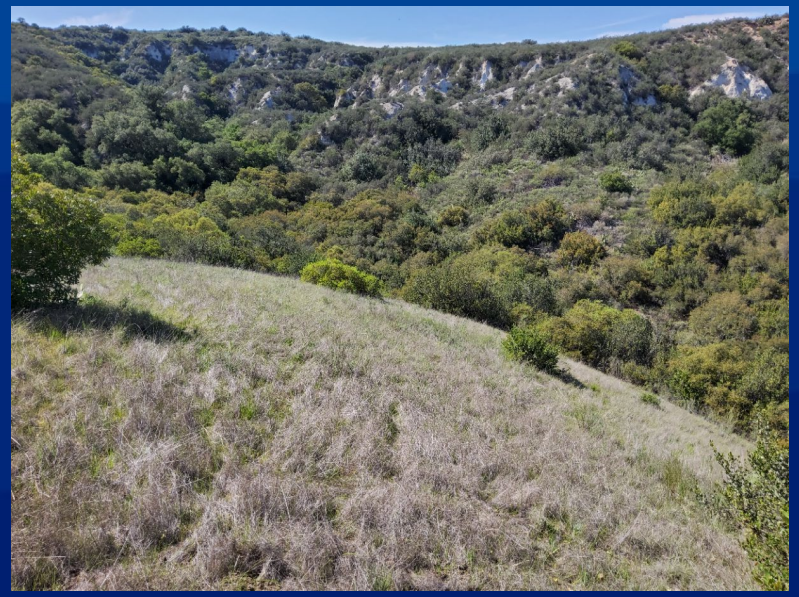
Surveying Needlegrass Grasslands to Plan Management Actions and Model Suitability in Southern Orange County Parks, CA

Matt Major (he)
Cal-IPC Symposium, November 2025



OCparks | County of Orange California

Project Background

California's needlegrass grasslands

- Conservation value; decline and ongoing threats

***Stipa pulchra* grassland in Audubon Starr Ranch Sanctuary, April 2025**

***Stipa pulchra* grassland in Carmel Valley, CA (Bartolome, 1981)**

Problem Statement and Project Objectives

Information gaps for grasslands in the Southern Subregion of OC

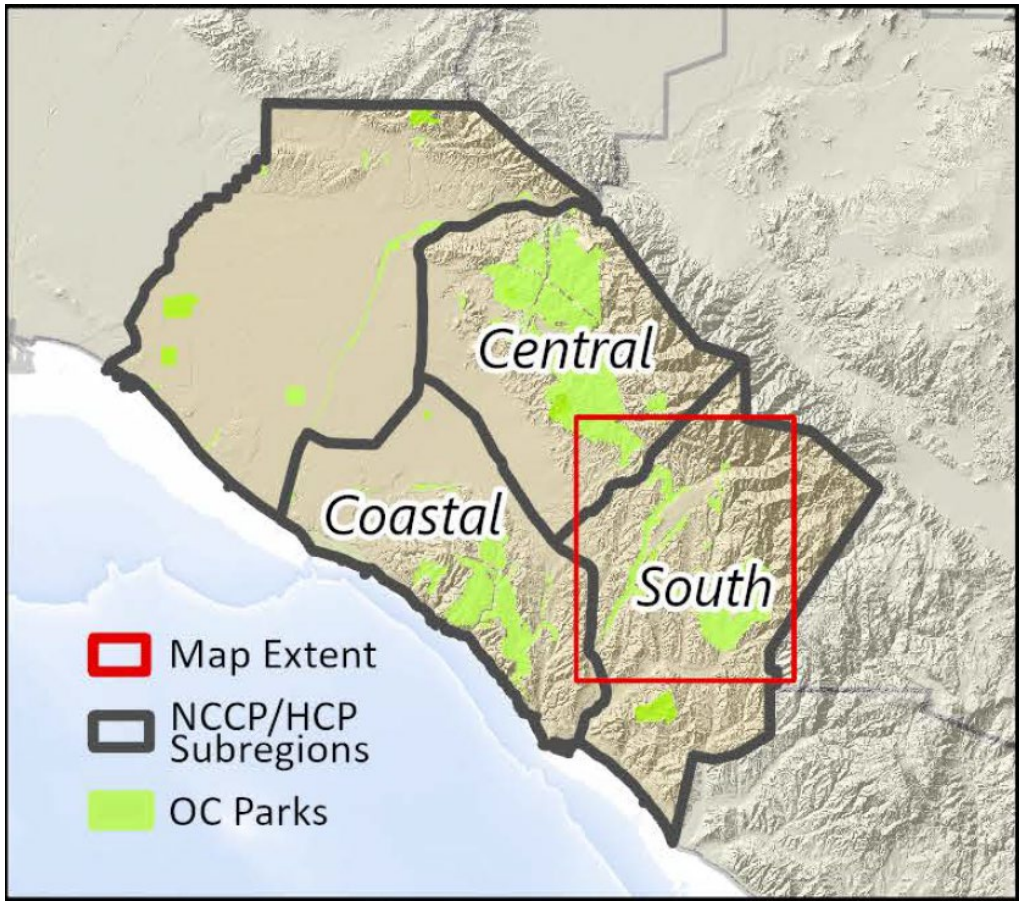
- Opaque & outdated data set of SSHCP mapped grassland polygons
- Uknown suitability for restoration & enhancement

<u>Objectives</u>

1. **Inventory needlegrass grasslands in the Southern Subregion**
    - Orange County Parks
    - Other conserved lands in the subregion

2. **Assess species composition of grasslands & discuss implications for management**
    - Native herbaceous species
    - Structurally problematic non-native species

3. **Model habitat suitability for needlegrass grasslands with MaxEnt**



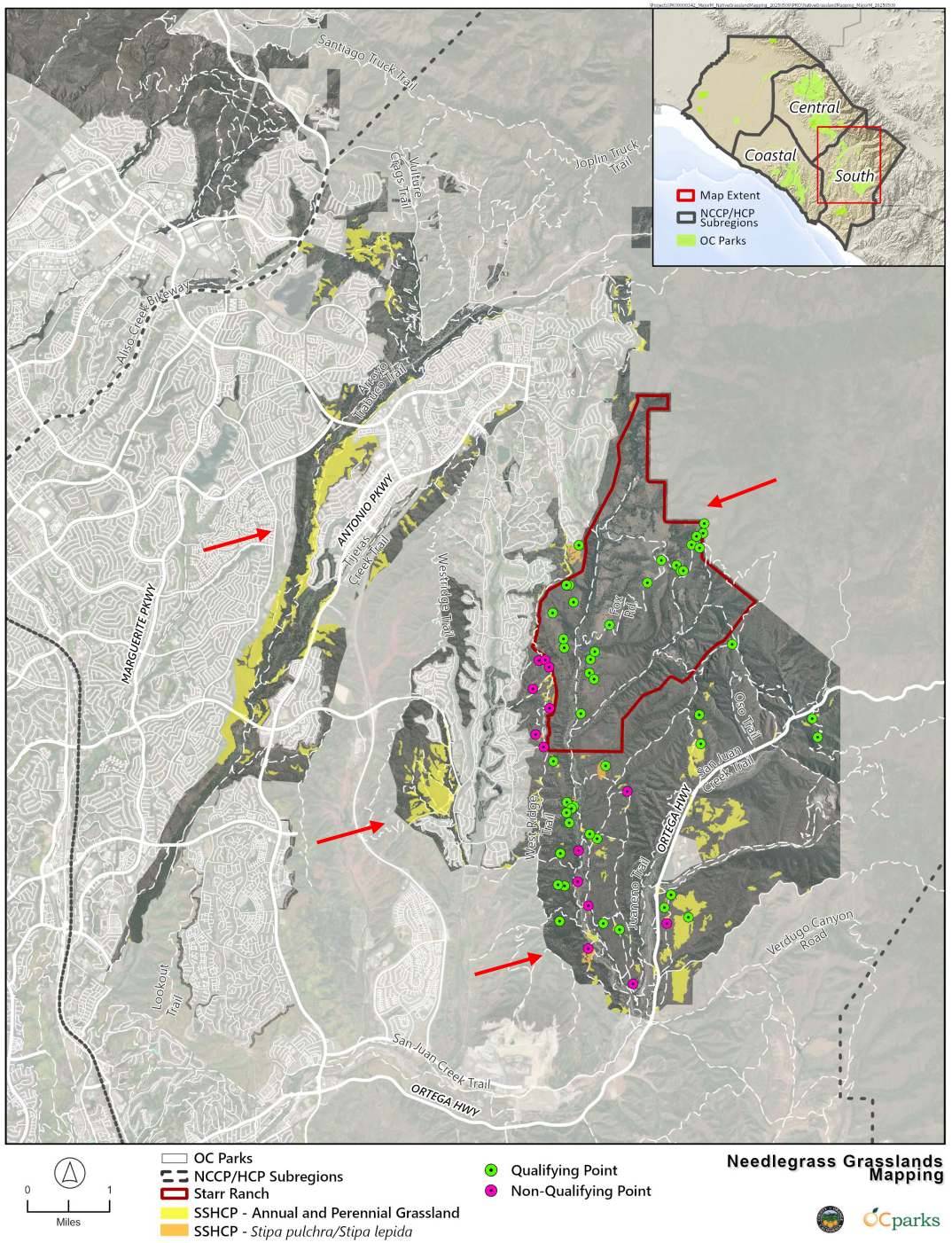
Study Area

Southern Subregion of Orange County

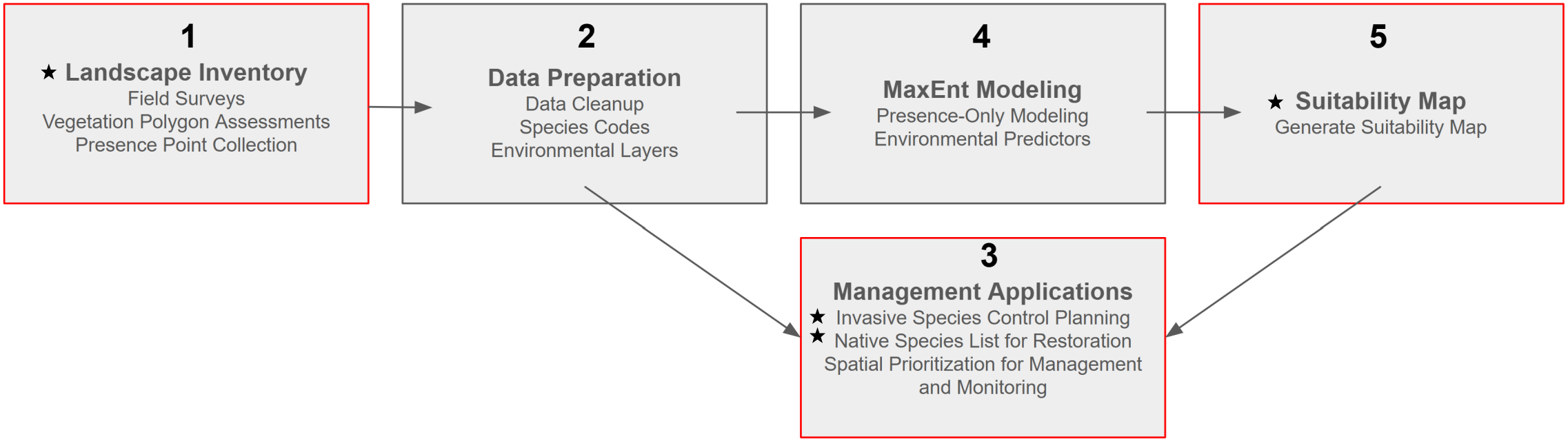
- Orange County Parks lands enrolled in the HCP (12,000 ac)
  - O'Neill Regional Park
  - Riley Wilderness Park
  - Caspers Wilderness Park

- Audubon Starr Ranch Sanctuary (4,000 ac)

Photo: Scott Gibson (https://starrranch.org/)



Project Workflow



★ *Project outputs*

Field Methods & Data Collection

Criteria: >10% *Stipa* cover

Field Maps app & digital form

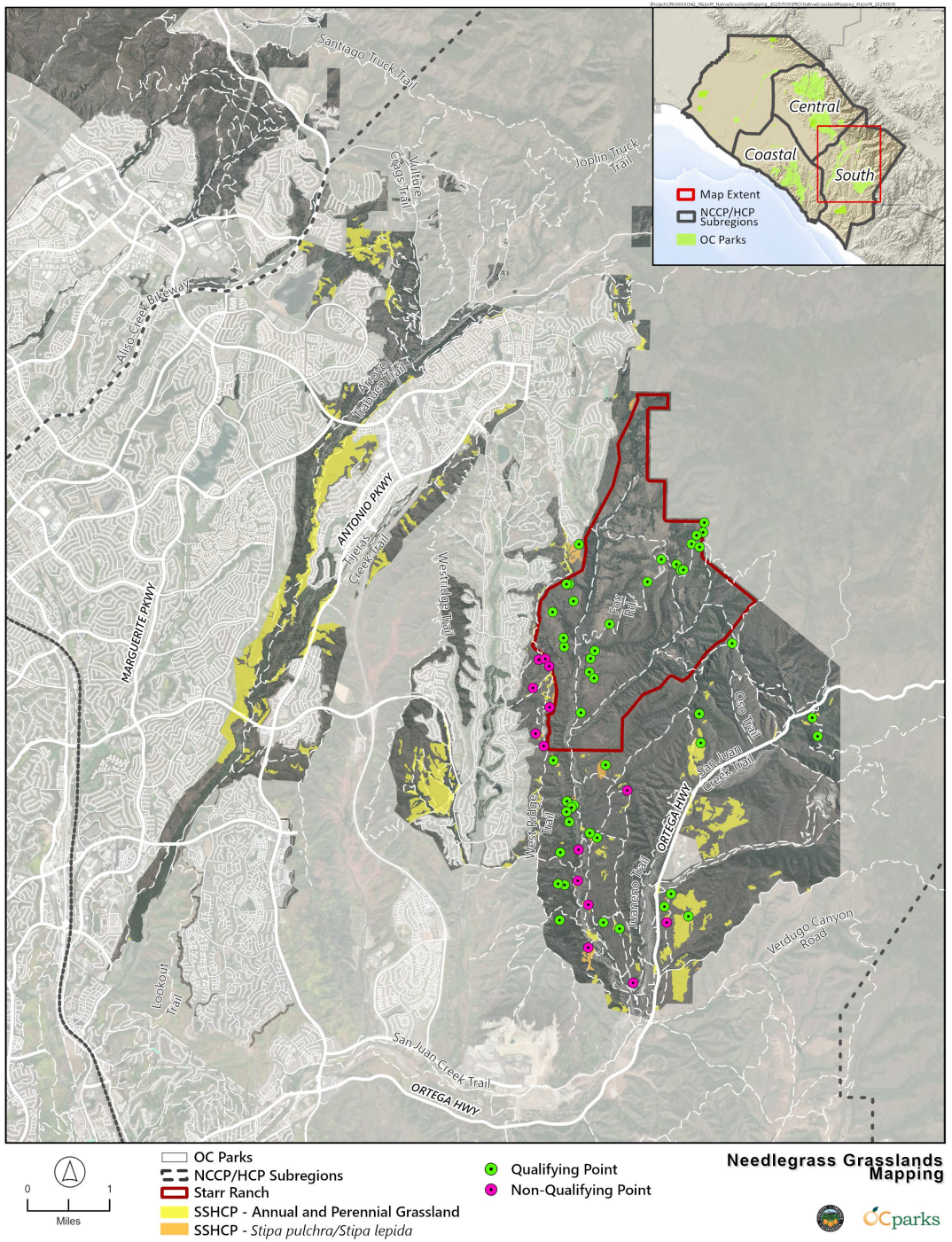
- Average and maximum *Stipa* cover
- Native herbaceous species
- Dominant species
- Structurally problematic invasive species

3-phase survey

- ***Stipa pulchra/Stipa lepida*** grassland polygons
- **Annual and Perennial Grassland** polygons
- Audubon Starr Ranch grassland stewardship areas

Survey methodology

- Zigzag walking pattern
- GPS point placed at max *Stipa* cover location (10x10m)



Composition & Management Findings

Most frequently observed native herbaceous species

- *Diptosteremon capitatum, Sisyrinchium bellum, Sanicula arguta*

Most frequently observed dominant structurally problematic non-native species

- *Centaurea melitensis, Cynara cardunculus, Brassica nigra*

Photos of *Primula clevelandii* in Caspers grasslands, March 2025

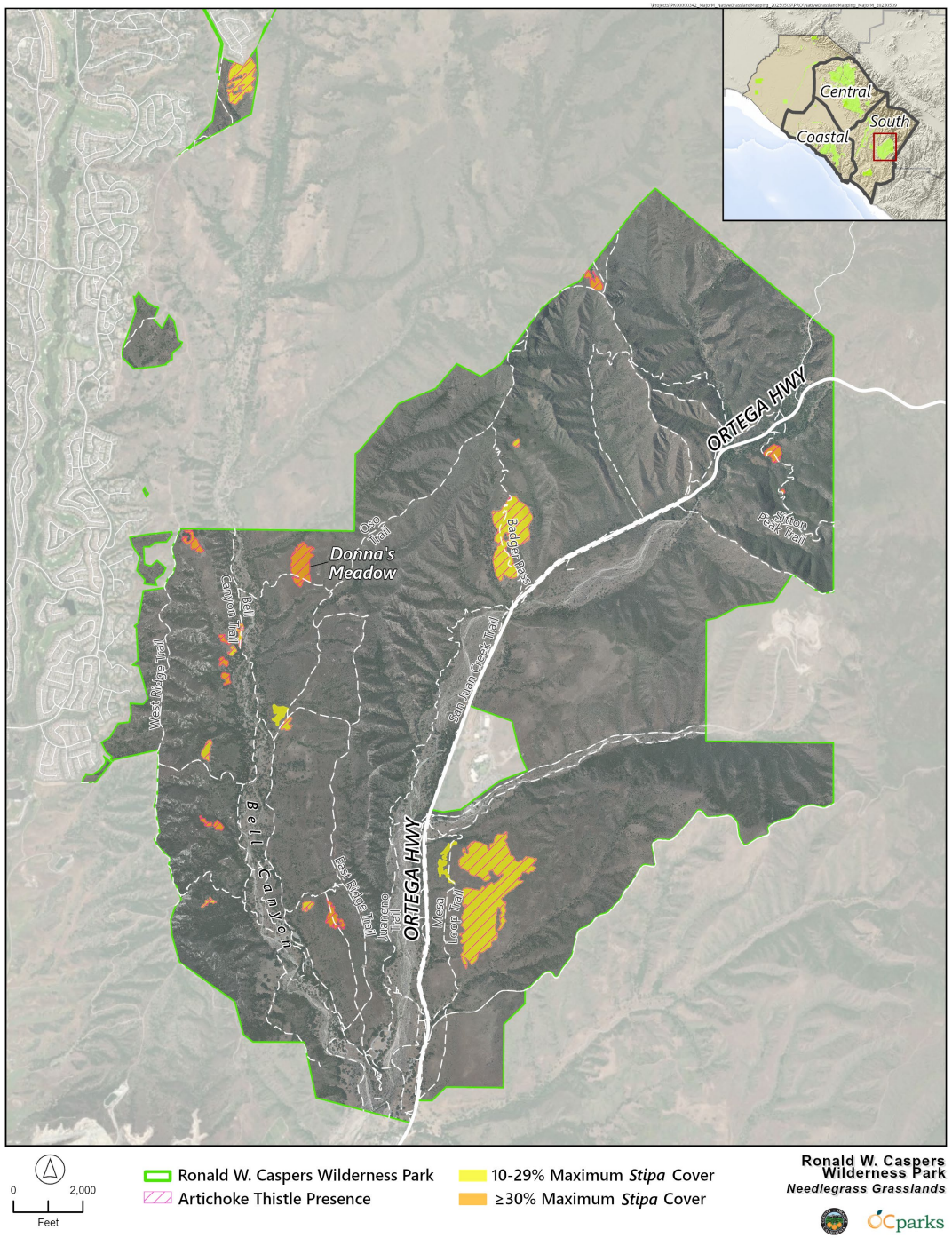
Species Compendium Table with Species Codes. All species observed in grasslands during the project are listed on this table.

Species Code	Scientific Name	Common Name	Status
ACMAME	*Acmispon americanus*	Spanish lotus	native
ACMSTR	*Acmispon strigosus*	strigose lotus	native
ACOMIC	*Acourtia microcephala*	sacapellote	native
AMBPSI	*Ambrosia psilostachya*	Western ragweed	native
AMSMEN	*Amsinckia menziesii*	Menzie's fiddleneck	native
ASCERI	*Asclepias eriocarpa*	woolypod milkweed	native
ASCFAS	*Asclepias fascicularis*	narrowleaf milkweed	native
BLOCRO	*Bloomeria crocea*	common goldenstar	native
BRADIS	*Bracypodium distachyon*	purple false brome	non-native
BRANIG	*Brassica nigra*	black mustard	non-native
BROFIL	*Brodiaea filifolia*	threadleaf brodiaea	native
CALMAC	*Calystegia macrostegia*	island morning glory	native
CALMEN	*Calandrinia menziesii*	red maids	native
CALSPL	*Calochortus splendens*	splendid mariposa lily	native
CARPYC	*Carduus pycnocephalus*	Italian thistle	non-native
CASFOL	*Castilleja foliolosa*	woolly paintbrush	native
CAUHET	*Caulanthus heterophyllus*	slender pod jewelflower	native
CENMEL	*Centaurea melitensis*	tocalote	non-native
CHLPOM	*Chlorogalum pomeridianum*	soap plant	native
CIROCC	*Cirsium occidentale*	Western thistle	native
CLAPER	*Claytonia perfoliata*	miner's lettuce	native
CORFIL	*Corethrogyne filaginifolia*	common sandaster	native
CROSET	*Croton setiger*	doveweed	native
CRYINT	*Cryptantha intermedia*	common cryptantha	native
CYNCAR	*Cynara cardunculus*	artichoke thistle	non-native
DATWRI	*Datura wrightii*	sacred datura	native
DEIFAS	*Deinandra fasciculata*	clustered tarweed	native
DIPCAP	*Dipterostemon capitatus*	blue dicks	native
DIPPUN	*Diplacus puniceus*	sticky monkeyflower	native
ELYCON	*Elymus condensatus*	giant wild rye	native
EPICAN	*Epilobium canum*	California fuchsia	native
ERICON	*Eriophyllum confertiflorum*	golden yarrow	native
ERIELO	*Eriogonum elongatum*	longstem buckwheat	native
ERIPAL	*Ericameria palmeri*	Palmer's goldenbush	native
EROCIC	*Erodium cicutarium*	redstem filaree	non-native
FOEVUL	*Foeniculum vulgare*	fennel	non-native
FRIBIF	*Fritillaria biflora*	chocolate lily	native
GRICAM	*Grindelia camporum*	gum plant	native
GUTCAL	*Gutierrezia californica*	matchweed	native

Decision-Support Product #1

Management map: *Cynara cardunculus*
Removal results in ecological uplift and passive expansion of *Stipa pulchra* (Suding, 2007).

Two photos taken in a single needlegrass grassland polygon in Caspers Wilderness Park in April 2025



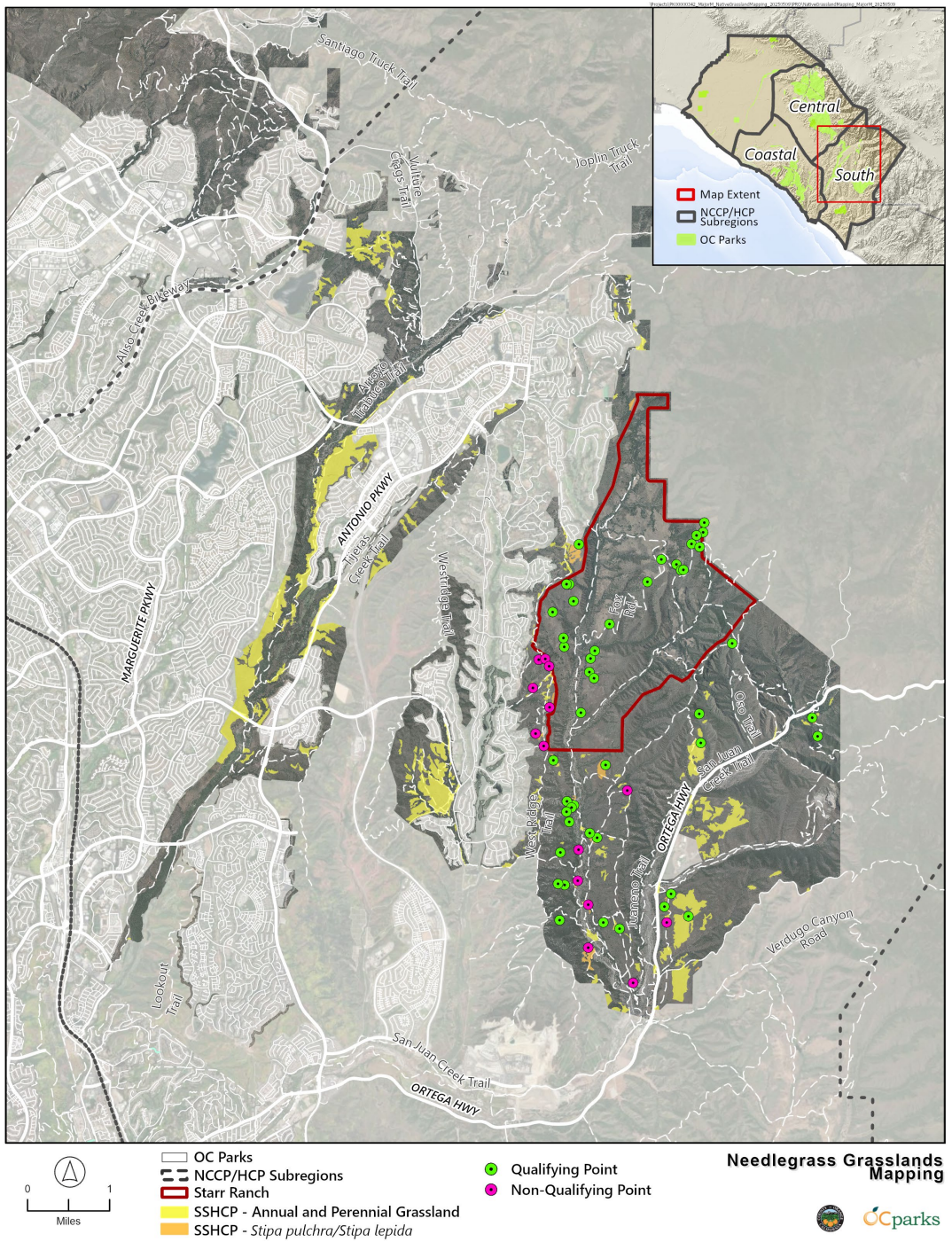
Modeling Methods: MaxEnt

Presence-only species distribution modeling (SDM) tool

- Statistical modeling approach that utilizes machine learning
- Widely used for habitat suitability prediction

46 qualifying points from grassland surveys

Points were merged with environmental variables for modeling

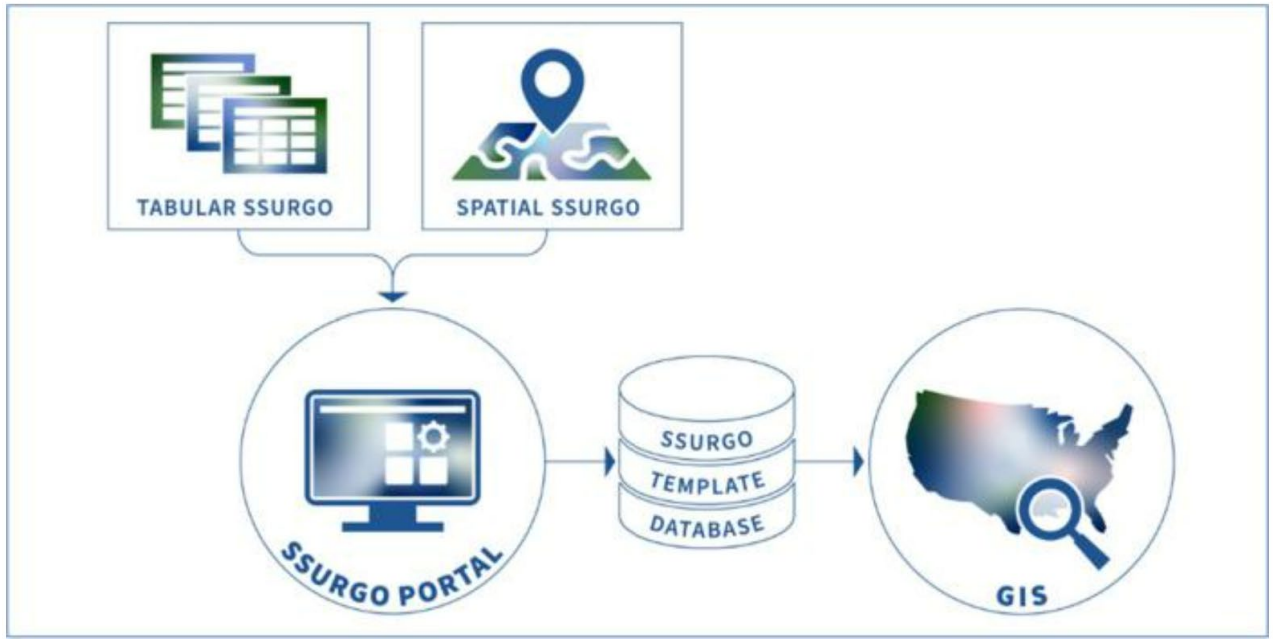


Modeling Methods: Variable Selection and Data Preparation

Literature review
Elevation, soil texture, aspect, soil depth, bulk density.

Variables selected for the model

- Elevation
- Slope
- Northness
- Eastness
- Topographic position index
- Flow direction
- Topographic roughness index
- Soil available water capacity
- Soil pH
- Soil texture (% sand, % clay)
- Soil bulk density
- Soil depth to any restrictive layer



SSURGO (Soil Survey Geographic Database)
https://www.nrcs.usda.gov/resources/data-and-reports/ssurgo-portal

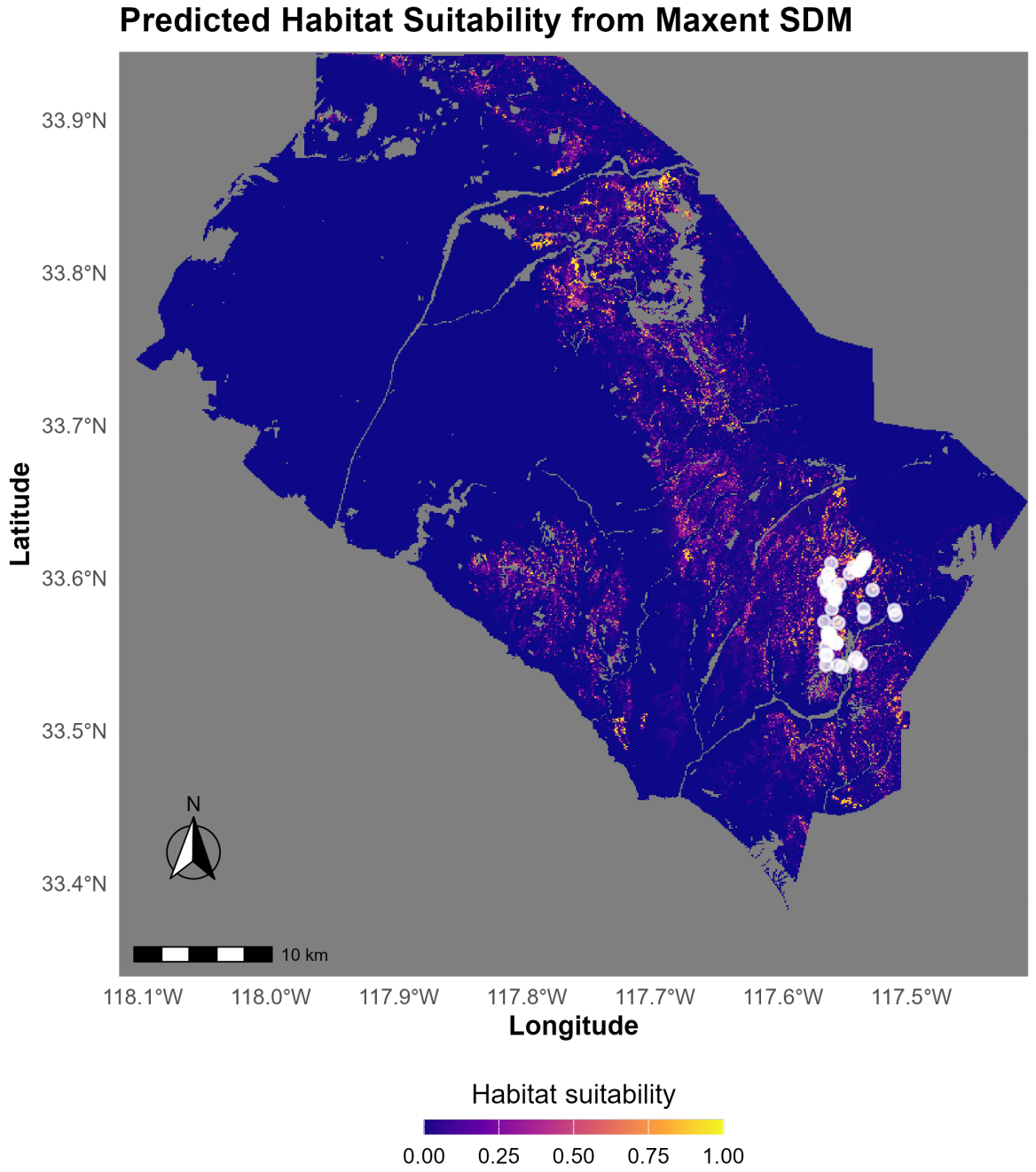
Modeling Methods and Outputs

Model development

- Addressed correlation among predictor variables
- Sampled background points
- Evaluated model performance using **flexsdm** in R

Suitability map

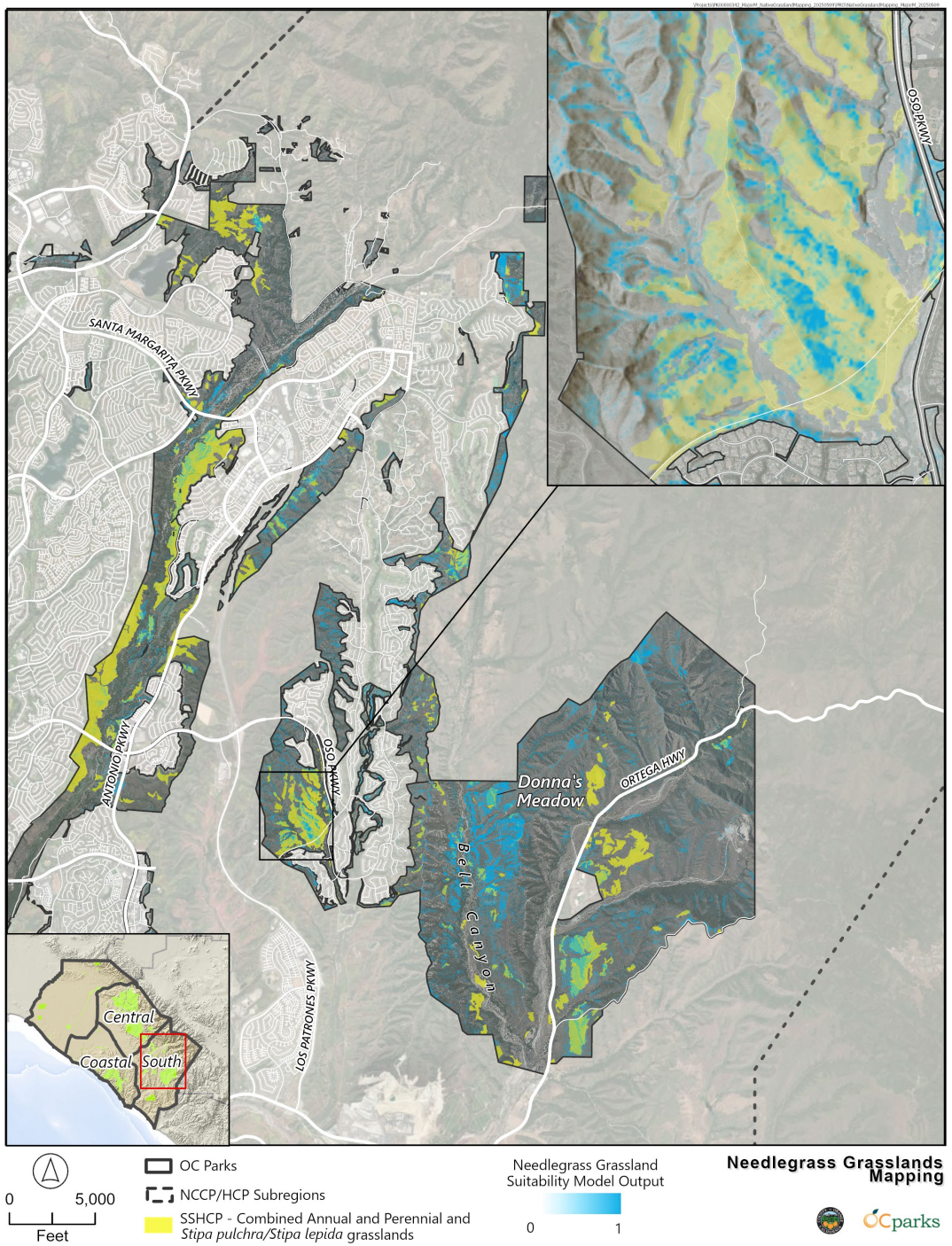
- Foothills of Orange County
- Slopes and flat terraces
- High suitability in Starr Ranch



Decision-Support Product #2

Needlegrass grassland suitability map

Donna’s Meadow, Caspers Wilderness Park, April 2025



Discussion

Objective 1: Develop a field-verified landscape inventory

- Insight into native grassland metrics (e.g., success criteria)
- Limitations: time constraints, detectability

Objective 2: Inform grassland restoration, enhancement, and stewardship planning

- Non-native invasive plant control
- Seeding and planting

Objective 3: Develop a suitability model (i.e., a spatial decision support tool)

- Strong model performance (AUC = 0.95; TSS = 0.84)
- Broad but precise suitability
- Sampling bias

Bell Canyon, looking south from Starr Ranch towards Caspers (April 2025)

Implications for Management

Goal-based land management decision-making:

- What type of target vegetation assemblage should be pursued?
- What type of action?

Caspers “Badger Pass” (April 2025)

Upper: Caspers “Mesa Loop North”; Lower: Starr Ranch (April 2025)

Future Directions

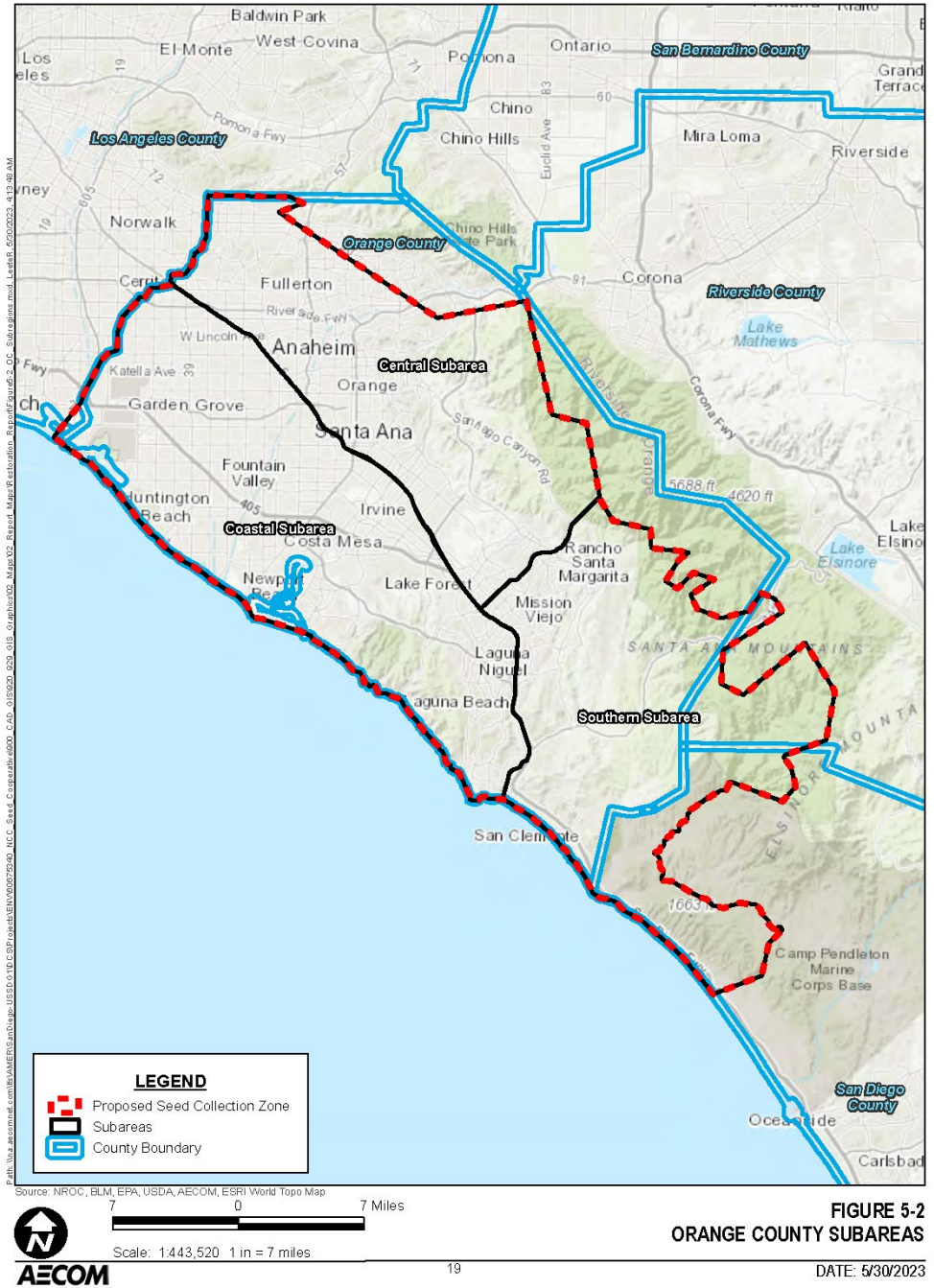
Continue landscape inventory surveys in OC Parks

- Spring 2026!

Restoration priority seed list

- List of needlegrass grassland native plant species compiled from multiple studies in the Orange County Region

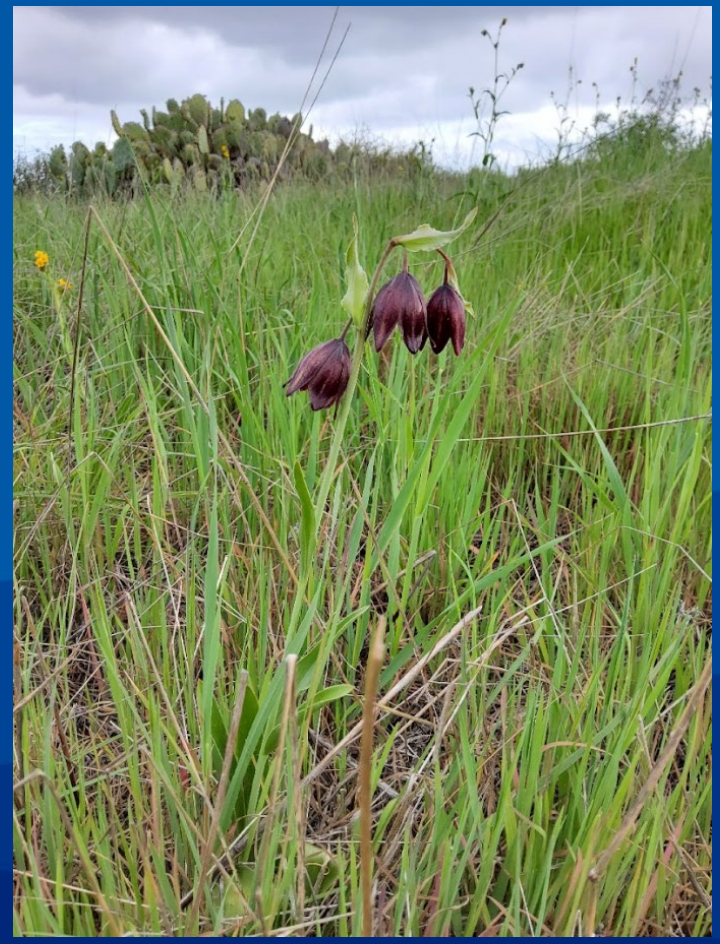
Species	Major, 2025	County of Orange, 2006	Harmsworth & Assoc., 1998	Boyd et al., 1995	Irvine Ranch Conservancy, 2018
Achyranchaeana mollis			X		
Acmispon americanus	X				
Acmispon spp.			X		X
Acmispon strigosus	X				X
Acourtia microcephala	X				
Agrostis diegoensis			X		
Agrostis pallens		X			
Allium haematochiton				X	
Allium praecox			X		
Amblyopappus pusillus			X		
Ambrosia psilostachya	X				
Amsinckia intermedia				X	
Amsinckia menziesii	X				
Amsinckia menziesii ssp. intermedia			X		



Blue dicks (*Dipterostemon capitatus*)

Thank you

Janet Franklin (UC Riverside, San Diego State University)
Brooke Rose (San Diego State University)
Loralee Larios (UC Riverside)
Andrew Wallace (OC Parks)
Sandy DeSimone (Starr Ranch Sanctuary)
Jennifer Naegele (OC Parks)



Chocolate lily (*Fritillaria biflora*)

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Supplementary Slides

Field Methods & Data Collection

Caspers grasslands inventory update nearing completion

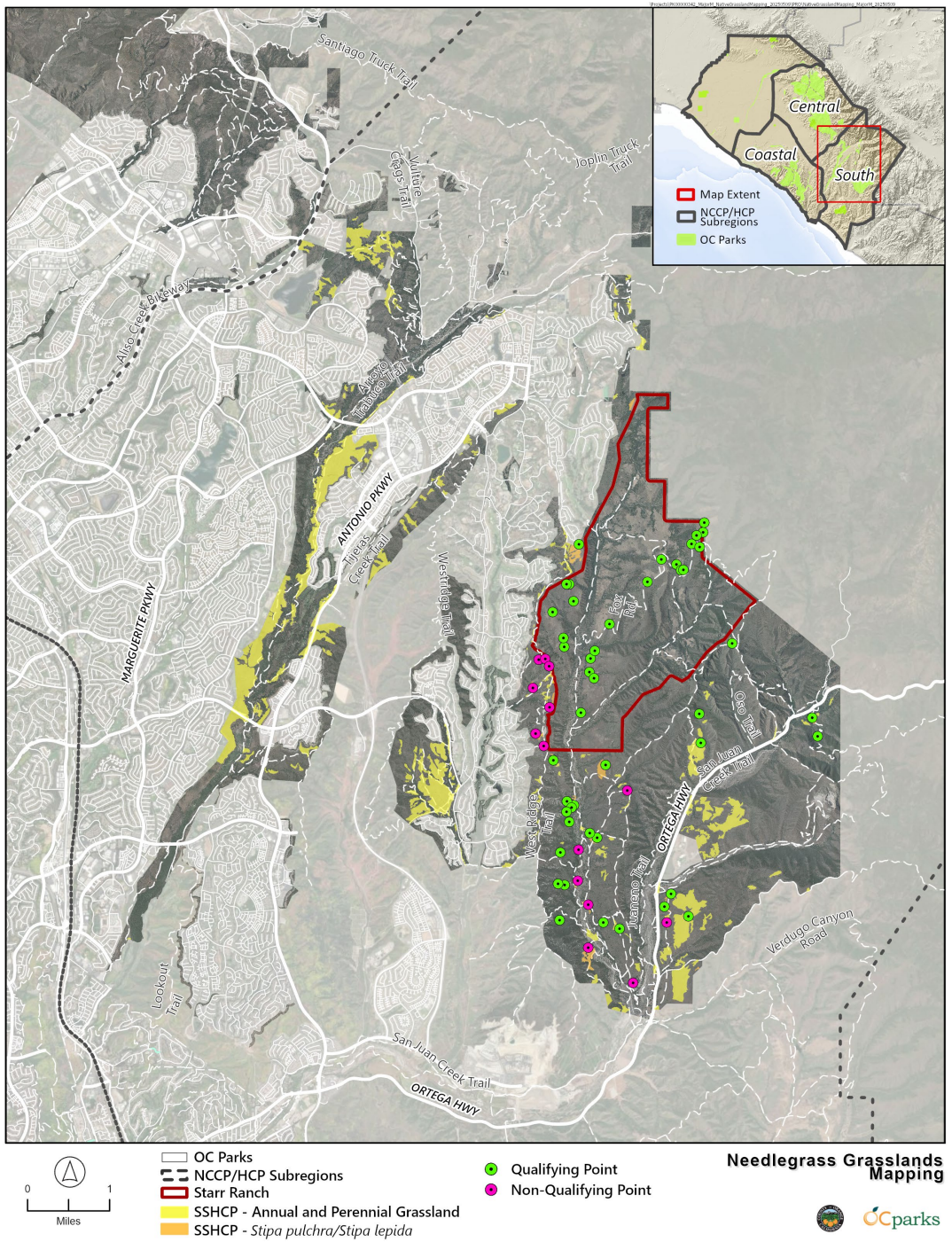
- Some *Stipa pulchra/Stipa lepida* polygons did not meet the criteria to be included as needlegrass grasslands

High-quality grasslands in Starr Ranch were surveyed

- Contributed to native species analyses and the SDM

Other parks were not surveyed

- Not enough time to visit all polygons



Future Directions

Expand surveys
- To improve the landscape inventory and the SDM
- Denser and broader sampling

Improve predictor data
- Find missing data
- Add other environmental variables

***Stipa pulchra* and *Sisyrinchium bellum* as co-dominants. Starr Ranch, April 2025.**

Modeling Methods: Address Correlation Among Predictor Variables

Remove highly correlated variables

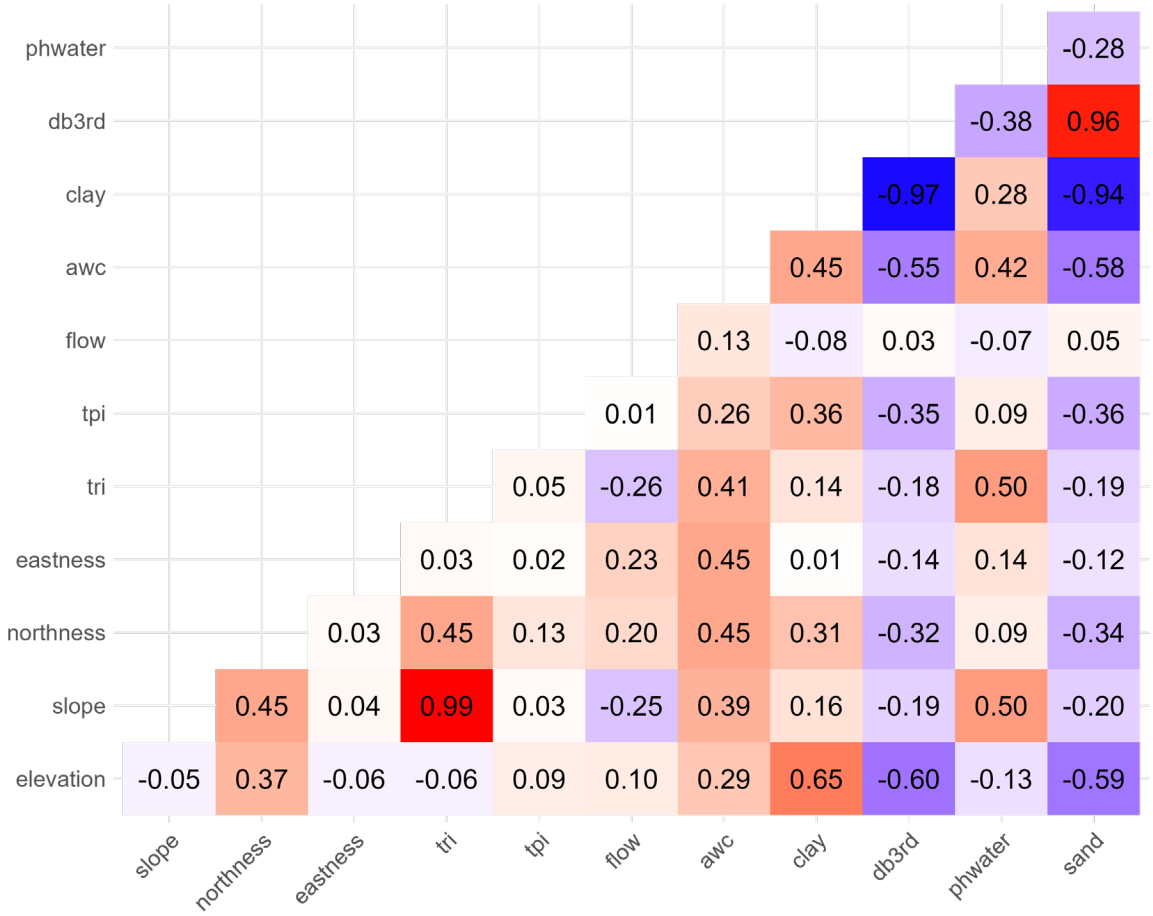
- Soil bulk density
- Clay
- Topographic roughness index

Remove variables with missing data at occurrence points

- Soil depth to any restrictive layer

Final variables used in the model

- Elevation
- Slope
- Northness
- Eastness
- Topographic position index
- Flow direction
- Soil available water capacity
- Soil pH
- Soil texture (% sand)



Environmental Variable Correlation Matrix heatmap

Modeling Methods: MaxEnt

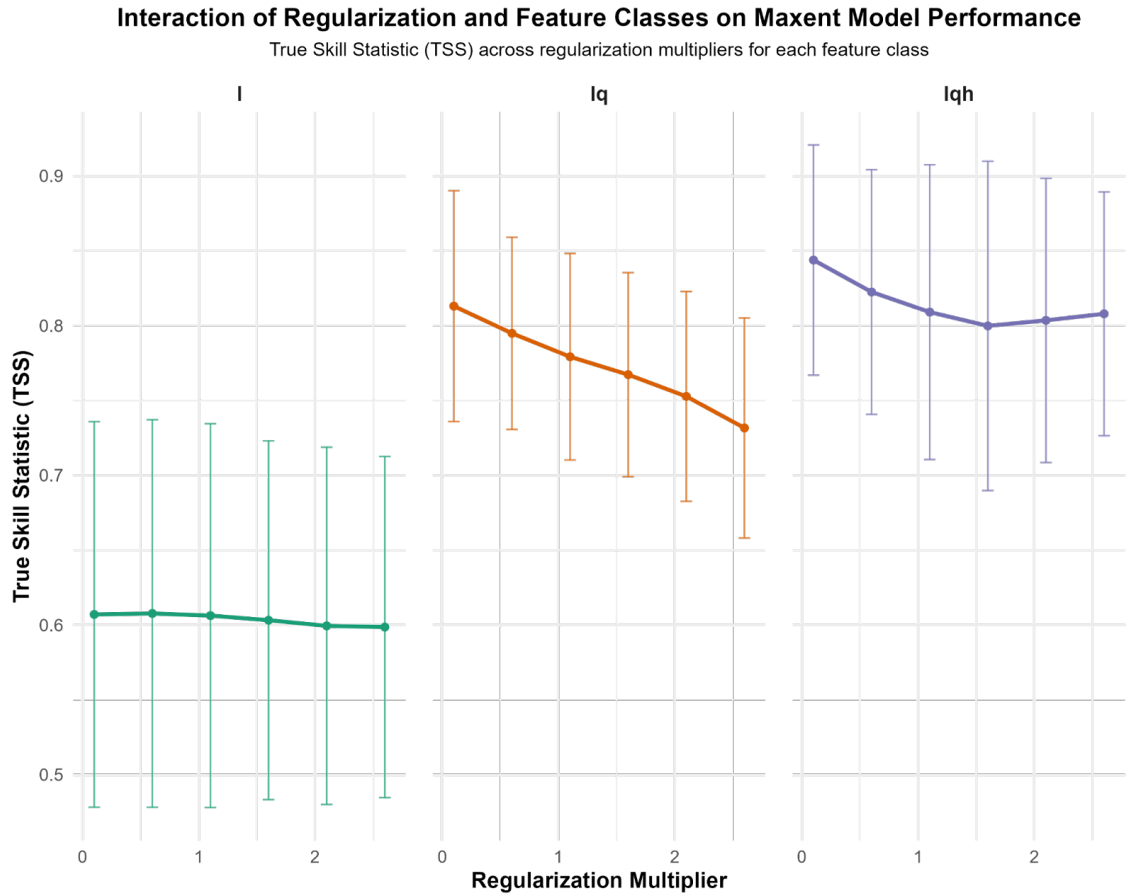
Sample background points
10,000 random points from across Orange County

Evaluate model performance using the flexsdm package in R
Randomly partitions occurrence data into training and testing subsets

Performance metrics:

- Area Under the Curve (AUC) = 0.95
- True Skill Statistic (TSS) = 0.84

Fit the model to balance complexity and performance
High response curve complexity (lqh)

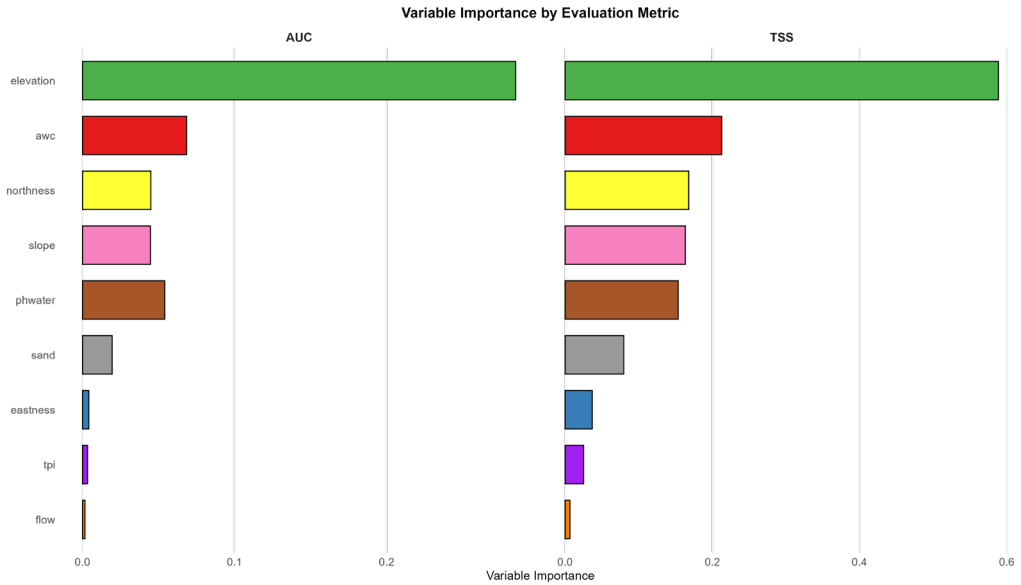


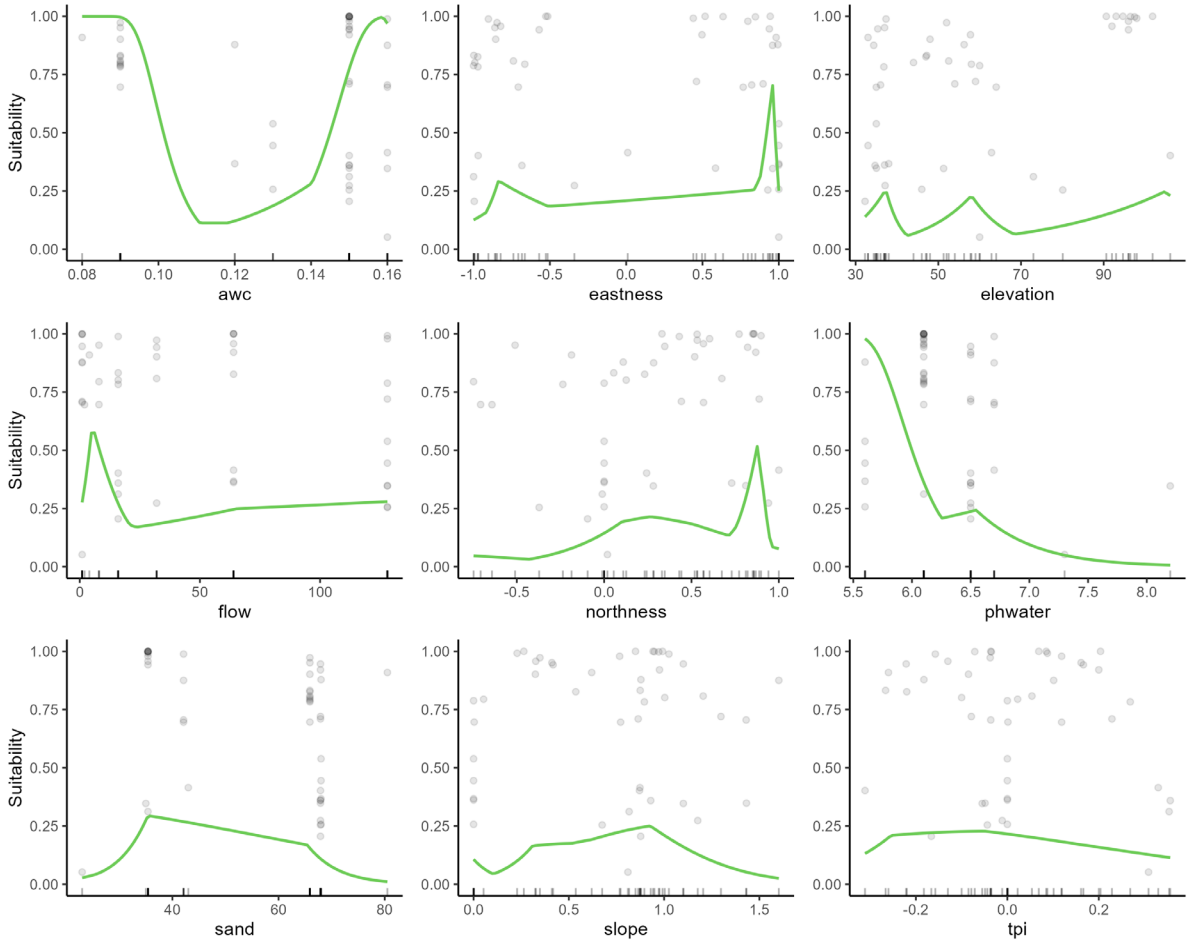
MaxEnt Model Performance

Model Outputs

High AUC (0.95) and TSS (0.84)
Strong model performance

Elevation most influential predictor
Notes





Partial Dependence Plots

Supplementary Tables and Figures

Table 3: Summary of Landscape Inventory Survey Effort.

Location	Number of SPSL Polygons Surveyed	Number of SPSL Polygons Surveyed that Qualified for MaxEnt	Number of APG Polygons Surveyed	Number of APG Polygons Surveyed that Qualified for MaxEnt	Total Number of SSHCP Polygons Surveyed	Number of Stewardship Areas Surveyed	Total Number of Points Collected	Total Number of Points Qualifying for MaxEnt	Number of Qualifying Points with CYNCAR in the Associated Polygon	Number of Points with More than 30% Cover of Stipa pulchra	Number of Points with Species Recorded and Incorporated into Data
Caspers	33	20	5	4	38	N/A	38	24	21	11	24
Starr Ranch	N/A	N/A	N/A	N/A	N/A	12	22	22	N/A	N/A	8
Combined Total	N/A	N/A	N/A	N/A	N/A	N/A	60	46	N/A	N/A	32

Supplementary Tables and Figures

Table 1: Digital Data Form Used in Field Maps. An electronic field tablet was used to collect data while surveying grasslands in the field. During and after walking through the entire polygon or stewardship area, the following fields were filled out. Vegetation cover was estimated using California Native Plant Society cover diagrams (CNPS, 2025).

Field	Description
GPS point (max Stipa cover)	Location of a 10m x 10m square representing the highest cover of needlegrass in the surveyed polygon or stewardship area
Max Stipa cover (%)	Estimated highest cover within the 10m x 10m square at GPS point (estimated in 5% increments if over 10%)
Average Stipa cover (%)	Estimated average cover within polygon or stewardship area (estimated in 5% increments if over 10%)
Stipa species	List of *Stipa* species (if identifiable) within polygon or stewardship area
Native herbaceous species	List of native herbaceous species (excluding all shrubby/woody species except *Ericameria* and *Isocoma*) within polygon or stewardship area
Structurally problematic invasive species	List of invasive species impacting structure (e.g., height of vegetation) within polygon or stewardship area
Dominant species	List of dominant species making up more than 20% cover within polygon or stewardship area
Average shrub/tree cover (%)	Estimated mean shrub cover within polygon or stewardship area (estimated in 5% increments if over 10%)
Notes	Additional observations (e.g., disturbance, bioturbation)
Photos	Photographic documentation

Supplementary Tables and Figures

Table 5: Maxent Model Parameter Setting Information and Performance Metrics. Performance metrics used in this study are highlighted.

parameter	value
regmult	0.1
classes	lqh
model	max
threshold	max_sens_spec
thr_value	0.205
n_presences	46
n_absences	7775
TPR_mean	0.956
TPR_sd	0.061
TNR_mean	0.888
TNR_sd	0.056
SORENSEN_mean	0.107
SORENSEN_sd	0.042
JACCARD_mean	0.057
JACCARD_sd	0.024
FPB_mean	0.114
FPB_sd	0.047
OR_mean	0.044
OR_sd	0.061
TSS_mean	0.844
TSS_sd	0.077
AUC_mean	0.949
AUC_sd	0.025
BOYCE_mean	0.939
BOYCE_sd	0.058
IMAE_mean	0.966
IMAE_sd	0.004

End

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