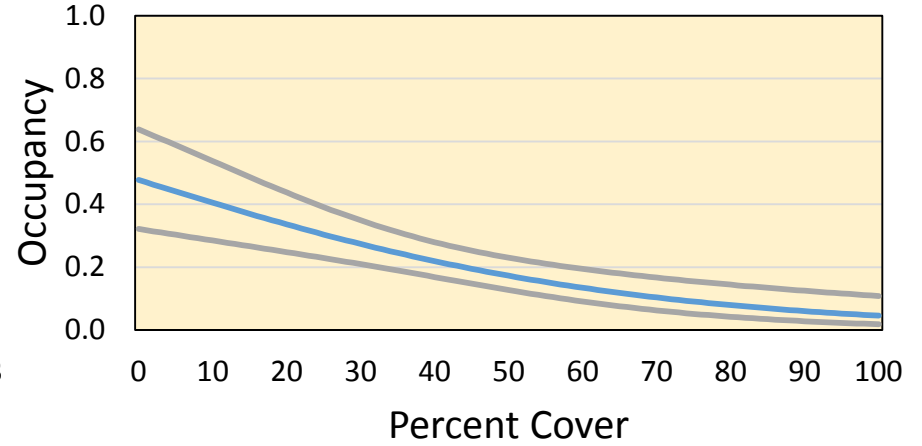
California Sagebrush



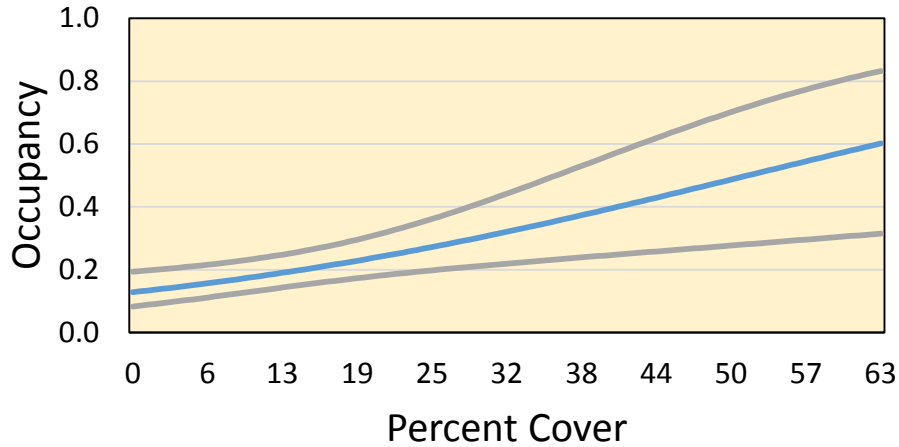
California Buckwheat



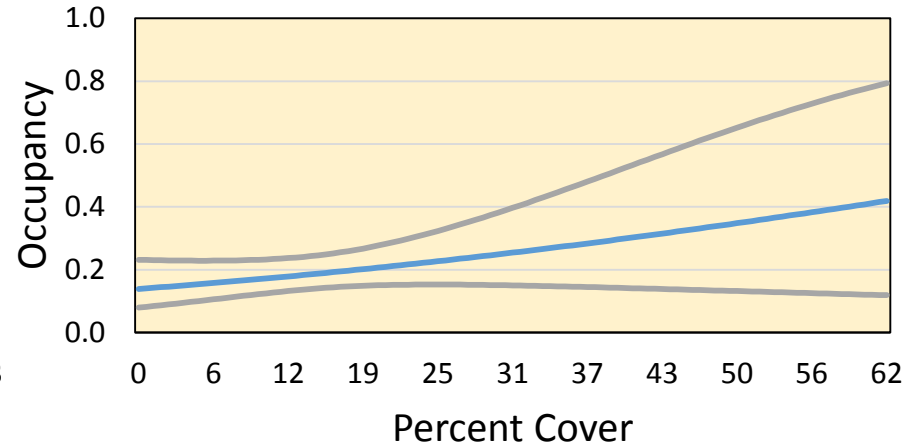
Total Herbaceous



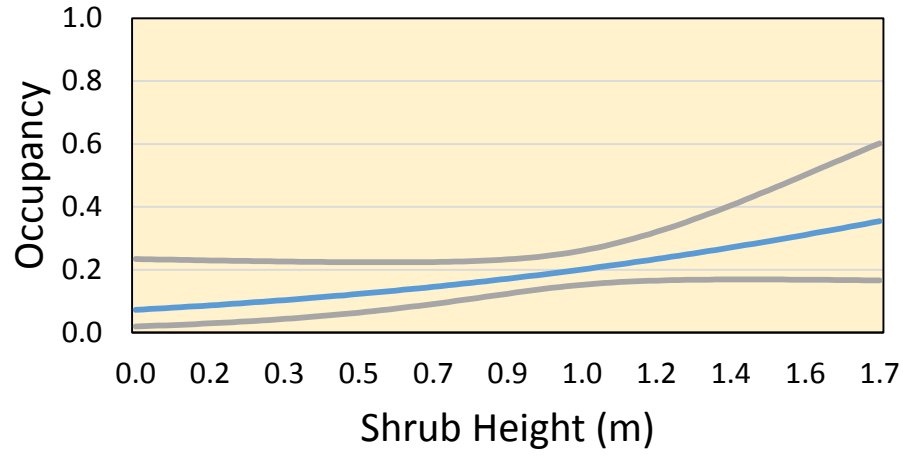
California Sagebrush



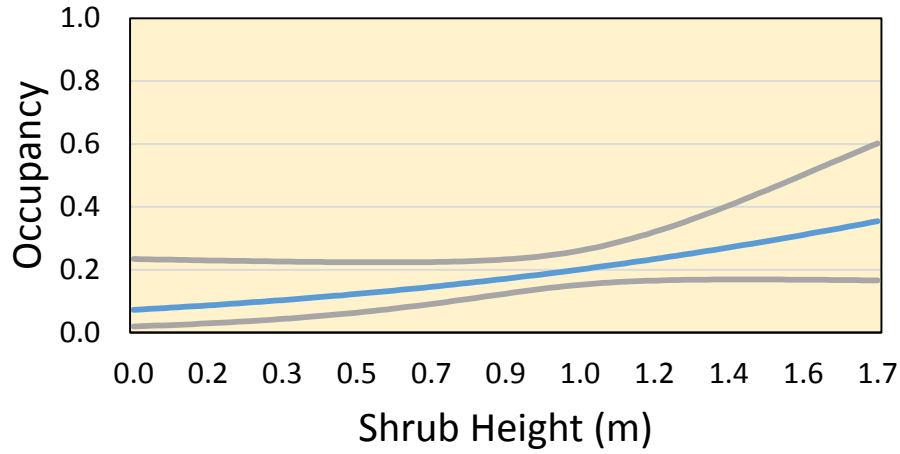
Bare Ground



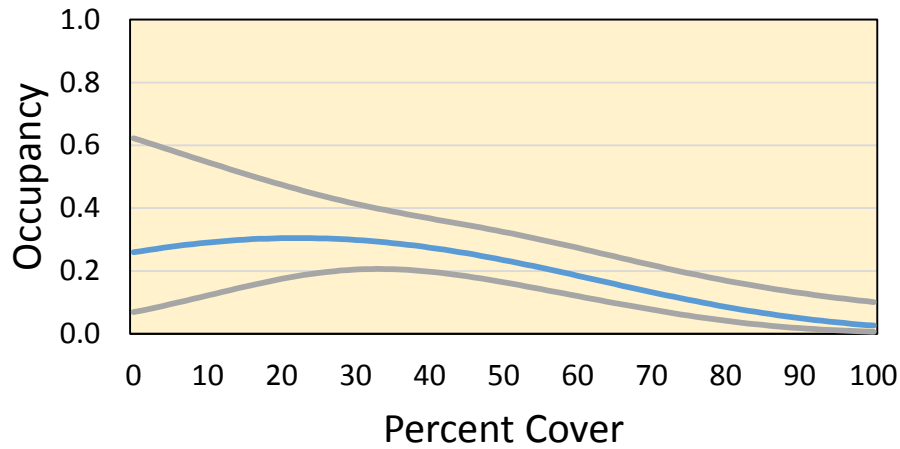
Shrub Height



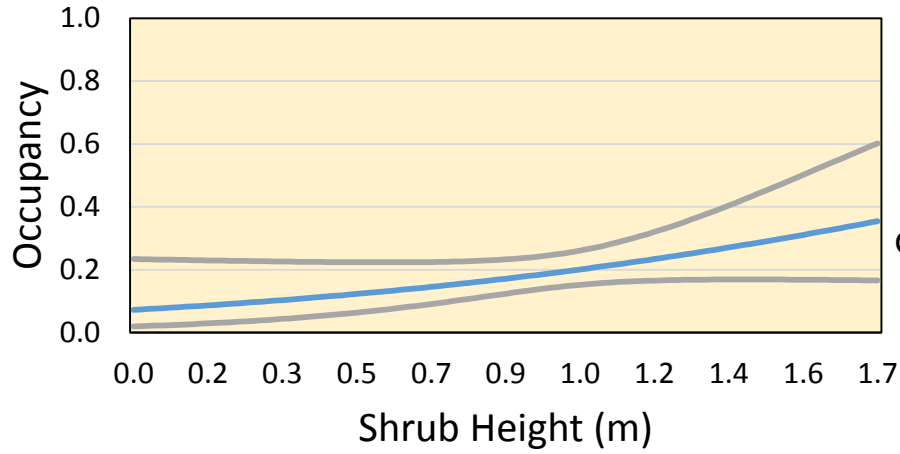
Shrub Height



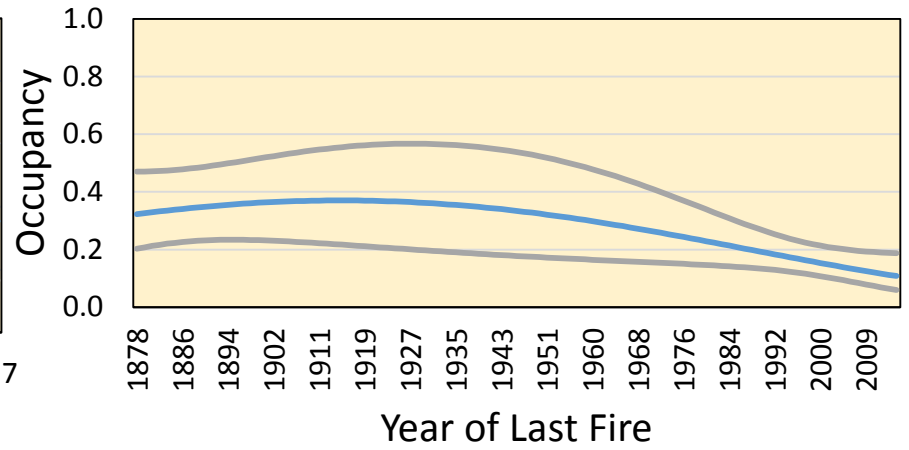
Total Shrub/Tree



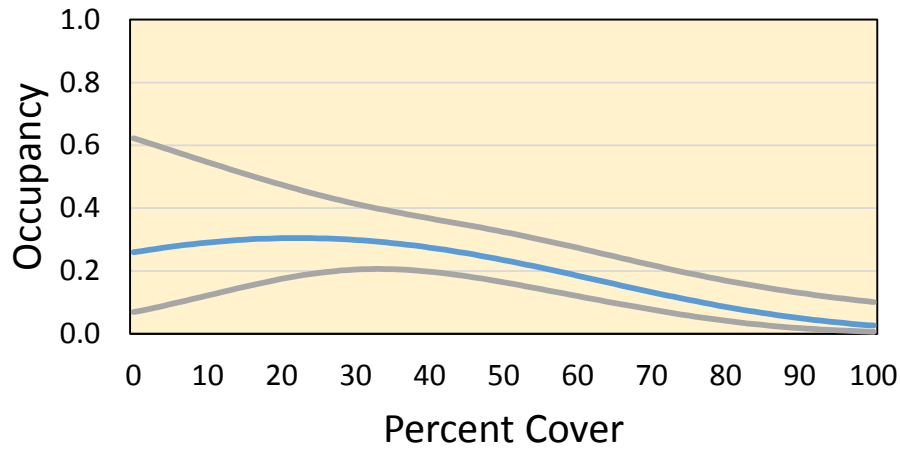
Shrub Height



Last Fire



Total Shrub/Tree



Comparisons of Models

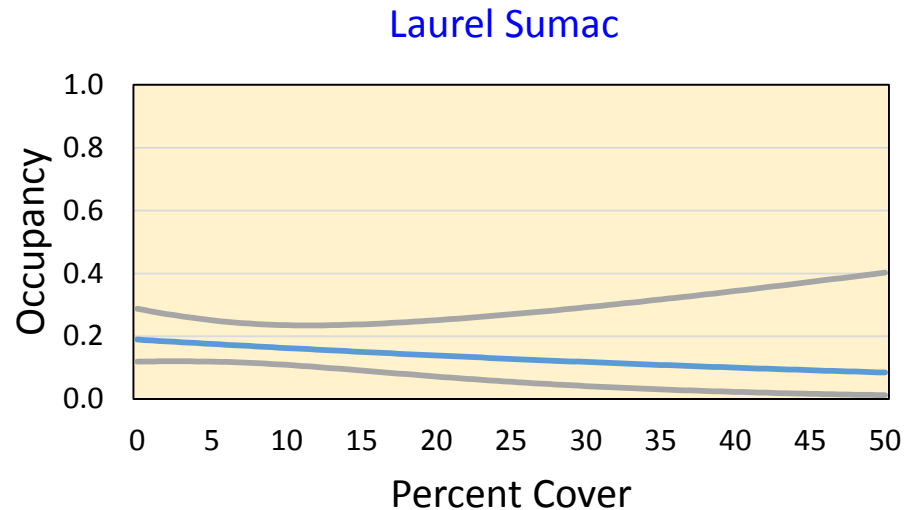
Variable	Regional	SD Subregion	OC Subregion	Unburned
California Sagebrush	+	+	+	+
California Buckwheat	+	+	+	
Total Shrub/Tree	+			
Total Herbaceous	-			
Bare	+		+	+
Shrub Height	+	+		+
Last Fire	+	+		
Laurel Sumac		-		-
Sunflowers		+	+	+
Distance to Coast		(-)		
Elevation		(-)	-	-
Grass				-
Star Thistle				+
Other Tree				-
Slope				-



SD Subregional Models

Occupancy a function of:

- California sagebrush (+)
- California buckwheat (+)
- Shrub Height (+)
- Time since last fire (+)
- Laurel sumac (-)
- Sunflowers (+)
- Distance to coast (-)
- Elevation (-)

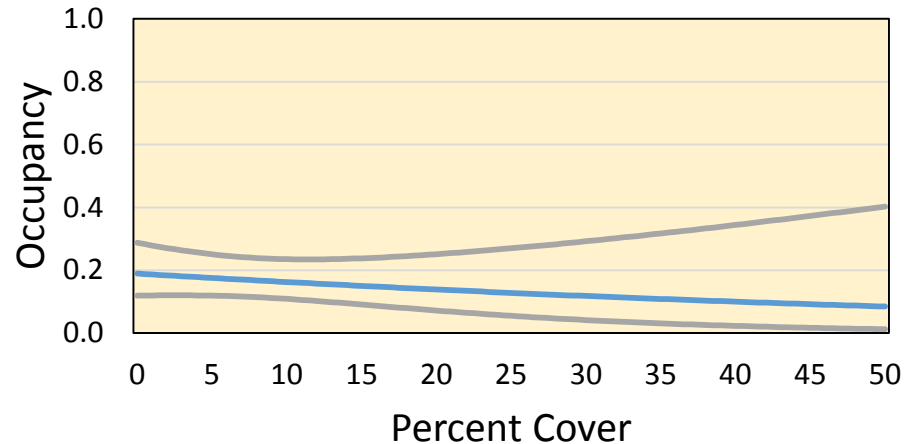


SD Subregional Models

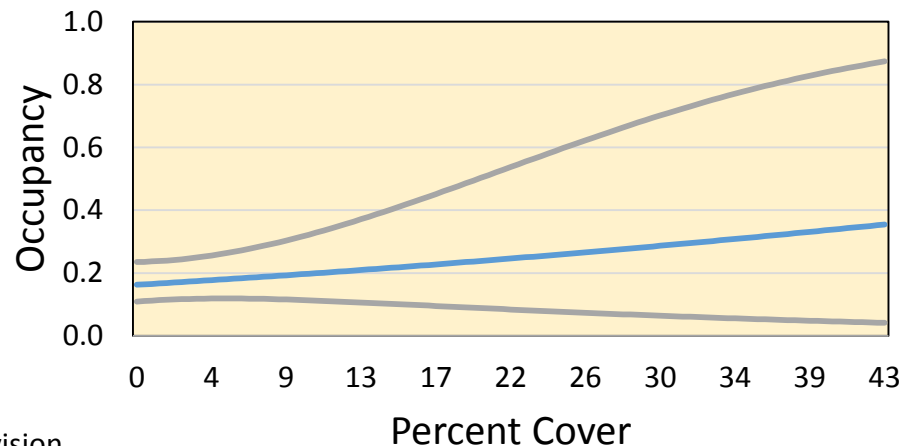
Occupancy a function of:

- California sagebrush (+)
- California buckwheat (+)
- Shrub Height (+)
- Time since last fire (+)
- Laurel sumac (-)
- Sunflowers (+)
- Distance to coast (-)
- Elevation (-)

Laurel Sumac



Sunflowers

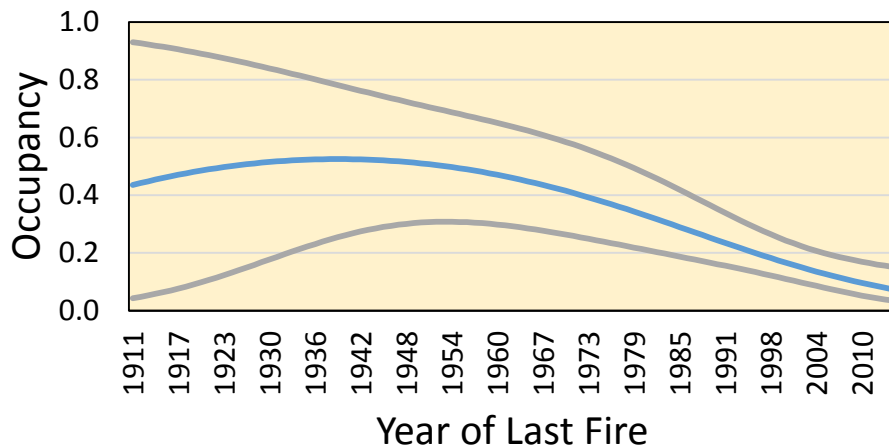


SD Subregional Models

Occupancy a function of:

- California sagebrush (+)
- California buckwheat (+)
- Shrub Height (+)
- Time since last fire (+)
- Laurel sumac (-)
- Sunflowers (+)
- Distance to coast (-)
- Elevation (-)

Last Fire



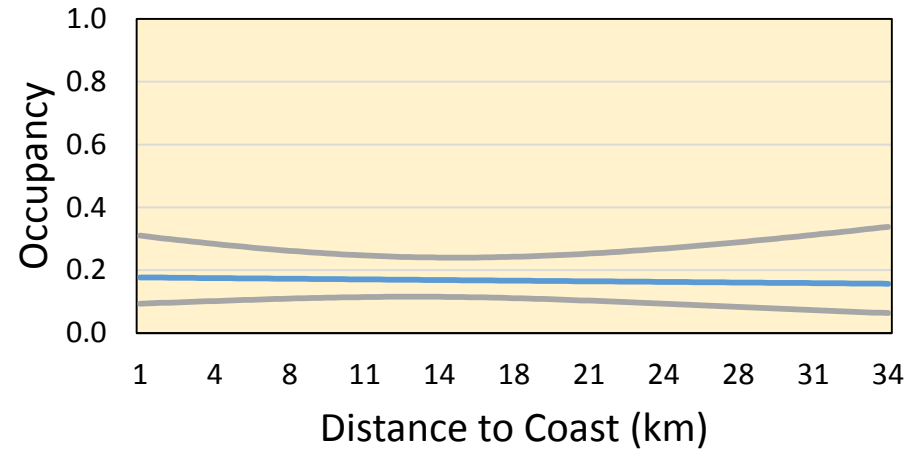
Preliminary Information-Subject to Revision.
Not for Citation

SD Subregional Models

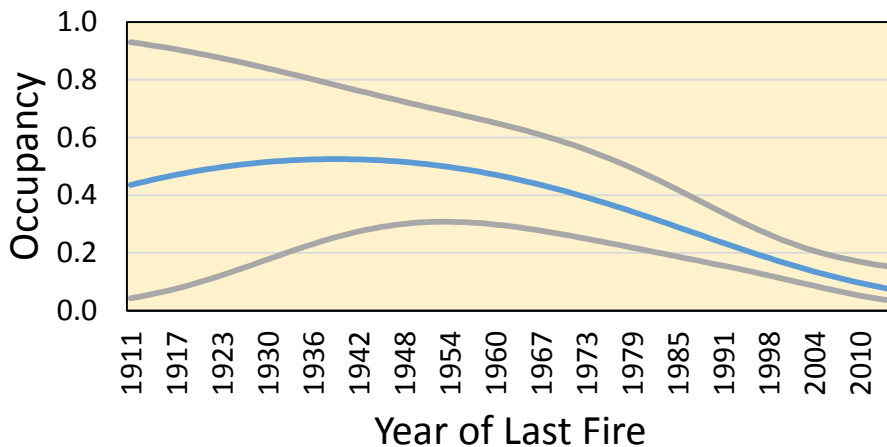
Occupancy a function of:

- California sagebrush (+)
- California buckwheat (+)
- Shrub Height (+)
- Time since last fire (+)
- Laurel sumac (-)
- Sunflowers (+)
- Distance to coast (-)
- Elevation (-)

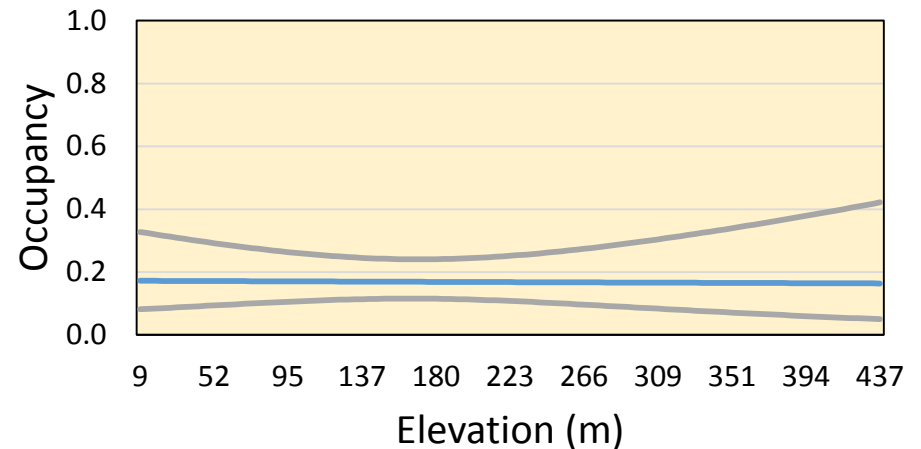
Distance to Coast



Last Fire



Elevation



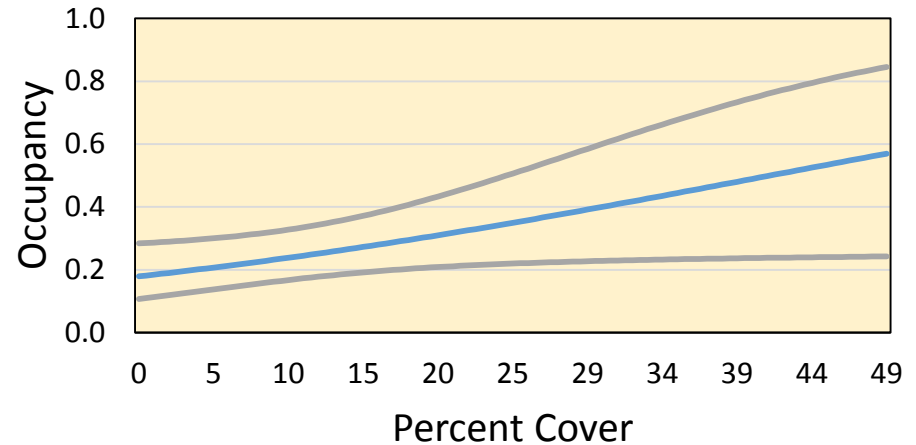
Year of Last Fire
 Preliminary Information-Subject to Revision.
 Not for Citation

OC Subregional Models

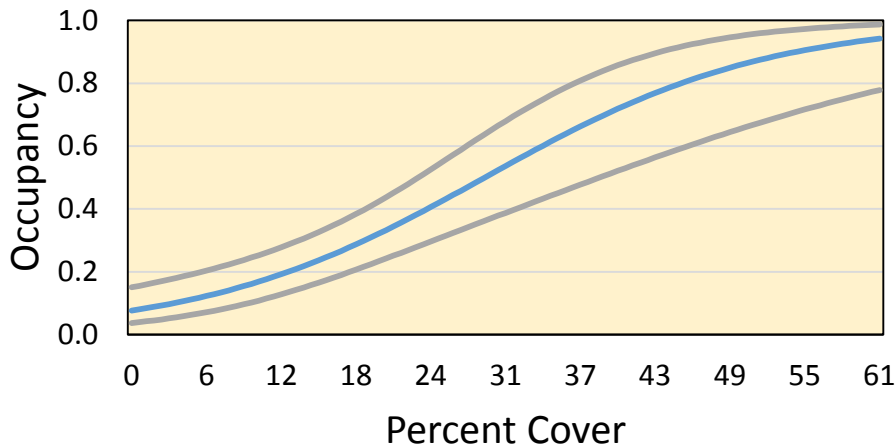
Occupancy a function of:

- California sagebrush (+)
- California buckwheat (+)
- Bare(+)
- Sunflowers (+)
- Elevation (-)

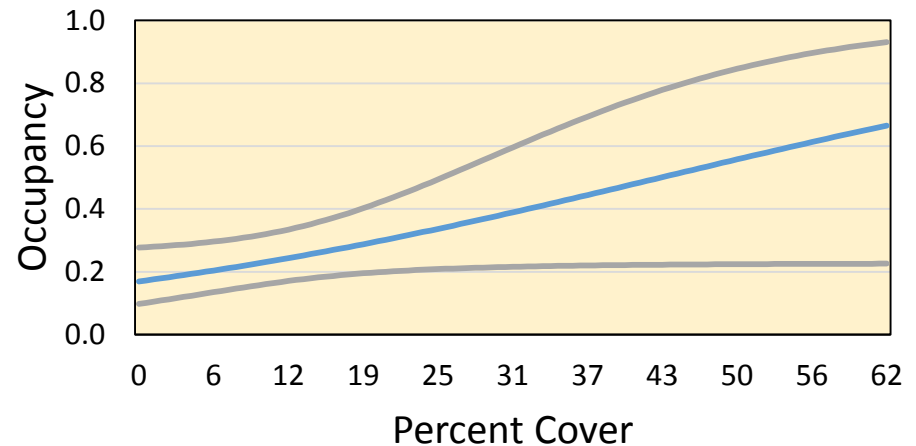
California Buckwheat



California Sagebrush



Bare Ground

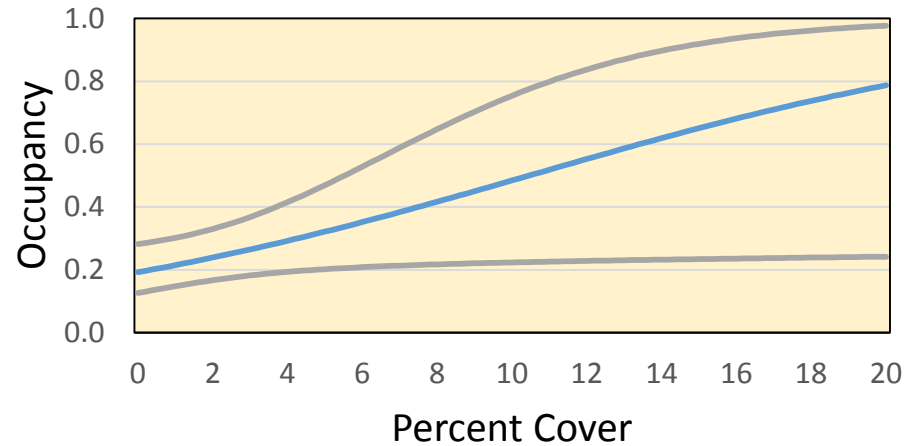


OC Subregional Models

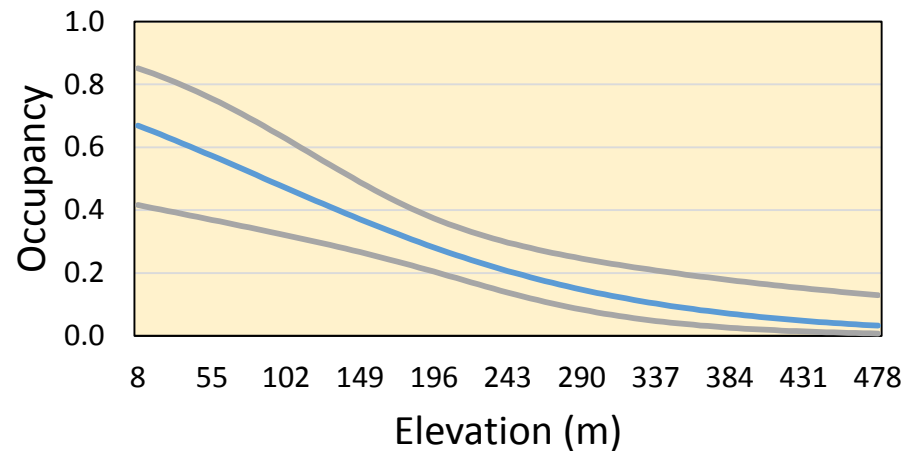
Occupancy a function of:

- California sagebrush (+)
- California buckwheat (+)
- Bare(+)
- Sunflowers (+)
- Elevation (-)

Sunflowers



Elevation

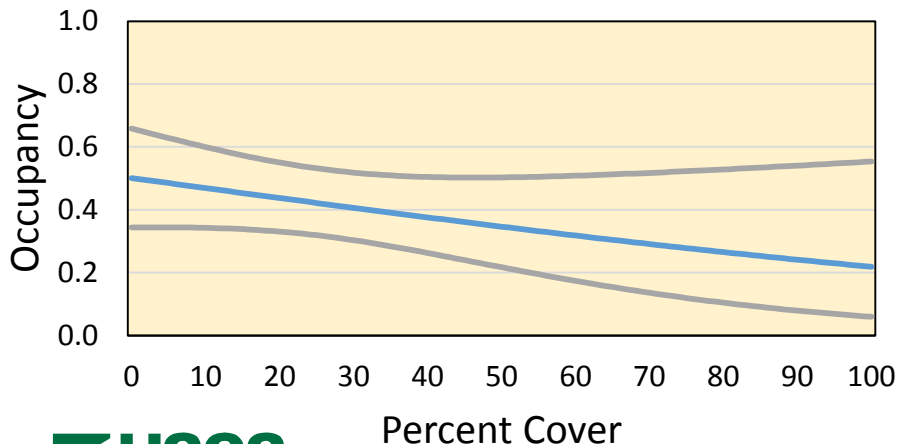


Unburned Models

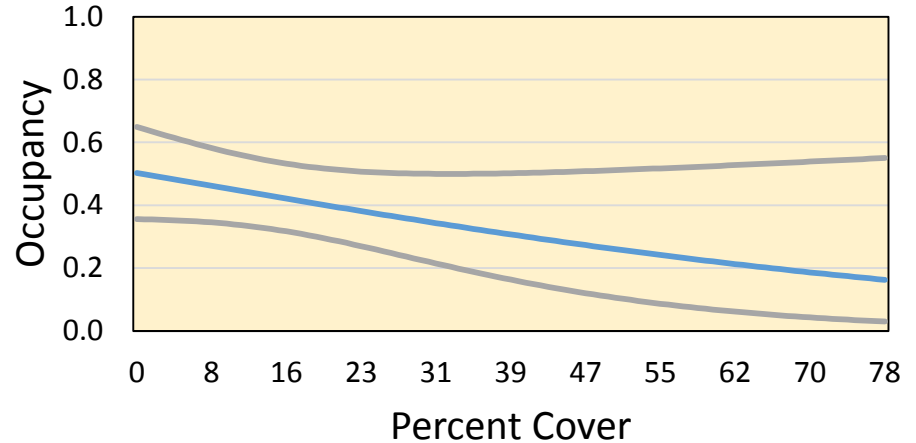
Occupancy a function of:

- California sagebrush (+)
- Bare(+)
- Shrub Height (+)
- Laurel Sumac (-)
- Sunflowers (+)
- Elevation (-)
- Grass (-)
- Star Thistle (+)
- Other Trees (-)
- Slope (-)

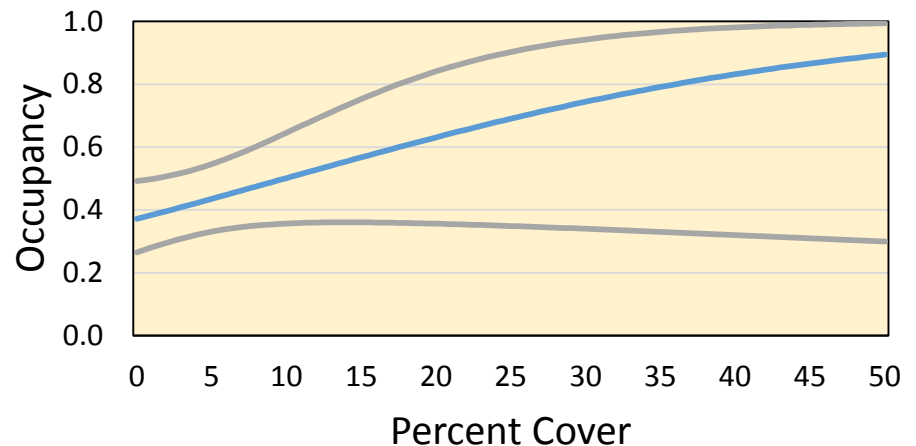
Grass



Other Trees



Star Thistle

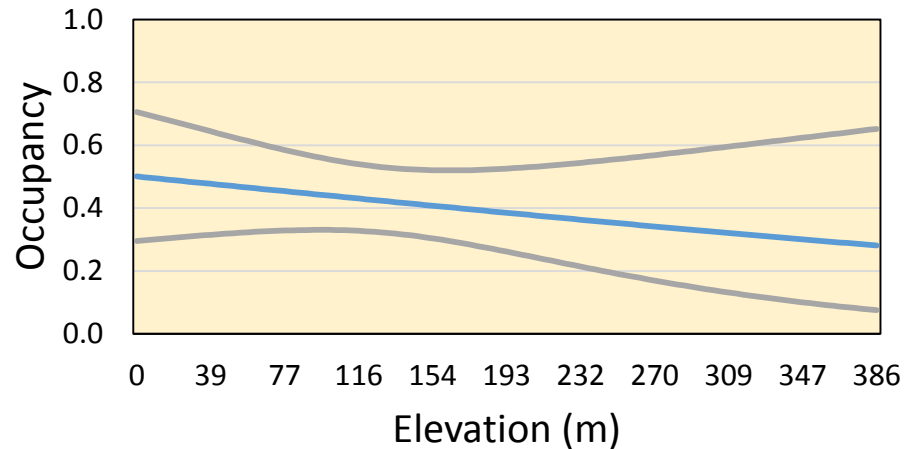


Unburned Models

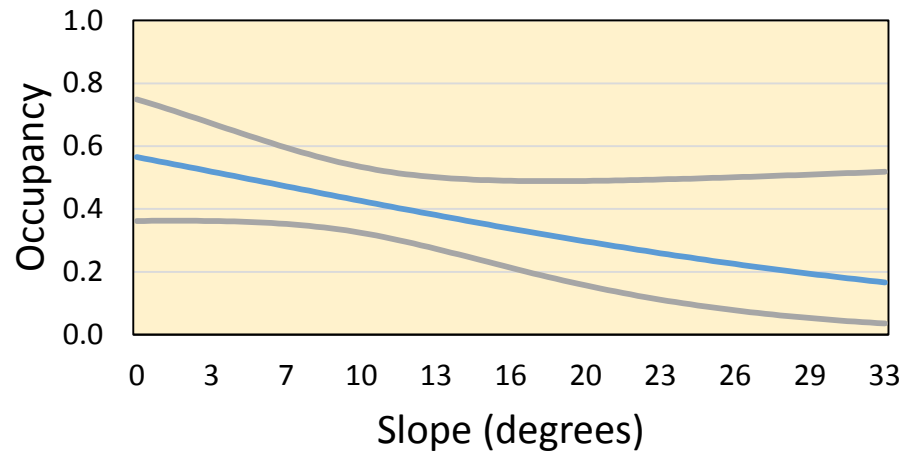
Occupancy a function of:

- California sagebrush (+)
- Bare(+)
- Shrub Height (+)
- Laurel Sumac (-)
- Sunflowers (+)
- Elevation (-)
- Grass (-)
- Star Thistle (+)
- Other Trees (-)
- Slope (-)

Elevation



Slope



Comparisons of Models

Variable	Unburned	2003-2006	2007-2010
California Sagebrush	+		+
California Buckwheat		+	+
Dead		-	-
Total Herbaceous			-
Bare	+		+
Shrub Height	+	+	+
White Sage			-
Black Sage		+	
Laurel Sumac	-	-	(-)
Sunflowers	+		+
Distance to Coast			-
Elevation	-	-	-
Grass	-		(-)
Star Thistle	+	+	
Other Tree	-		
Slope	-	-	



Preliminary Information-Subject to Revision.
Not for Citation

Summary

Positive effect on CAGN occupancy:

- California sagebrush
- California buckwheat
- Sunflower spp.
- Bare ground
- Shrub height

Negative effect on CAGN occupancy:

- Grass
- Total herbaceous
- Laurel sumac
- (Time since fire)

Summary

Following wildfire:

- Grass/total herbaceous increases and remains high
- Laurel sumac increases and remains high
- California sagebrush and buckwheat increase gradually
- California buckwheat appears to recover more quickly than California sagebrush
- Black sage may be a surrogate for California sagebrush during recovery
- Post-fire recovery may take 6-7 decades

Summary

We now have:

- A standardized, question-based protocol for monitoring California gnatcatchers and CSS habitat region-wide
- A large, engaged partner base
- Baseline for analyzing trends in occupancy, colonization and extinction
- Data from which targets for habitat restoration and management can be derived and applied



Thank-you!