The Heart of Conservation

Engaging Human Passion for Conservation Success

John Vollmar, Principal Ecologist – Vollmar Natural Lands Consulting


Photo Credit: Doug Wirtz


Photo Credit: Trent Pearce


Photo Credit: Vernon Smith

China Hat Ridge Vernal Pool Landscape
Chance Ranch Preserve, Eastern Merced Co.

Photo Credit: Evan Keeler-Wolf


3301
DEL ORO
HIGH SCHOOL


Photo Credit: Doug Wirtz

Early VNLC Team in East Merced Playa Pool


TIM VENDLINSKI
U.S. ENVIRONMENTAL PROTECTION AGENCY


East Merced
Resource Conservation District
Photo Credit: Evan Keeler-Wolf

East Merced Resource Conservation District

GOAL: Conserve 30,000 acres of Vernal Pool Habitat

Photo Credit: Evan Keeler-Wolf

Most Vernal Pool Habitat in the Great Valley in on Private Ranches and Requires the Willing Private Ranchers to Conserve the Habitat

Photo Credit: Anton Bokisch

East Merced Resource Conservation District

GOAL: Conserve 30, 000 acres of Vernal Pool Habitat

- Region has Largest Remaining Block of Hardpan Vernal Pool Habitat in State

Photo Credit: Evan Keeler-Wolf

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- Region has Largest Remaining Block of Hardpan Vernal Pool Habitat in State
- New University of California (UC Merced) Proposed in Heart of Habitat Block

Photo Credit: Evan Keeler-Wolf

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- Region has Largest Remaining Block of Hardpan Vernal Pool Habitat in State
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- Conservation-minded Ranching Families

Photo Credit: Evan Keeler-Wolf

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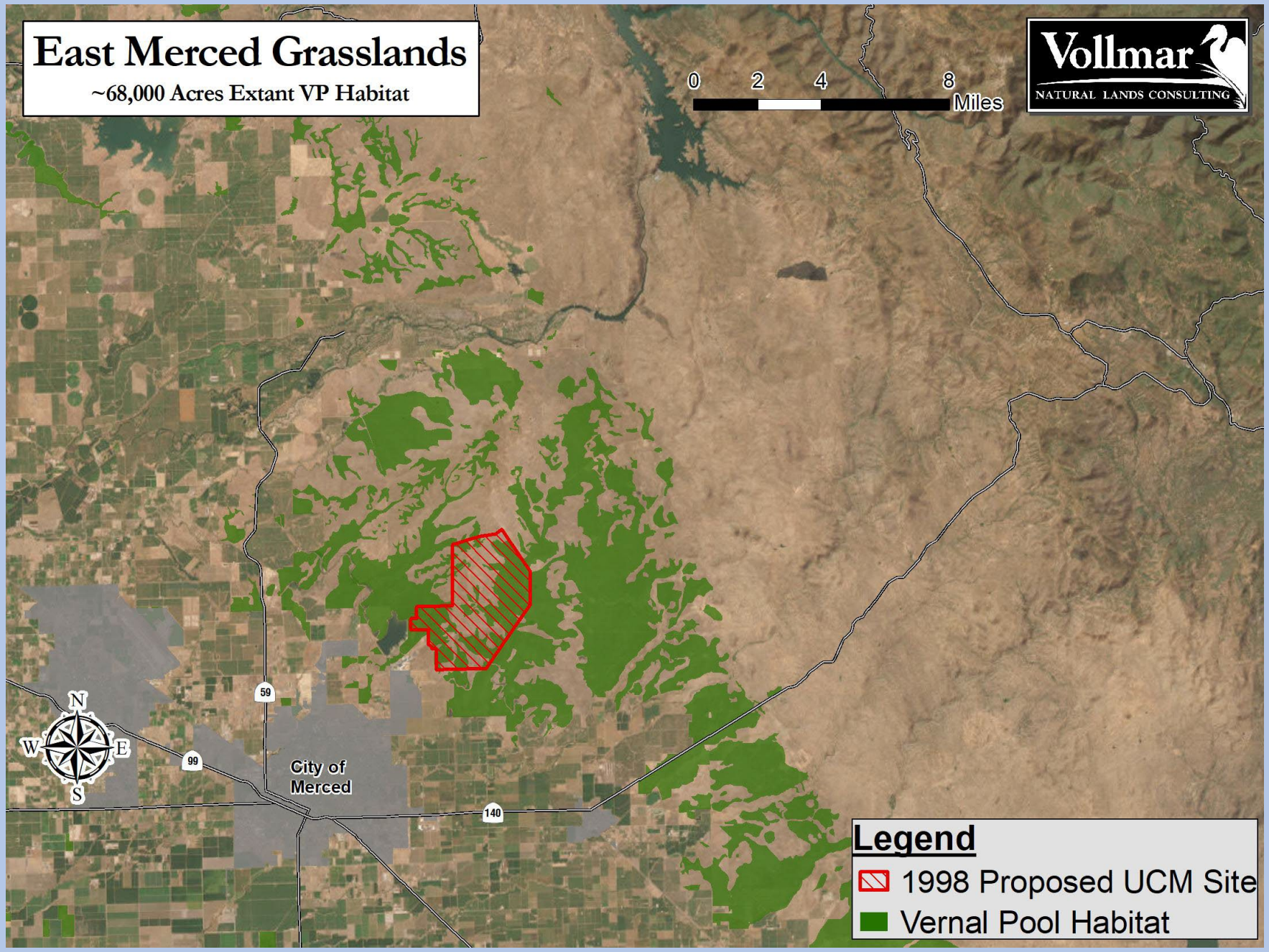
GOAL: Conserve 30, 000 acres of Vernal Pool Habitat

- Region has Largest Remaining Block of Hardpan Vernal Pool Habitat in State
- New University oif Calfornia (UC Merced) Proposed in Heart of Habitat Block
- Conservation-minded Ranching Families
- Extraordinary Landscapes Ignited a Passion in Me to Conserve Them

Photo Credit: Evan Keeler-Wolf


East Merced Grasslands
~68,000 Acres Extant VP Habitat
0 2 4 8
Miles
Vollmar
NATURAL LANDS CONSULTING
N
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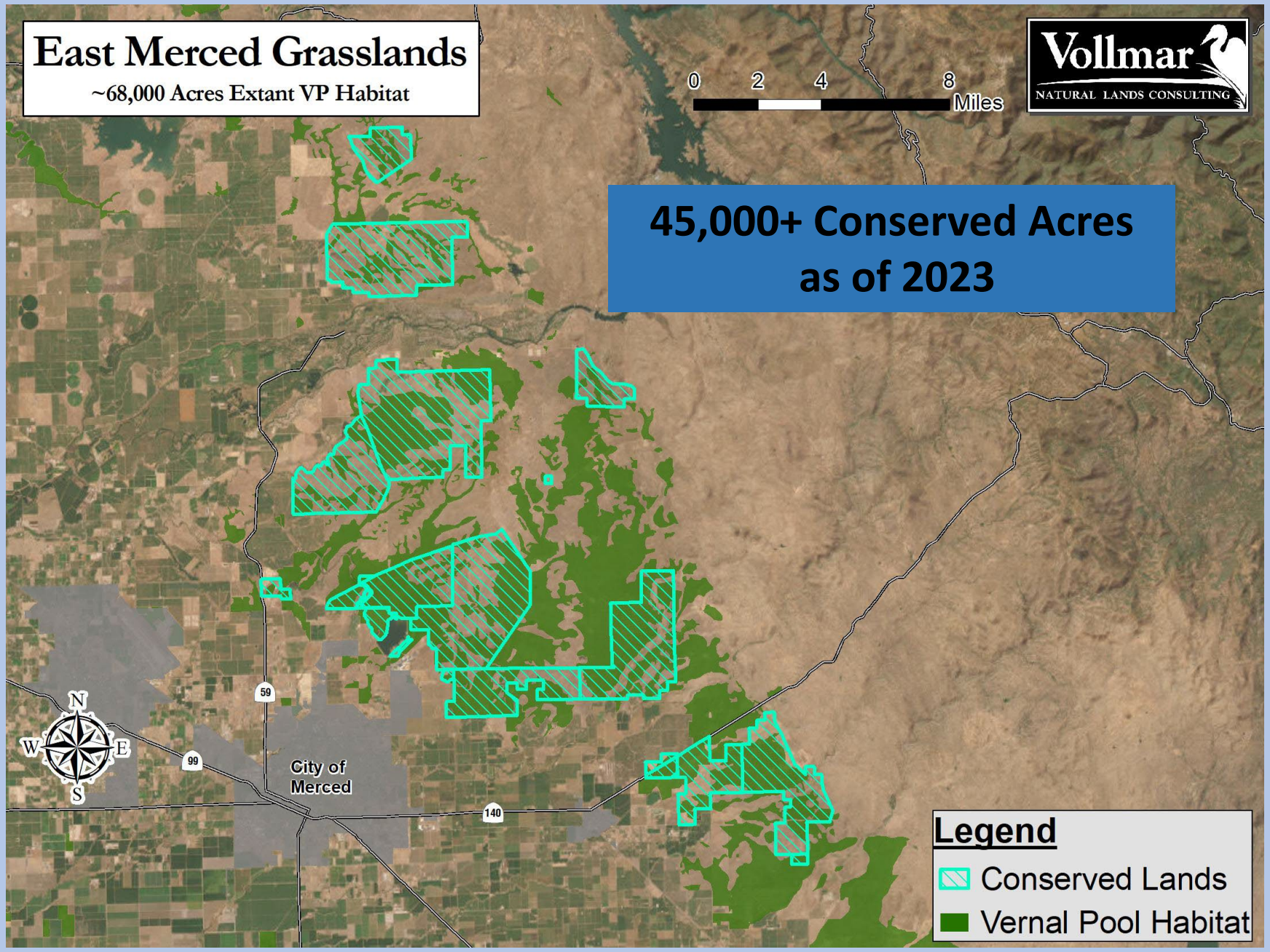
59
99
140
City of
Merced
Legend
1998 Proposed UCM Site
Vernal Pool Habitat


Chance Snelling Ranch
Northeastern Merced County, CA
Photo Credit: Evan Keeler-Wolf


East Merced Grasslands
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0 2 4 8 Miles
Vollmar
NATURAL LANDS CONSULTING
45,000+ Conserved Acres
as of 2023
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59
99
140
City of
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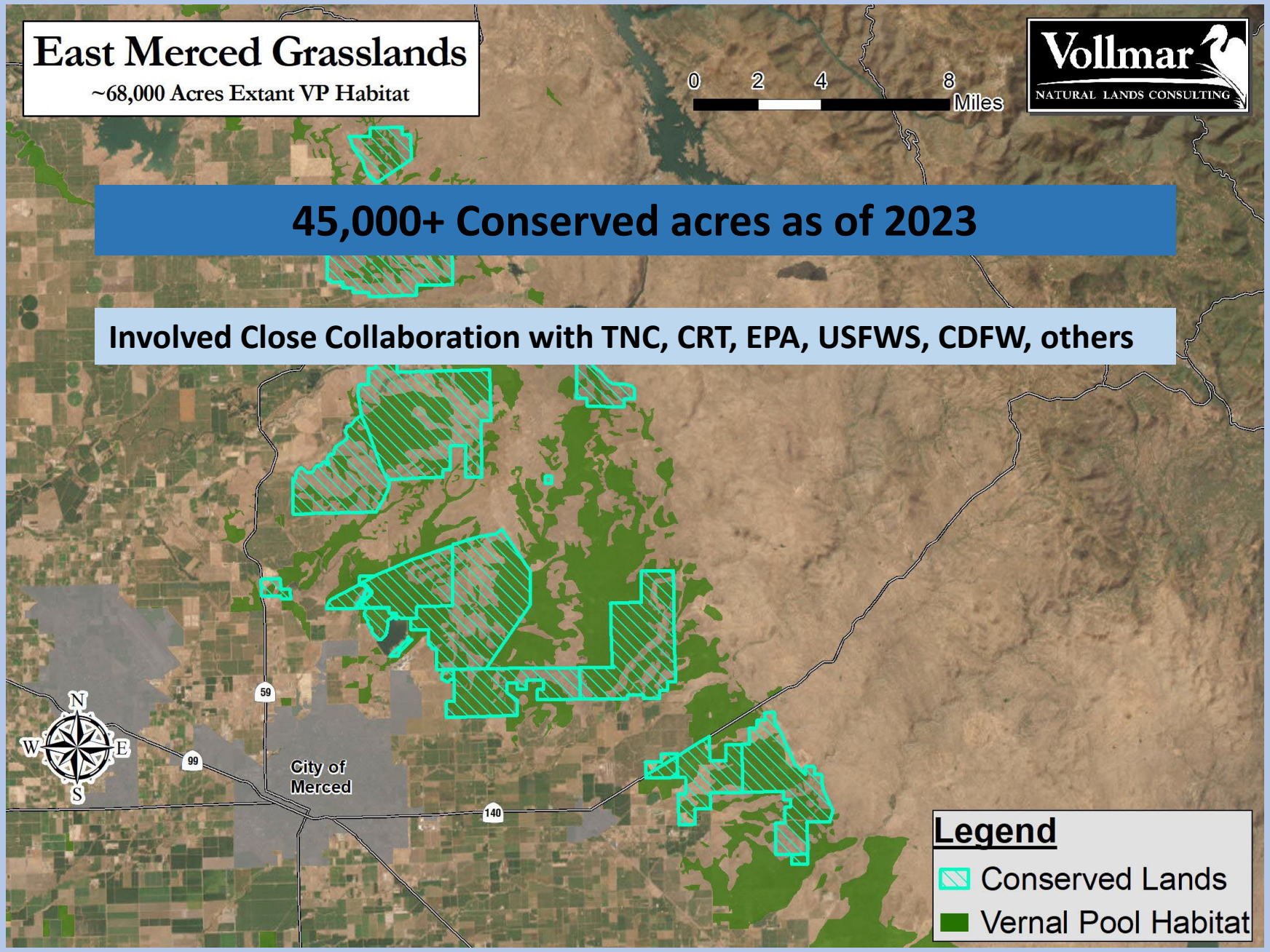
Legend
Conserved Lands
Vernal Pool Habitat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NATURAL LANDS CONSULTING
45,000+ Conserved acres as of 2023
Involved Close Collaboration with TNC, CRT, EPA, USFWS, CDFW, others
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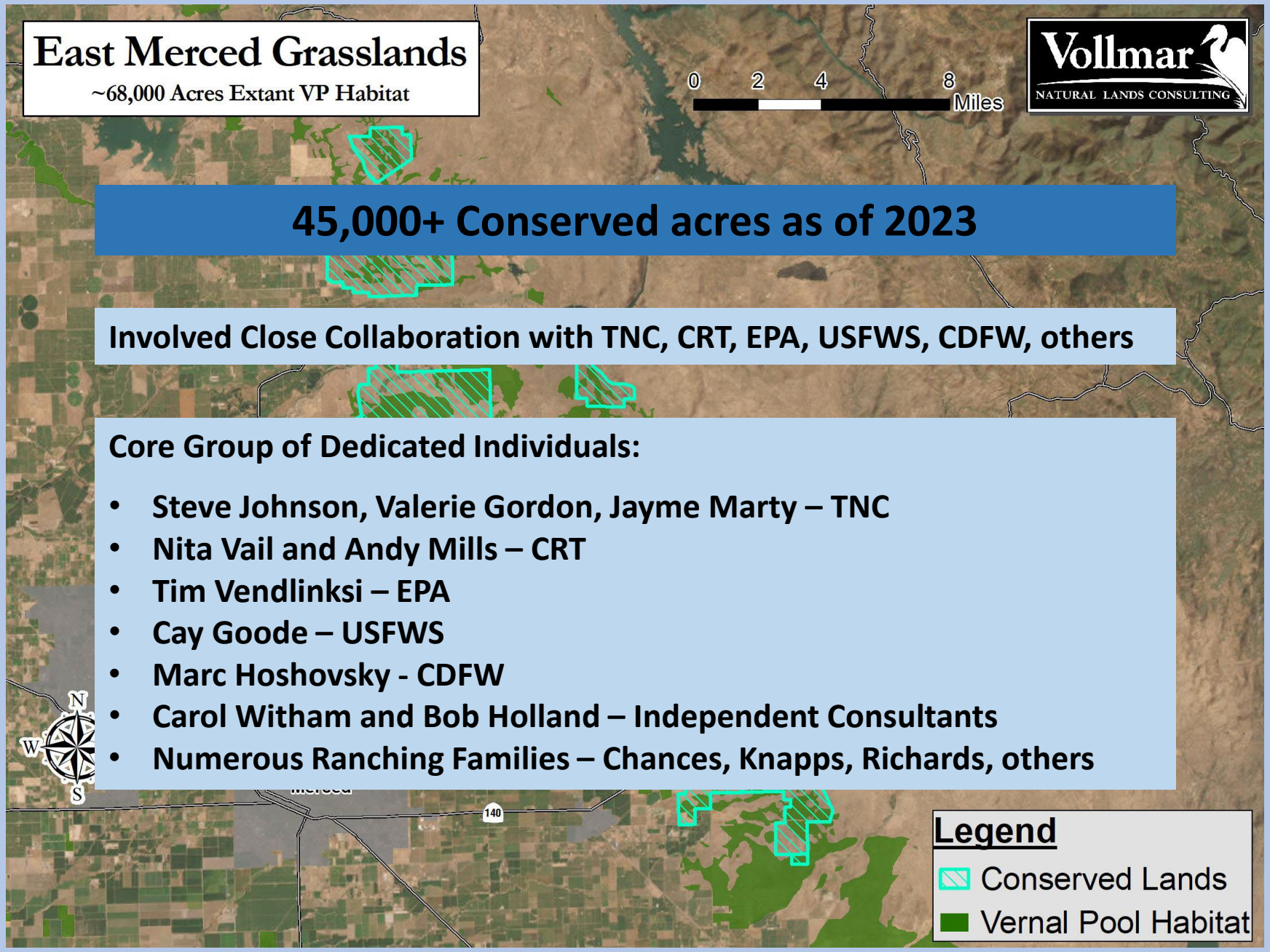
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0 2 4 8 Miles
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NATURAL LANDS CONSULTING
45,000+ Conserved acres as of 2023
Involved Close Collaboration with TNC, CRT, EPA, USFWS, CDFW, others
Core Group of Dedicated Individuals:
• Steve Johnson, Valerie Gordon, Jayme Marty – TNC
• Nita Vail and Andy Mills – CRT
• Tim Vendlinksi – EPA
• Cay Goode – USFWS
• Marc Hoshovsky - CDFW
• Carol Witham and Bob Holland – Independent Consultants
• Numerous Ranching Families – Chances, Knapps, Richards, others
N
W
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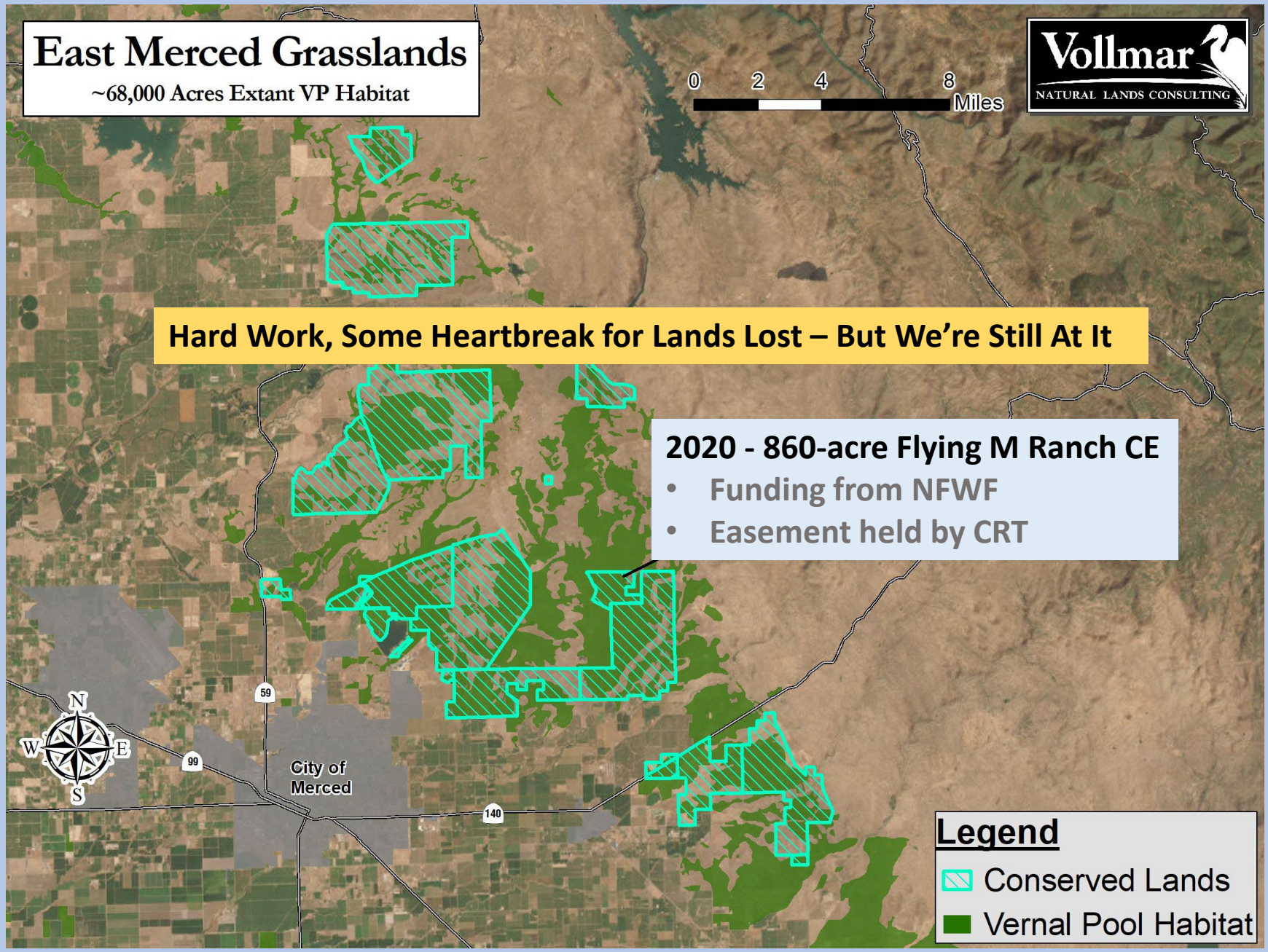
140
Legend
Conserved Lands
Vernal Pool Habitat


East Merced Grasslands
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0 2 4 8 Miles
Vollmar
NATURAL LANDS CONSULTING
Hard Work, Some Heartbreak for Lands Lost – But We're Still At It
2020 - 860-acre Flying M Ranch CE
• Funding from NFWF
• Easement held by CRT
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City of Merced
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Conserved Lands
Vernal Pool Habitat

EPA STUDY ELEMENTS

- Acreage and Distribution of Conserved VP Habitat
- Owners of Conserved Lands
- Easement Holders
- Funding Sources

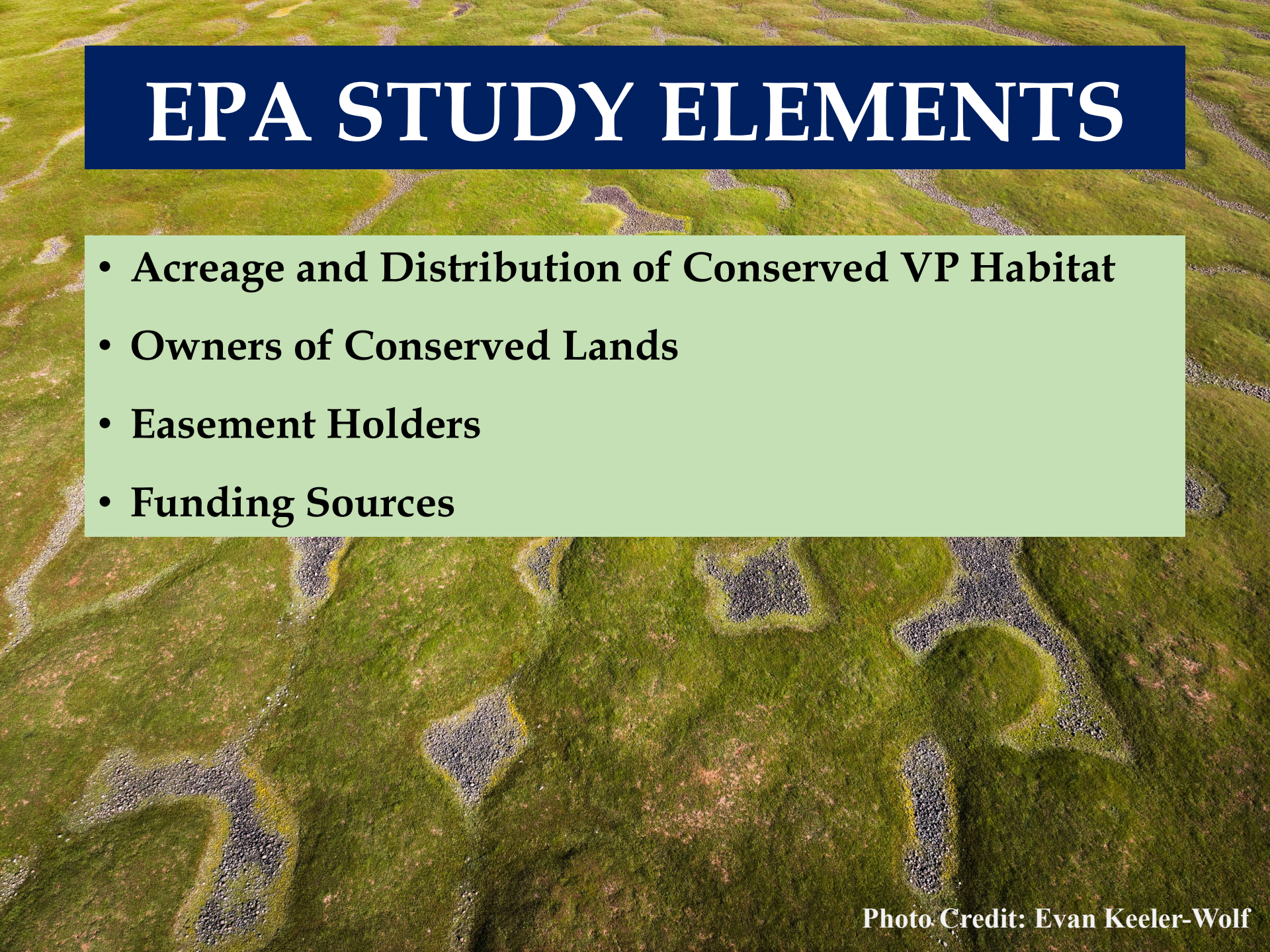


Photo Credit: Evan Keeler-Wolf

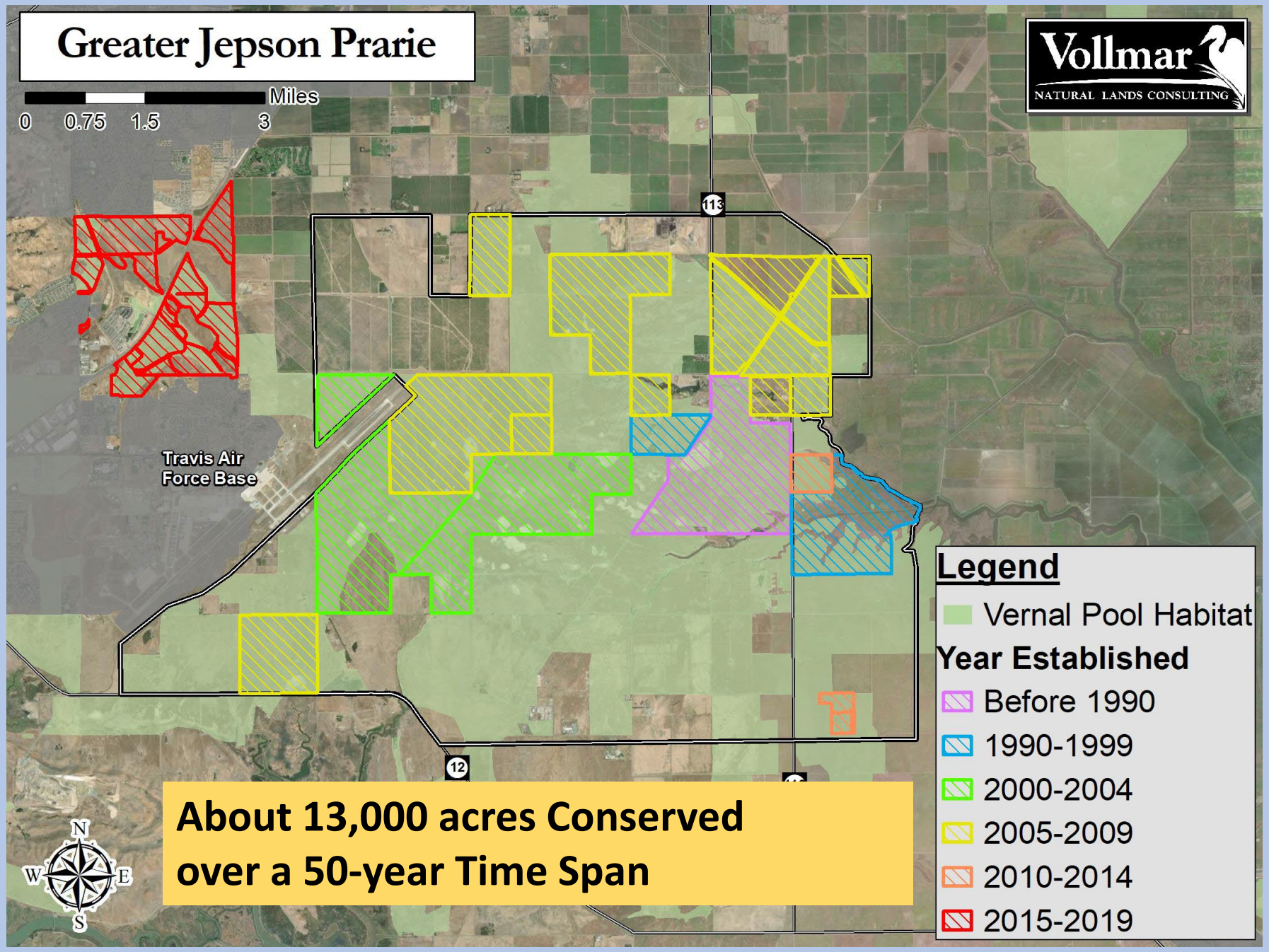
EPA STUDY ELEMENTS

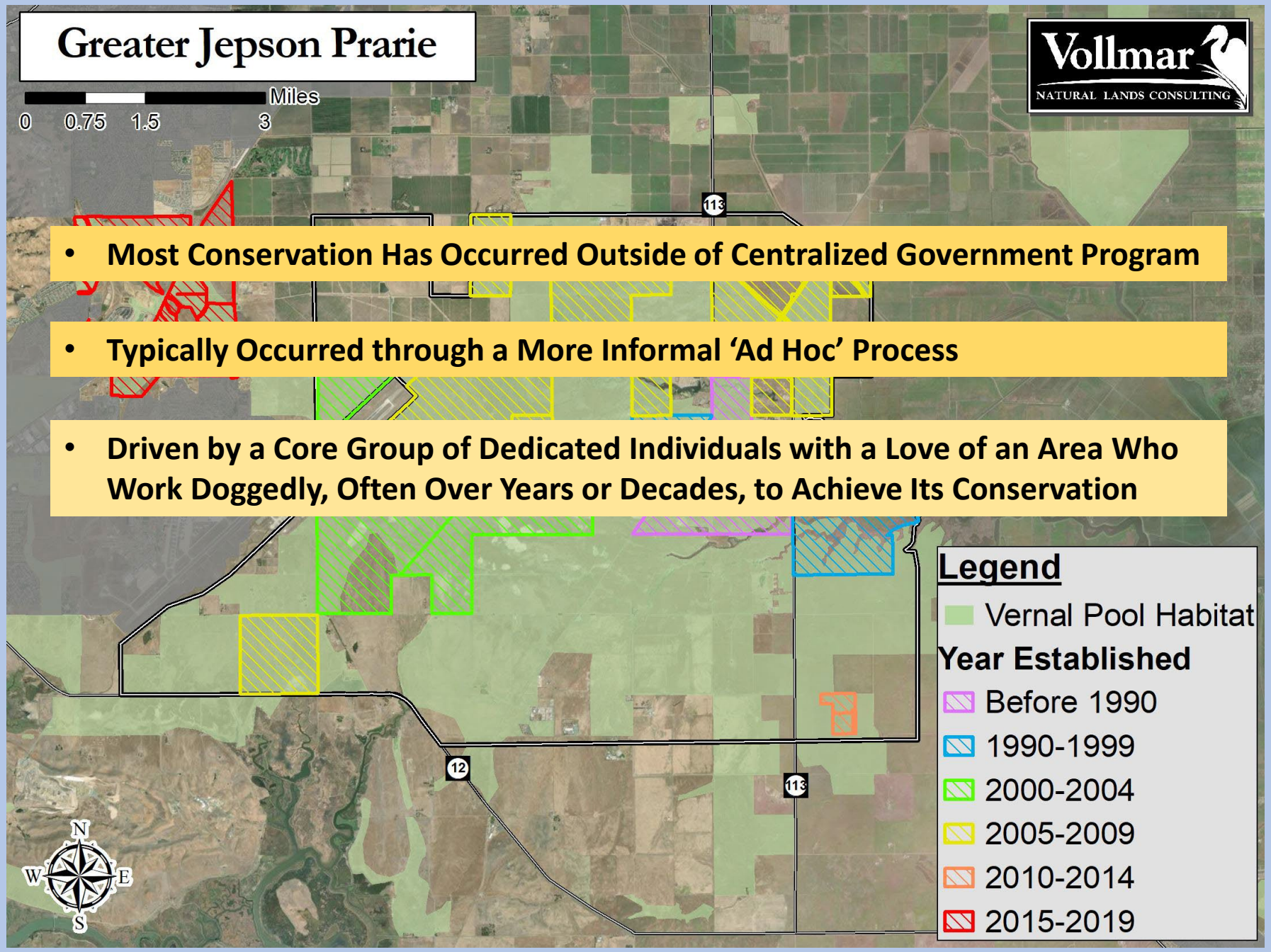
- Acreage and Distribution of Conserved Habitat
- Landowners of Conserved Lands
- Conservation Instruments/Easement Holders
- Funding Sources

Two papers published in 2018 Chico State Vernal Pool Conference Proceedings

- First Paper: Summary of Findings
- Second Paper: Profile of Conservation Process in East Merced Grasslands and Greater Jepson Prairie

Photo Credit: Evan Keeler-Wolf


Greater Jepson Prarie
Miles
0 0.75 1.5 3
Vollmar
NATURAL LANDS CONSULTING
Travis Air Force Base
113
12
Legend
Vernal Pool Habitat
Year Established
Before 1990
1990-1999
2000-2004
2005-2009
2010-2014
2015-2019
N
W
E
S
About 13,000 acres Conserved over a 50-year Time Span


Greater Jepson Prarie
Miles
0 0.75 1.5 3
Vollmar
NATURAL LANDS CONSULTING
• Most Conservation Has Occurred Outside of Centralized Government Program
• Typically Occurred through a More Informal 'Ad Hoc' Process
• Driven by a Core Group of Dedicated Individuals with a Love of an Area Who Work Doggedly, Often Over Years or Decades, to Achieve Its Conservation
Legend
Vernal Pool Habitat
Year Established
Before 1990
1990-1999
2000-2004
2005-2009
2010-2014
2015-2019
N
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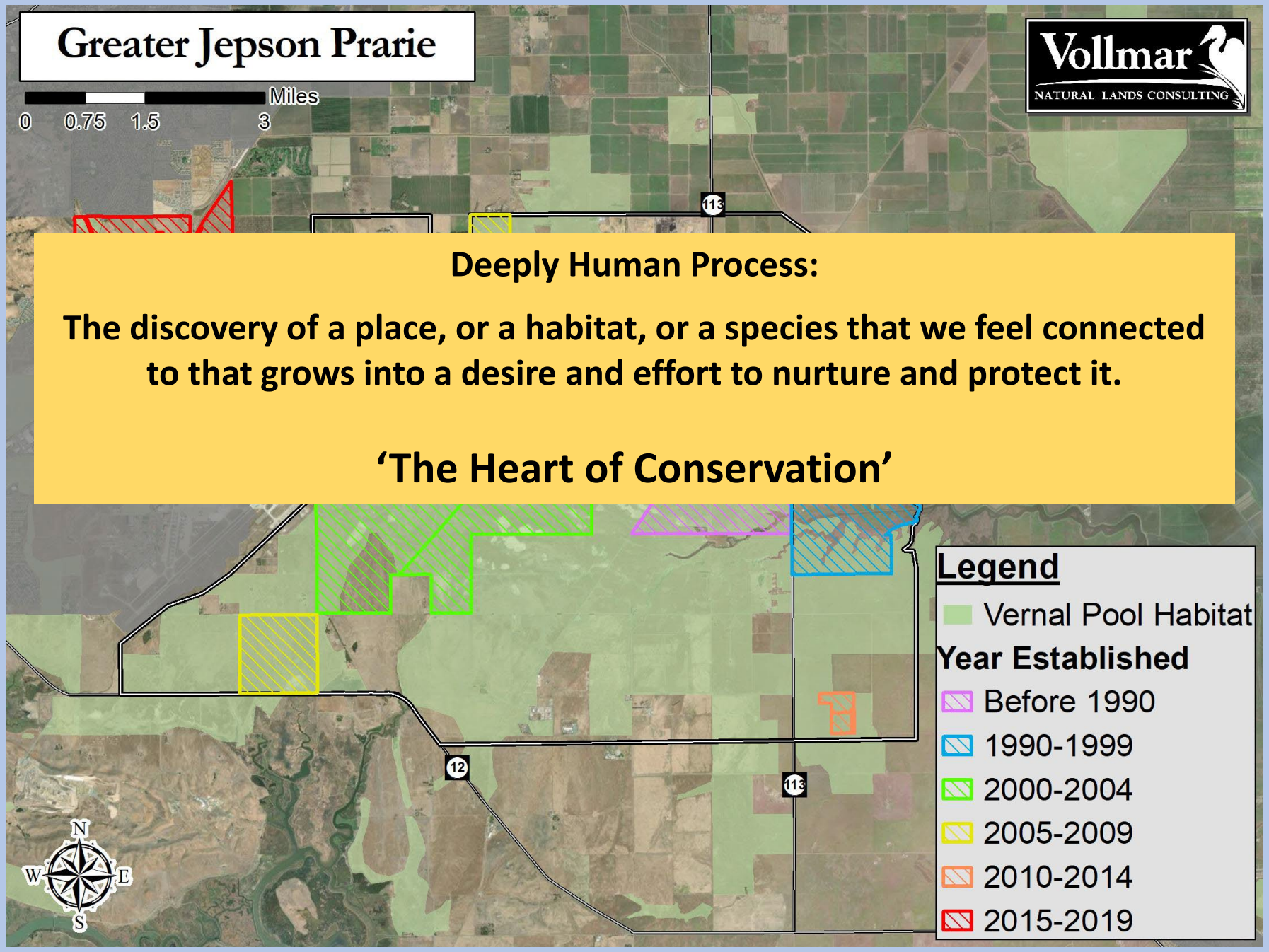
S
12
113
113


Greater Jepson Prarie
Miles
0 0.75 1.5 3
Vollmar
NATURAL LANDS CONSULTING
113
Deeply Human Process:
The discovery of a place, or a habitat, or a species that we feel connected to that grows into a desire and effort to nurture and protect it.
'The Heart of Conservation'
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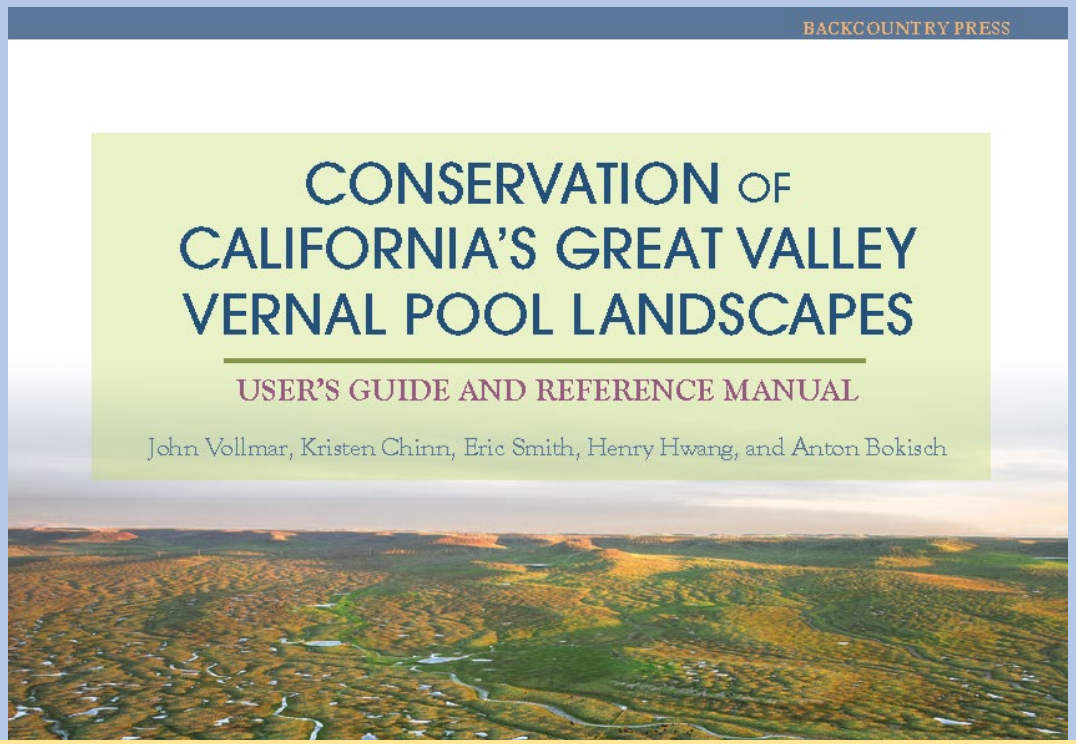
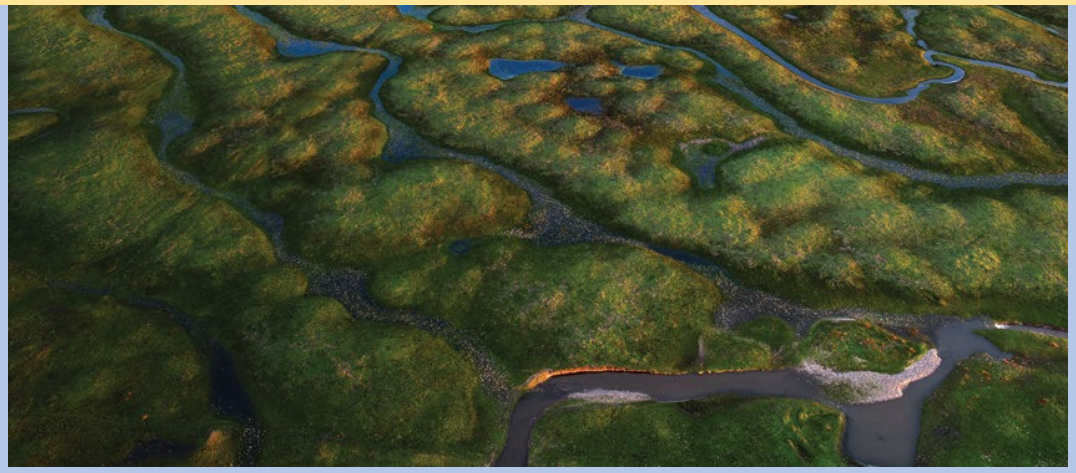


Specifically Crafted to Promote and Guide the Ad Hoc Conservation Process



Main Topics of Presentation

- Tell the Story of Habitat Conservation in Eastern Merced County to Highlight the 'Ad Hoc' Conservation Process
- Give a Brief Overview of Our New Conservation Guide to Entice You to Read It, Use It, and Incorporate Its Concepts into Your Own Work

Photo Credit: Evan Keeler-Wolf

Main Topics of Presentation

- Tell the Story of Habitat Conservation in Eastern Merced County to Highlight the 'Ad Hoc Conservation Process'
- Give a Brief Overview of Our New Conservation Guide to Entice You to Read It, Use It, and Incorporate Its Concepts into Your Own Work
- Goal: Hone Your Awareness of Our Individual Impact as Conservationists Wherever You May Work - and Inspire You to Dedicate Yourself to Helping Conserve a Natural Area You Love over the Next Decade or More – Maybe Even A Vernal Pool Landscape!

Photo Credit: Evan Keeler-Wolf


Photo Credit: David Rosen


Photo Credit: Evan Keeler-Wolf

Photo Credit: Doug Wirtz

Delta green ground beetle
(*Elaphrus viridis*)

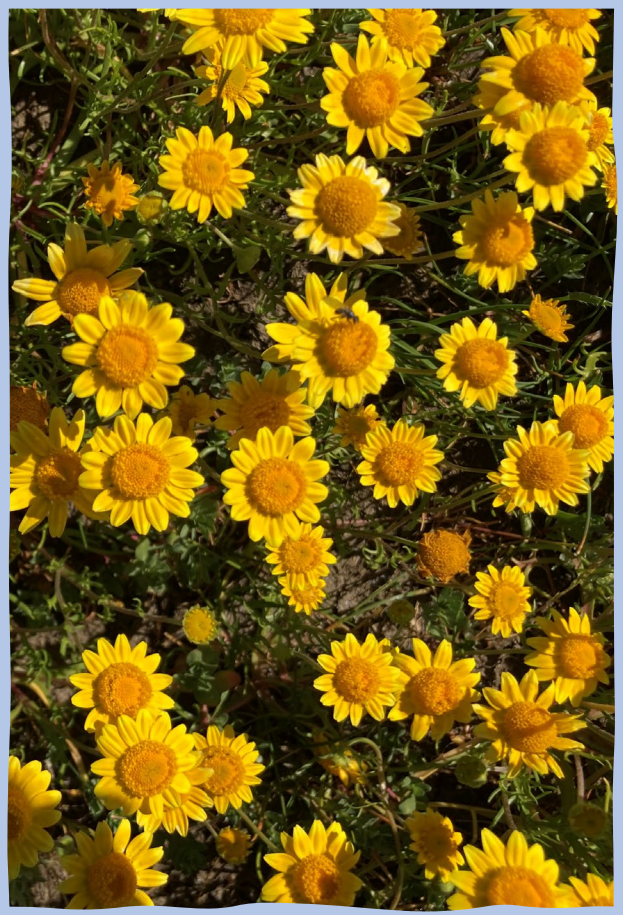


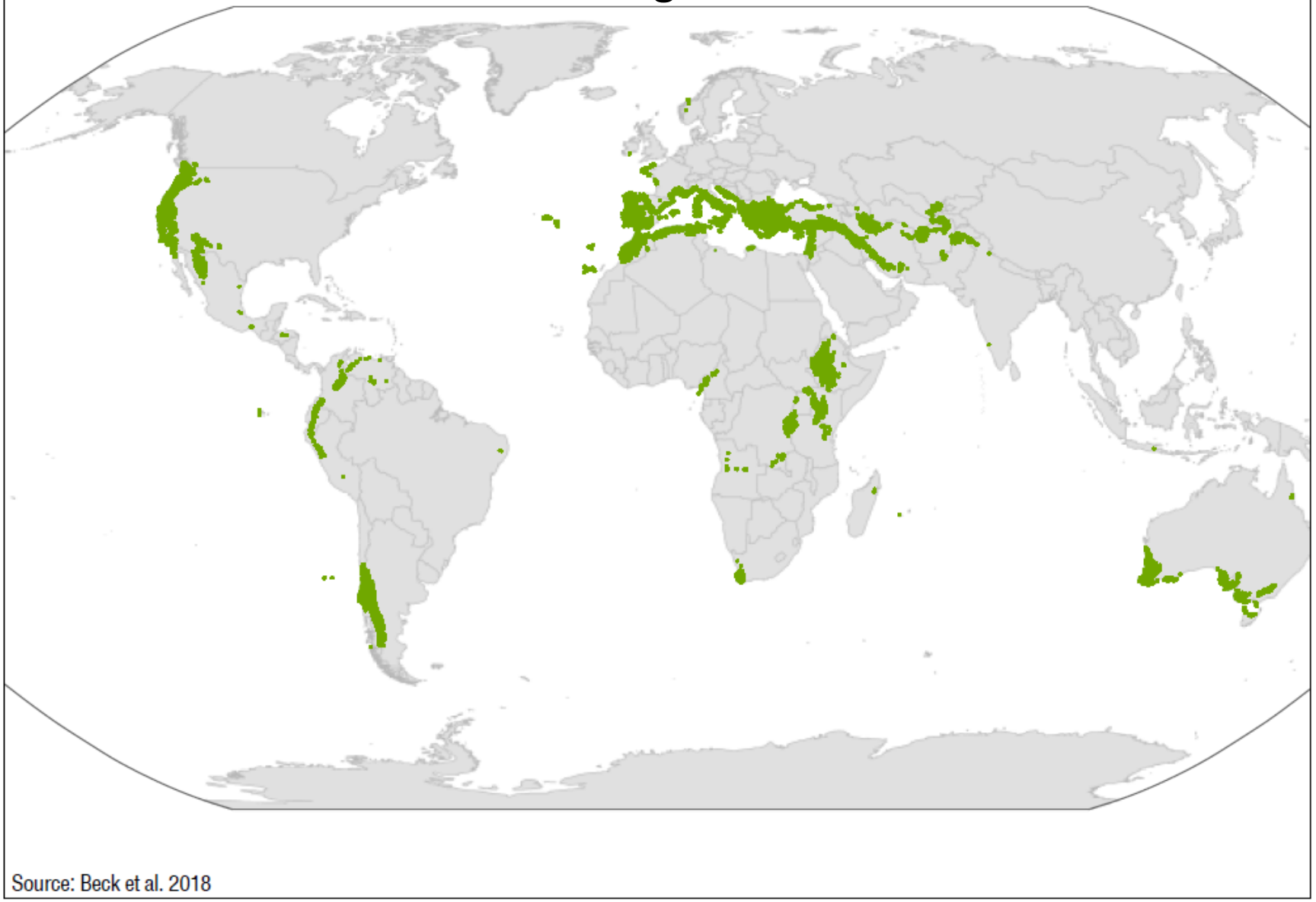
Photo Credit: John Vollmar

Contra Costa goldfields
(*Lasthenia conjugens*)

Photo Credit: Doug Wirtz

California tiger salamander
(*Ambystoma californiense*)

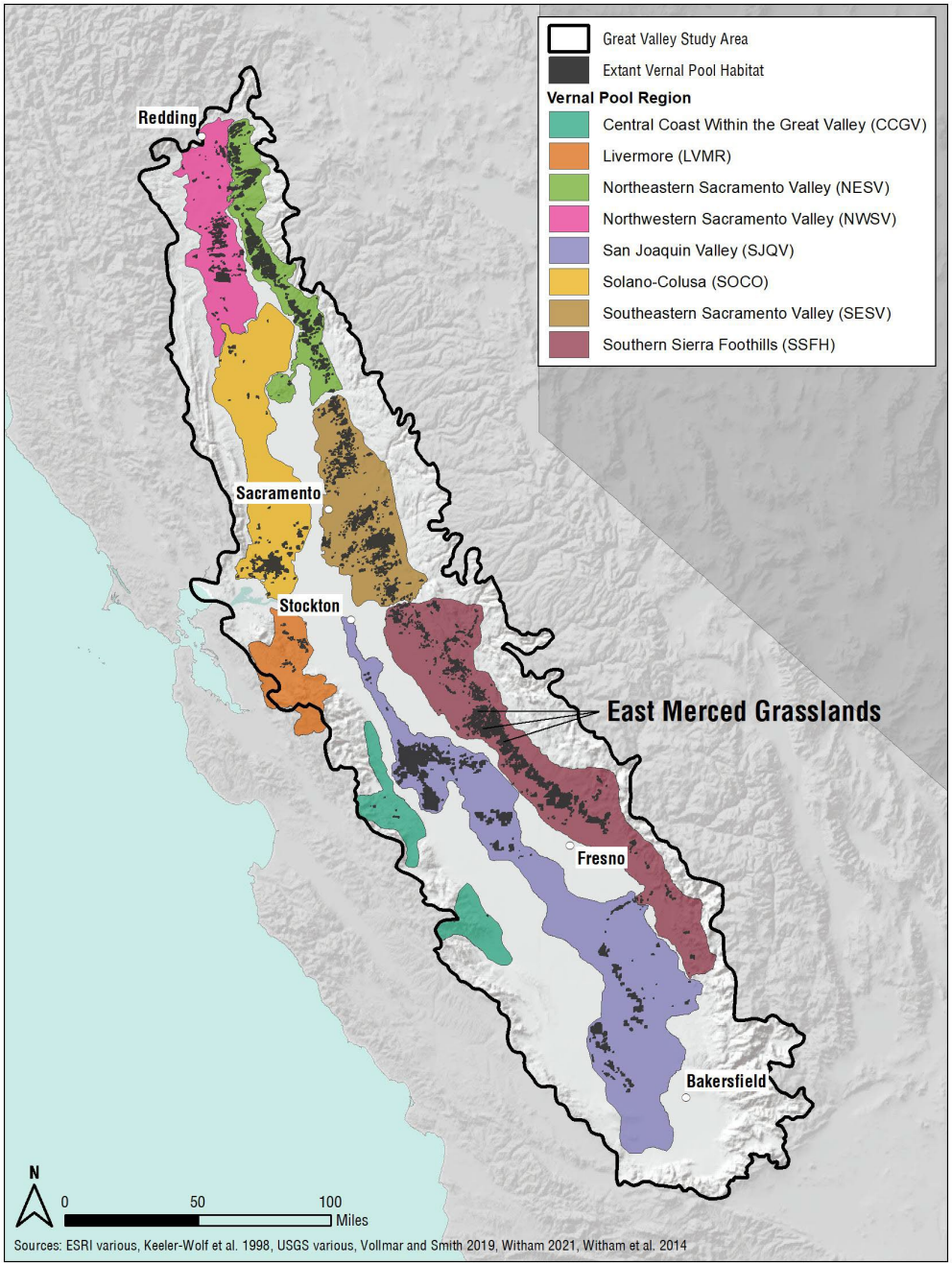
Mediterranean Regions of the World

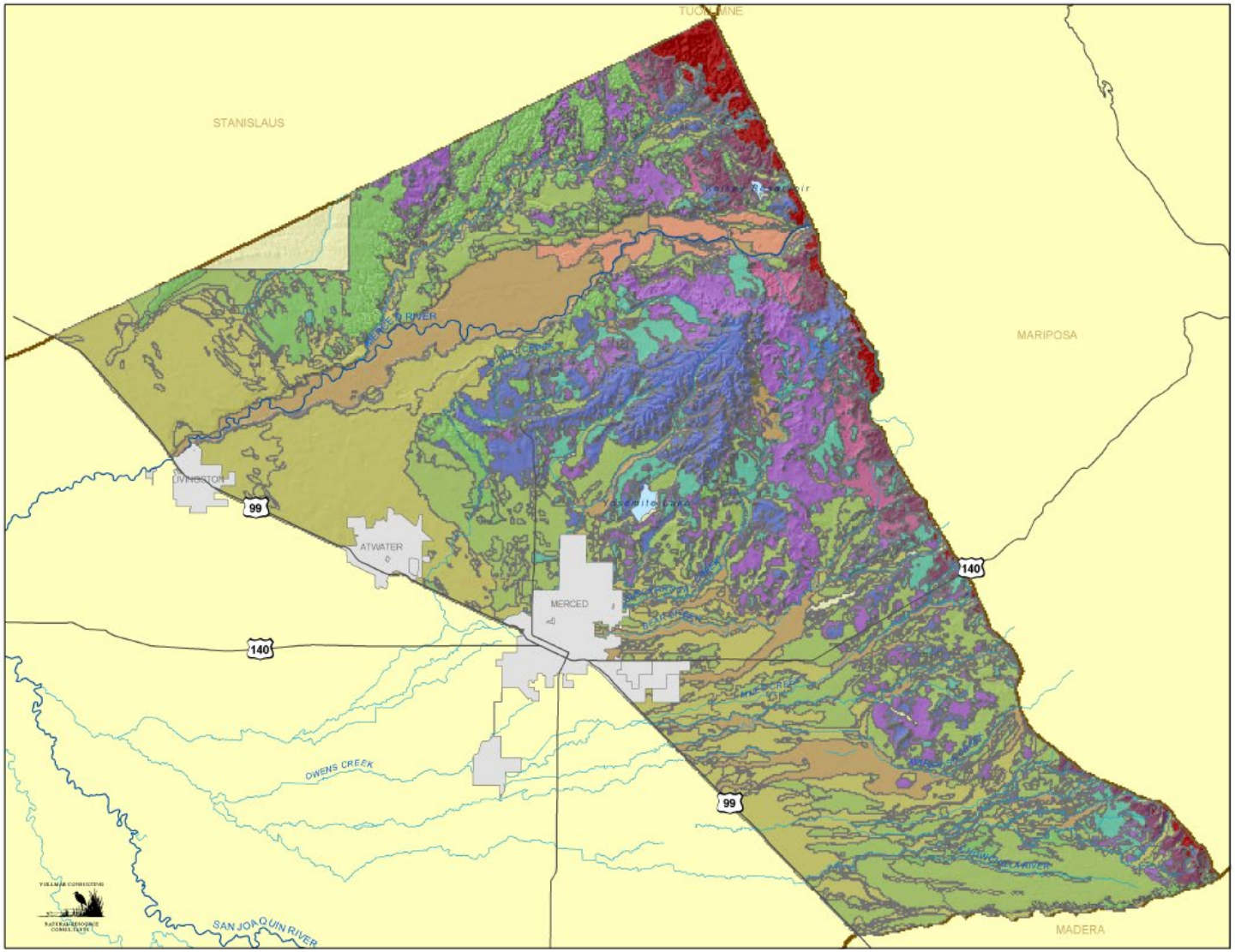


Source: Beck et al. 2018

17 Vernal Pool Regions of California


Photo Credit: Evan Keeler-Wolf


Great Valley Study Area
Extant Vernal Pool Habitat
Vernal Pool Region
Central Coast Within the Great Valley (CCGV)
Livermore (LVMR)
Northeastern Sacramento Valley (NESV)
Northwestern Sacramento Valley (NWSV)
San Joaquin Valley (SJQV)
Solano-Colusa (SOCO)
Southeastern Sacramento Valley (SESV)
Southern Sierra Foothills (SSFH)
Redding
Sacramento
Stockton
East Merced Grasslands
Fresno
Bakersfield
N
0
50
100
Miles
Sources: ESRI various, Keeler-Wolf et al. 1998, USGS various, Vollmar and Smith 2019, Witham 2021, Witham et al. 2014



Eastern Merced County

Major Geologic Surfaces

N

0 1.5 3 6 9 Kilometers

0 1 2 4 6 Miles

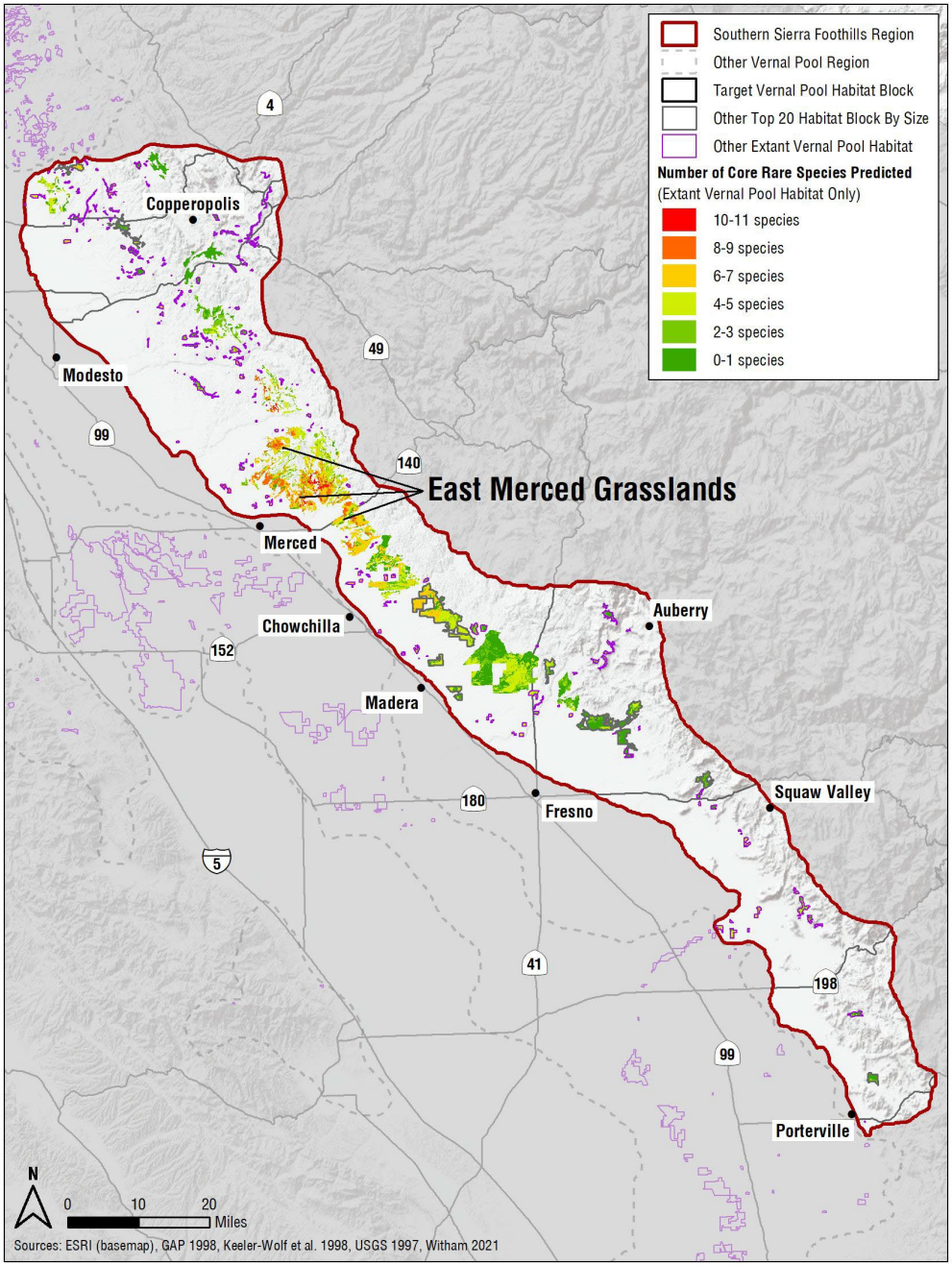
Legend

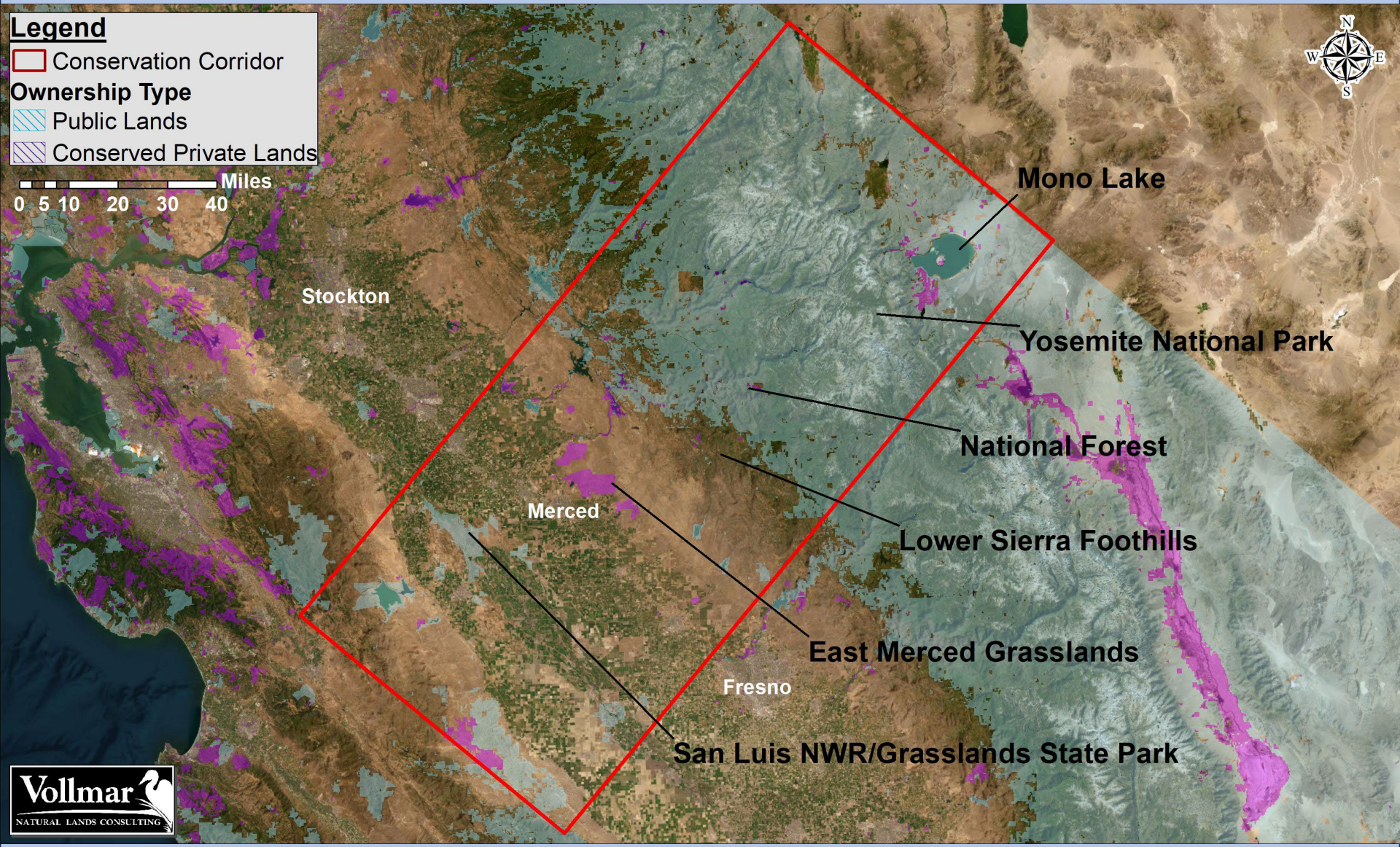
- Mesozoic intrusive
- Ione
- Valley Springs
- Mehrten
- Laguna
- North Merced Gravel
- Turlock Lake
- Riverbank
- Modesto
- Holocene alluvium
- Dredge Tailings
- Undescribed

Data Sources: Geology - Marchand 1976a-f; Streams, Rivers, City Limits and Highways, MCAG.
Data Projection: Teale Albers, Units Meters, NAD27

Map Produced by Metz Consulting, 11/15/2001

Southern Sierra Foothill (SSFH) core species hot spot map




Legend
Conservation Corridor
Ownership Type
Public Lands
Conserved Private Lands
Miles
0 5 10 20 30 40
N
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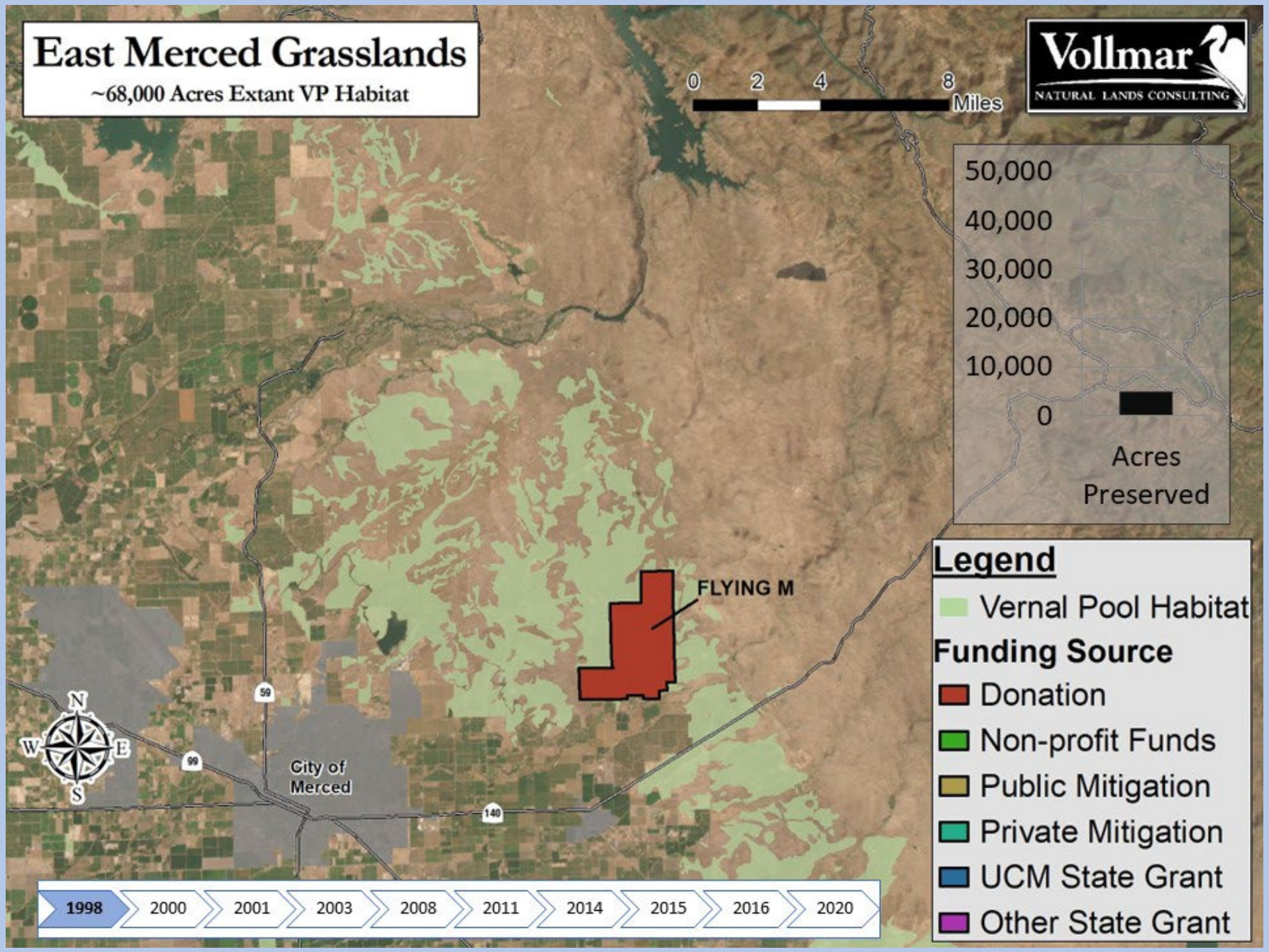
Mono Lake
Yosemite National Park
National Forest
Lower Sierra Foothills
East Merced Grasslands
San Luis NWR/Grasslands State Park
Stockton
Merced
Fresno
Vollmar
NATURAL LANDS CONSULTING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Miles
Vollmar
NATURAL LANDS CONSULTING
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Acres Preserved
FLYING M
Legend
Vernal Pool Habitat
Funding Source
Donation
Non-profit Funds
Public Mitigation
Private Mitigation
UCM State Grant
Other State Grant
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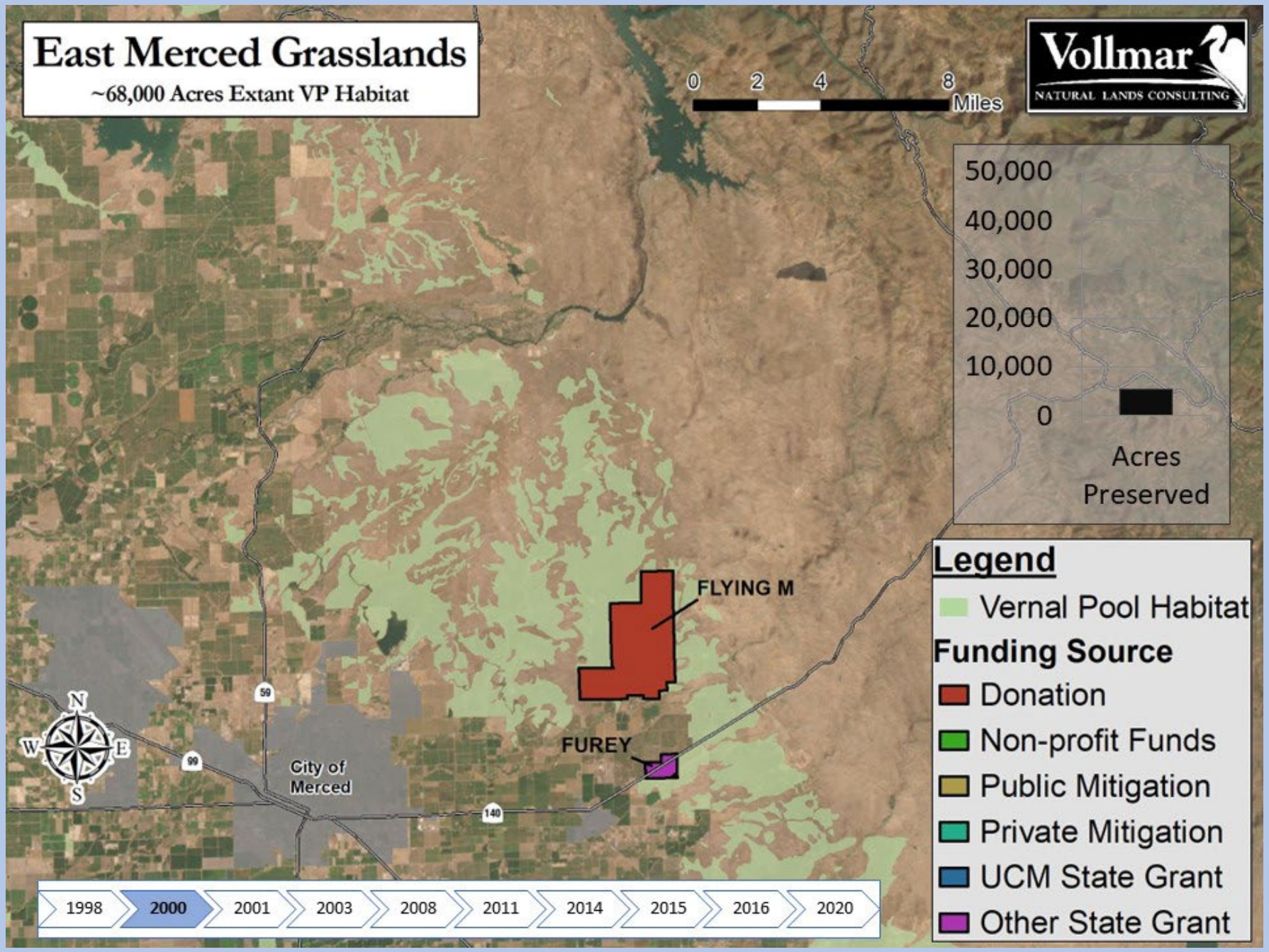
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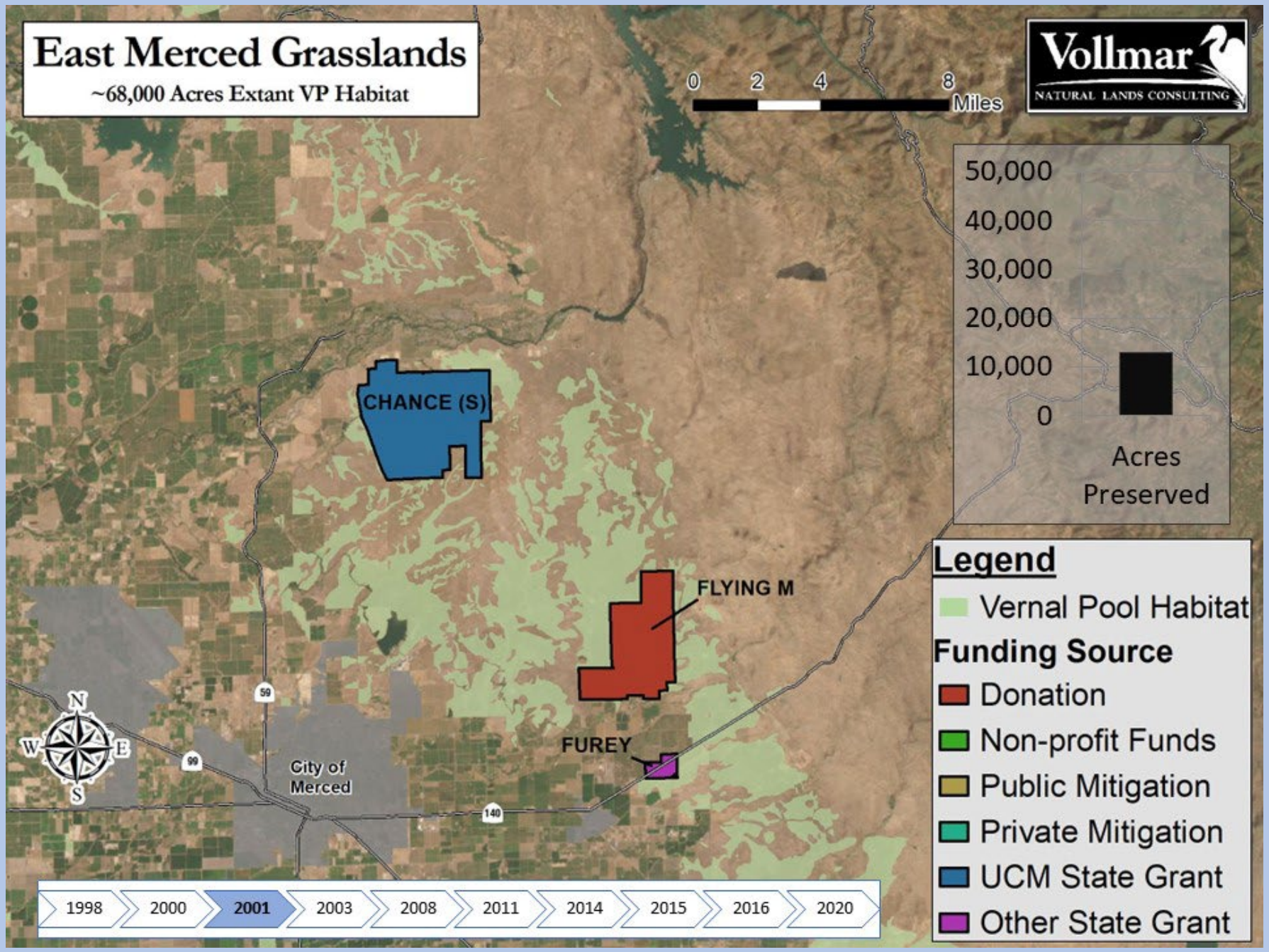
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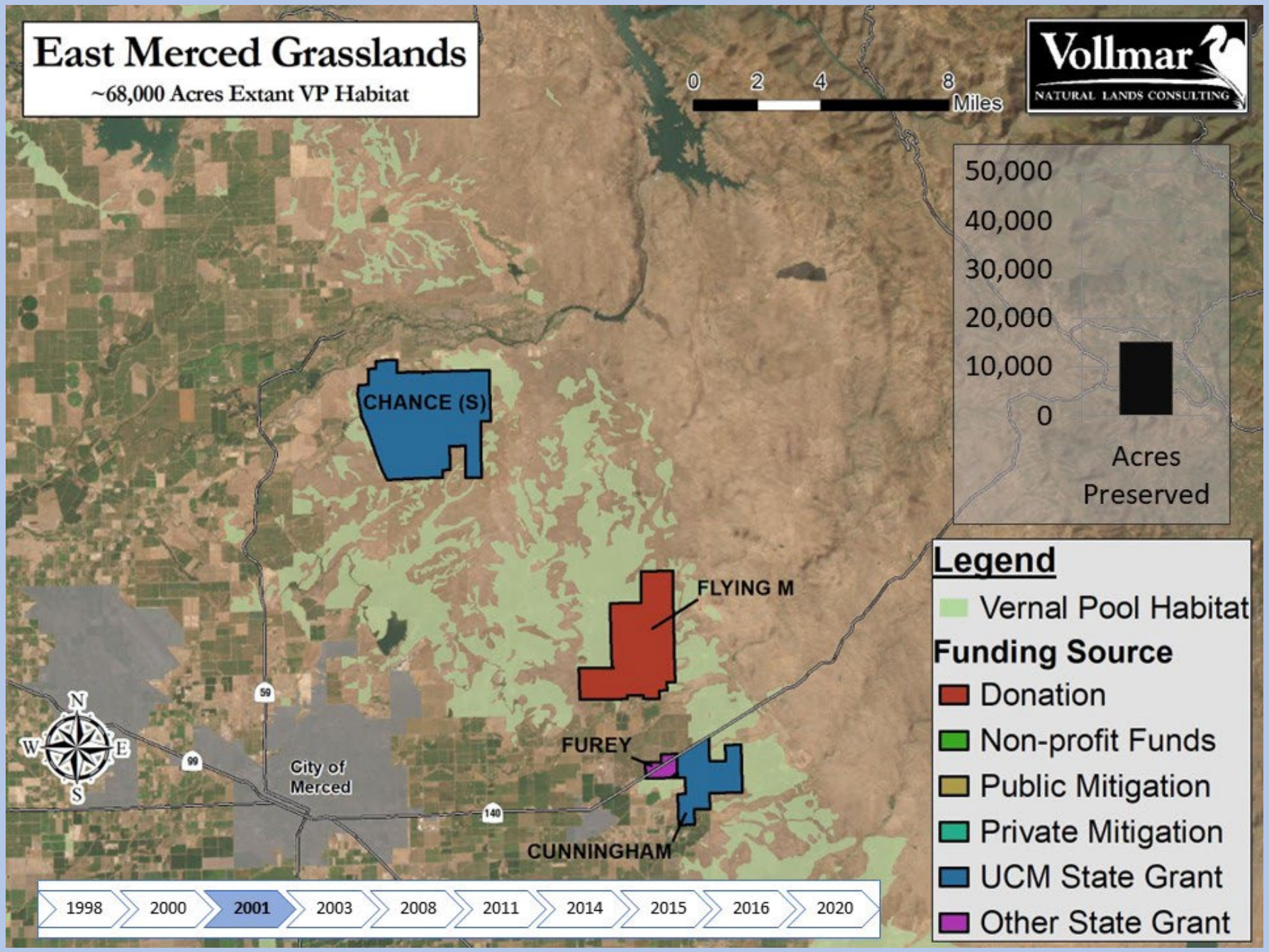
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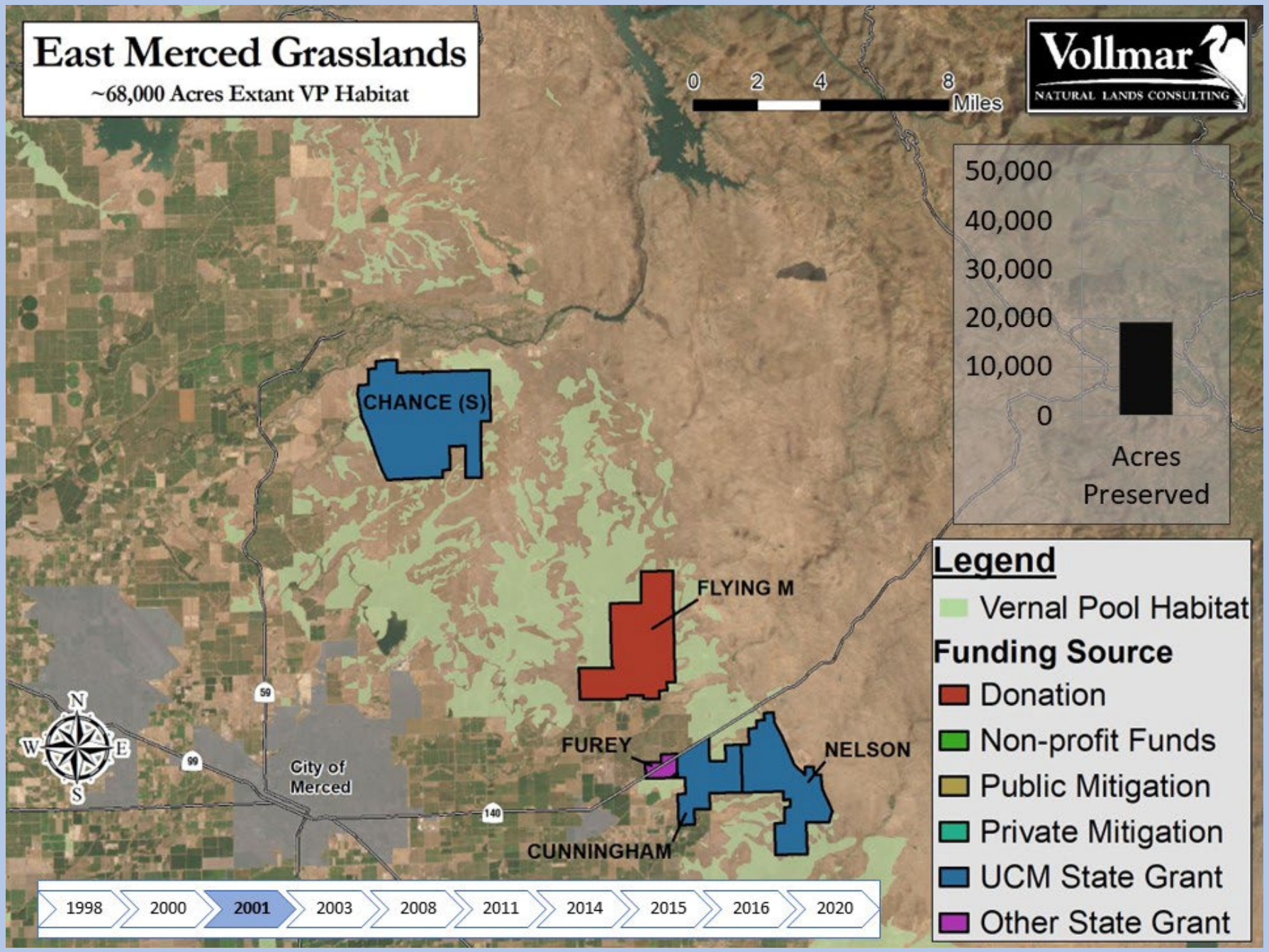
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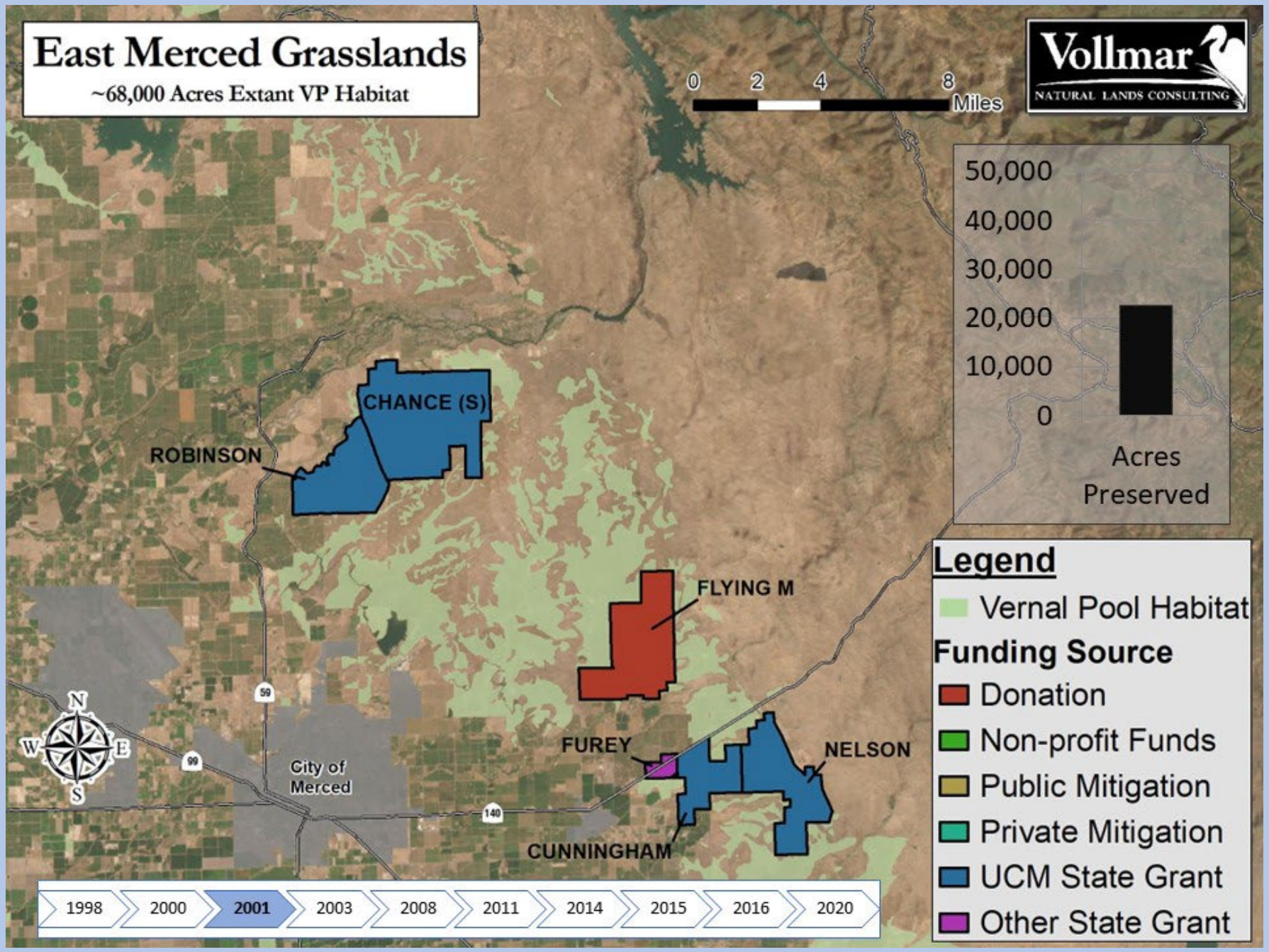
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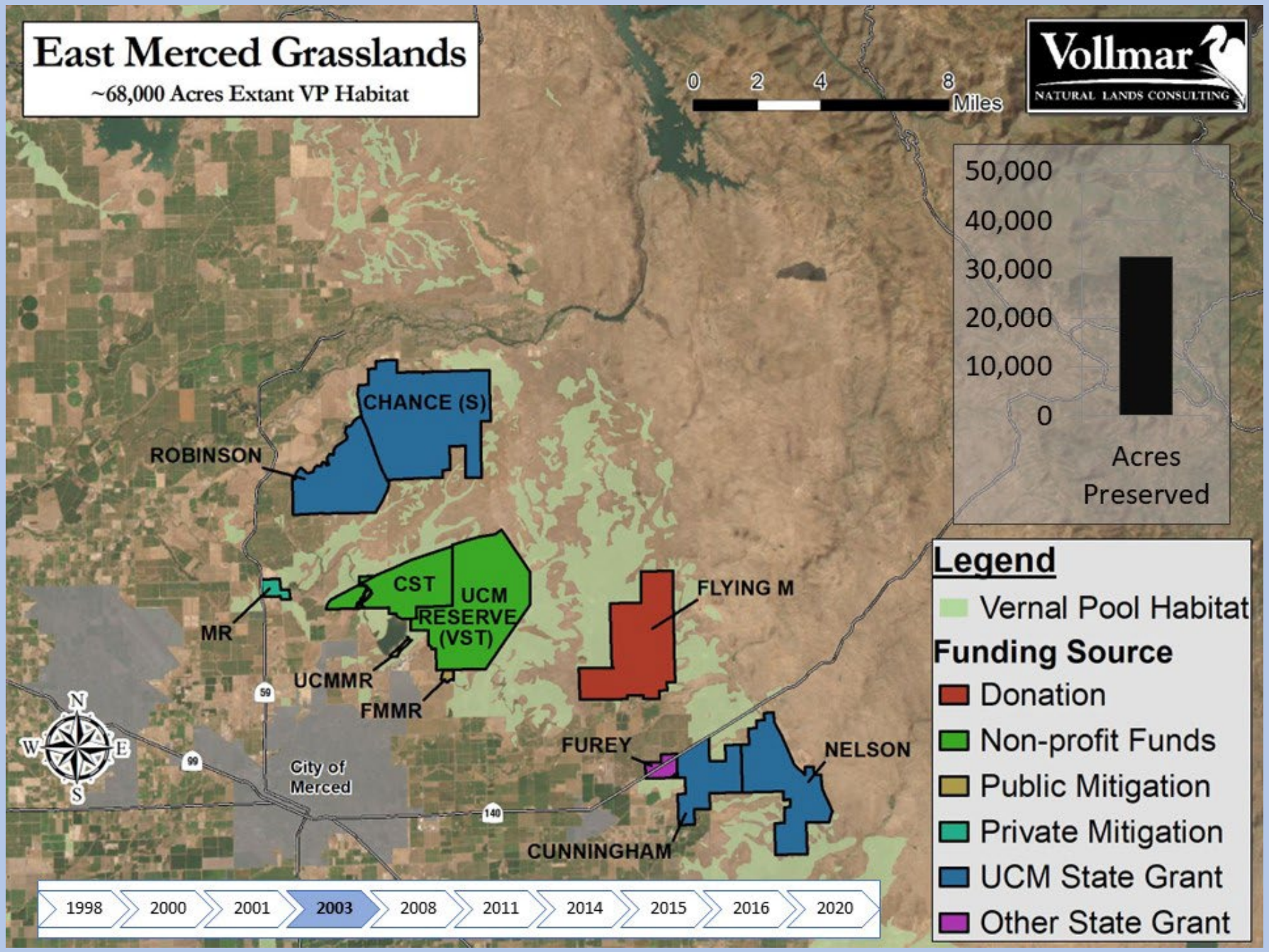
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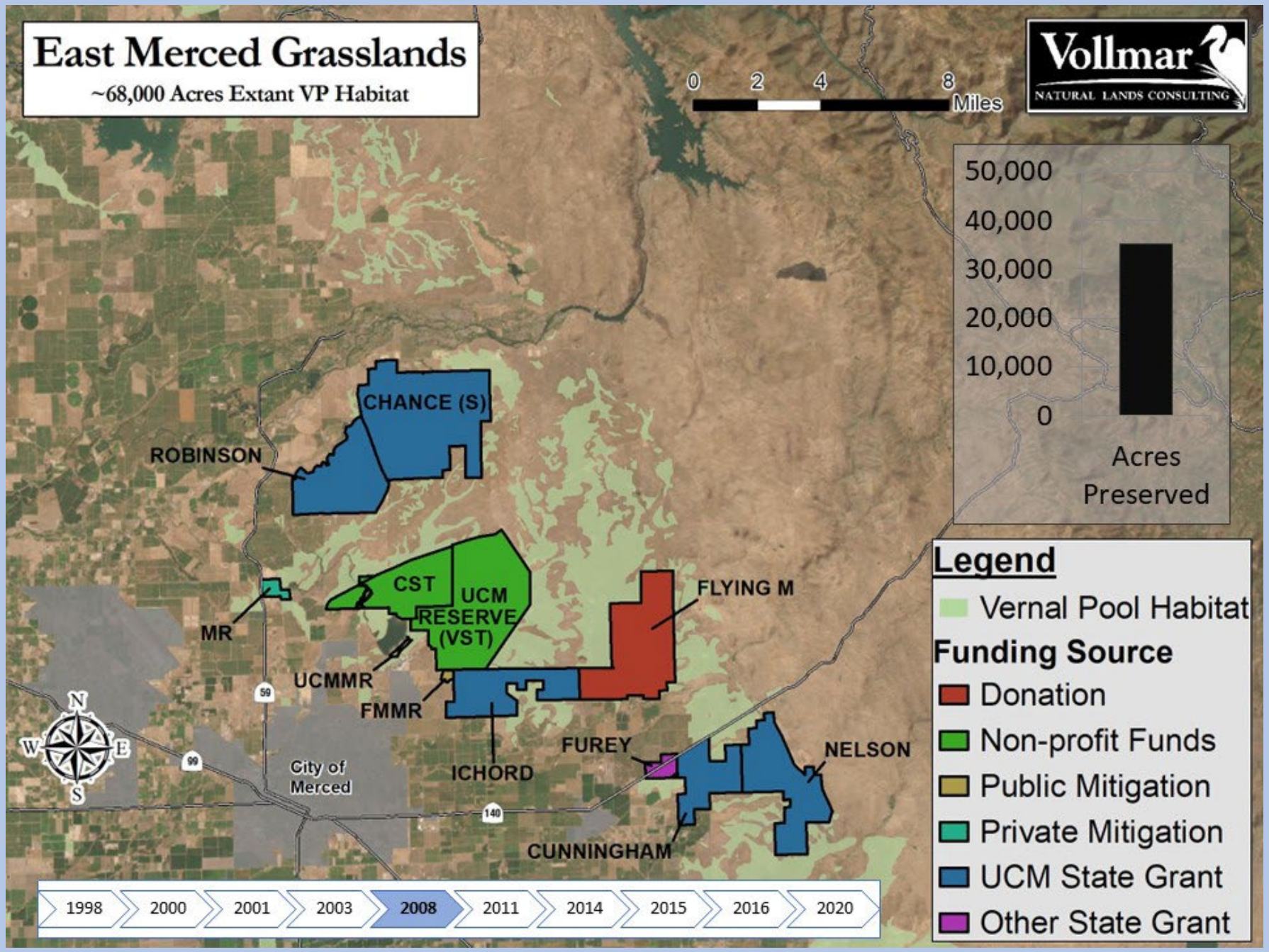
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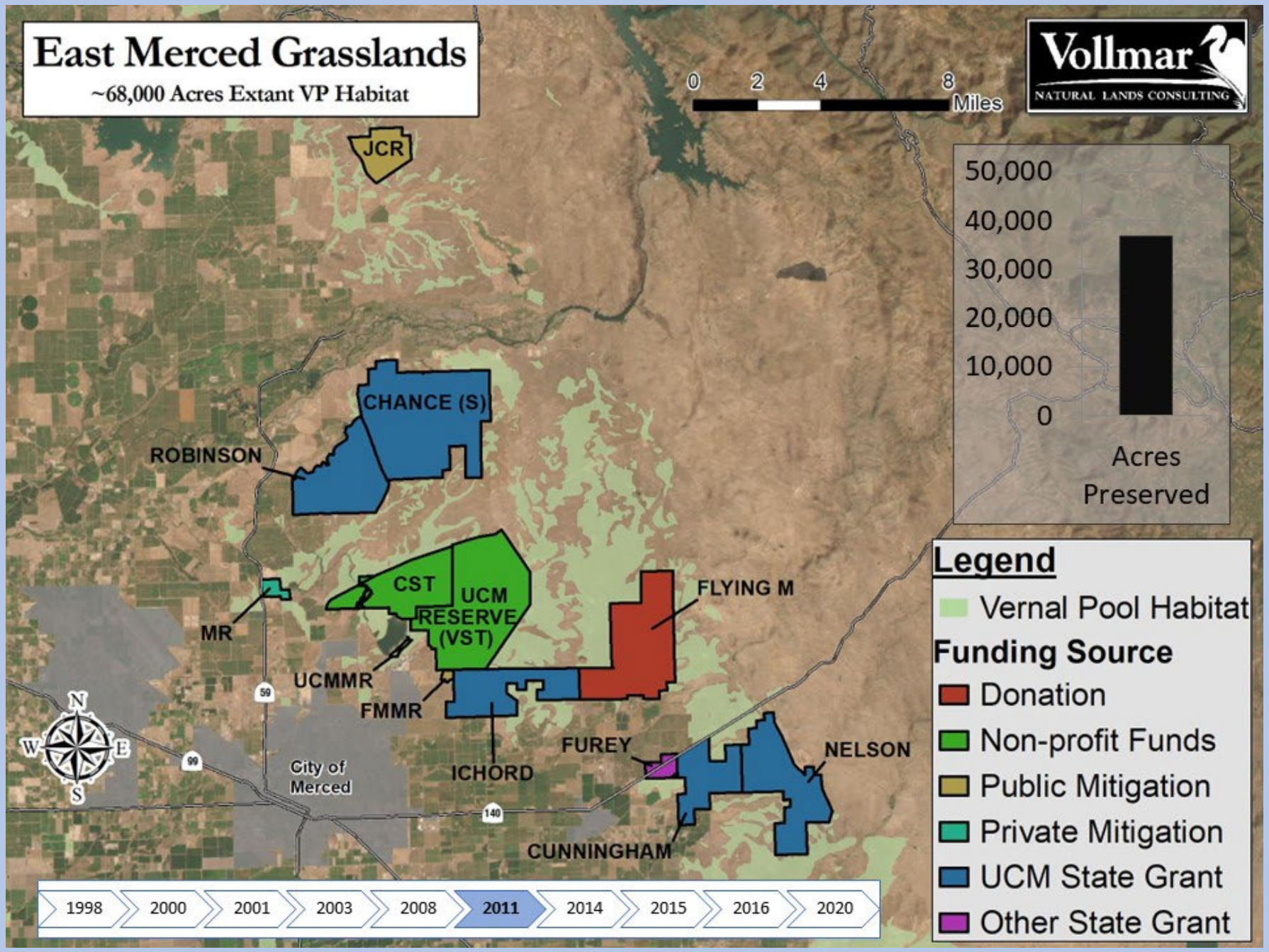
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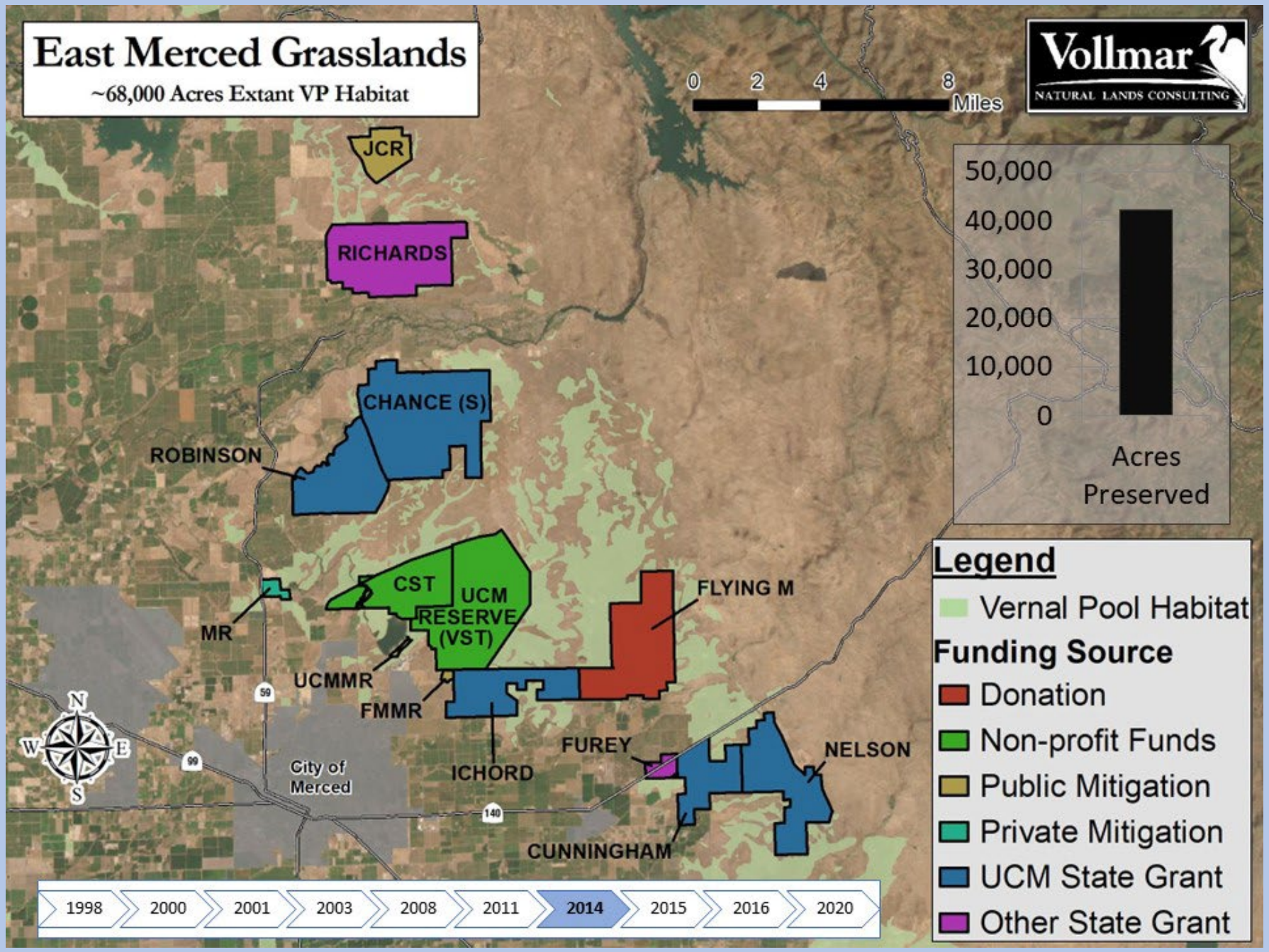
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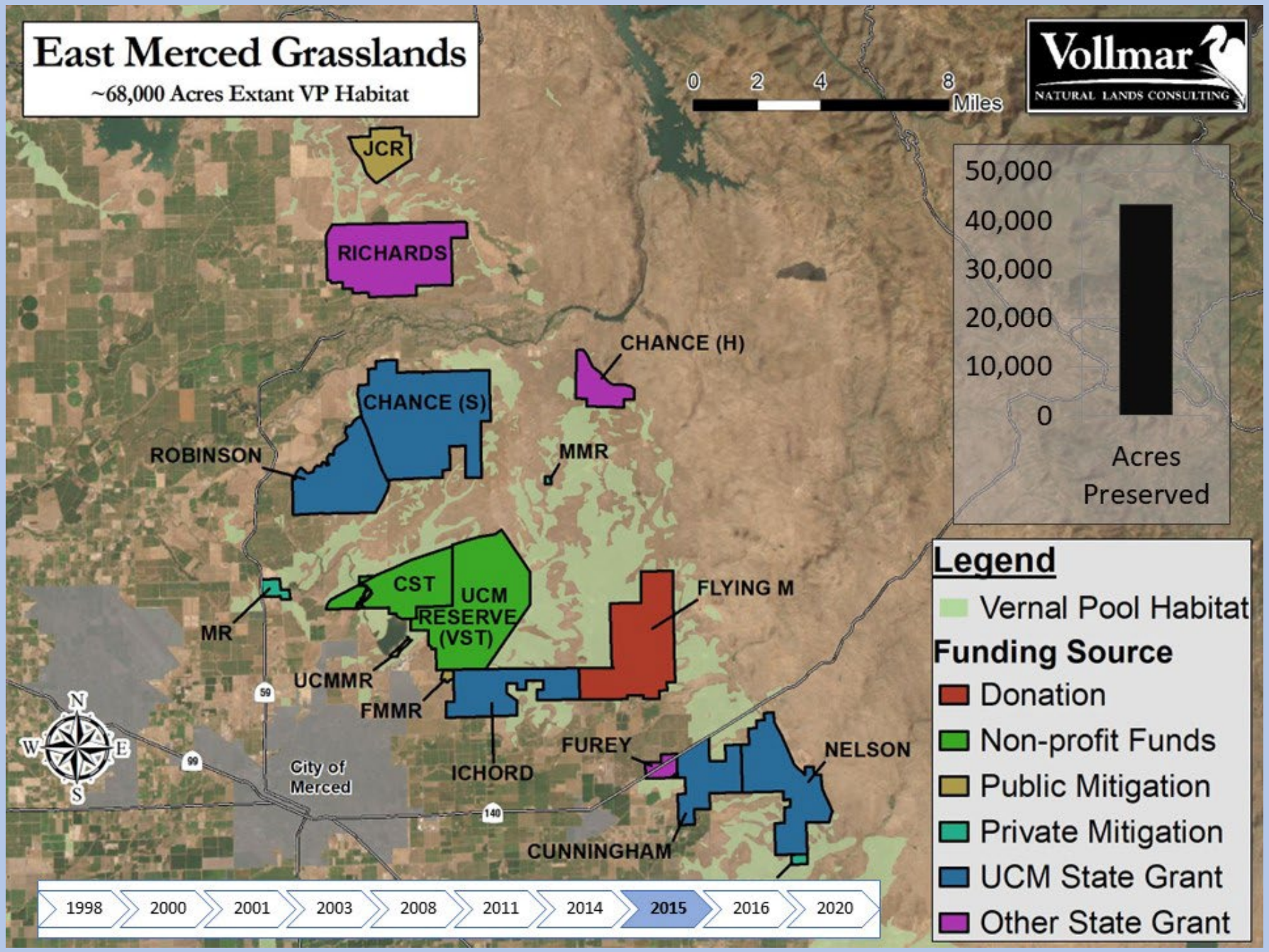
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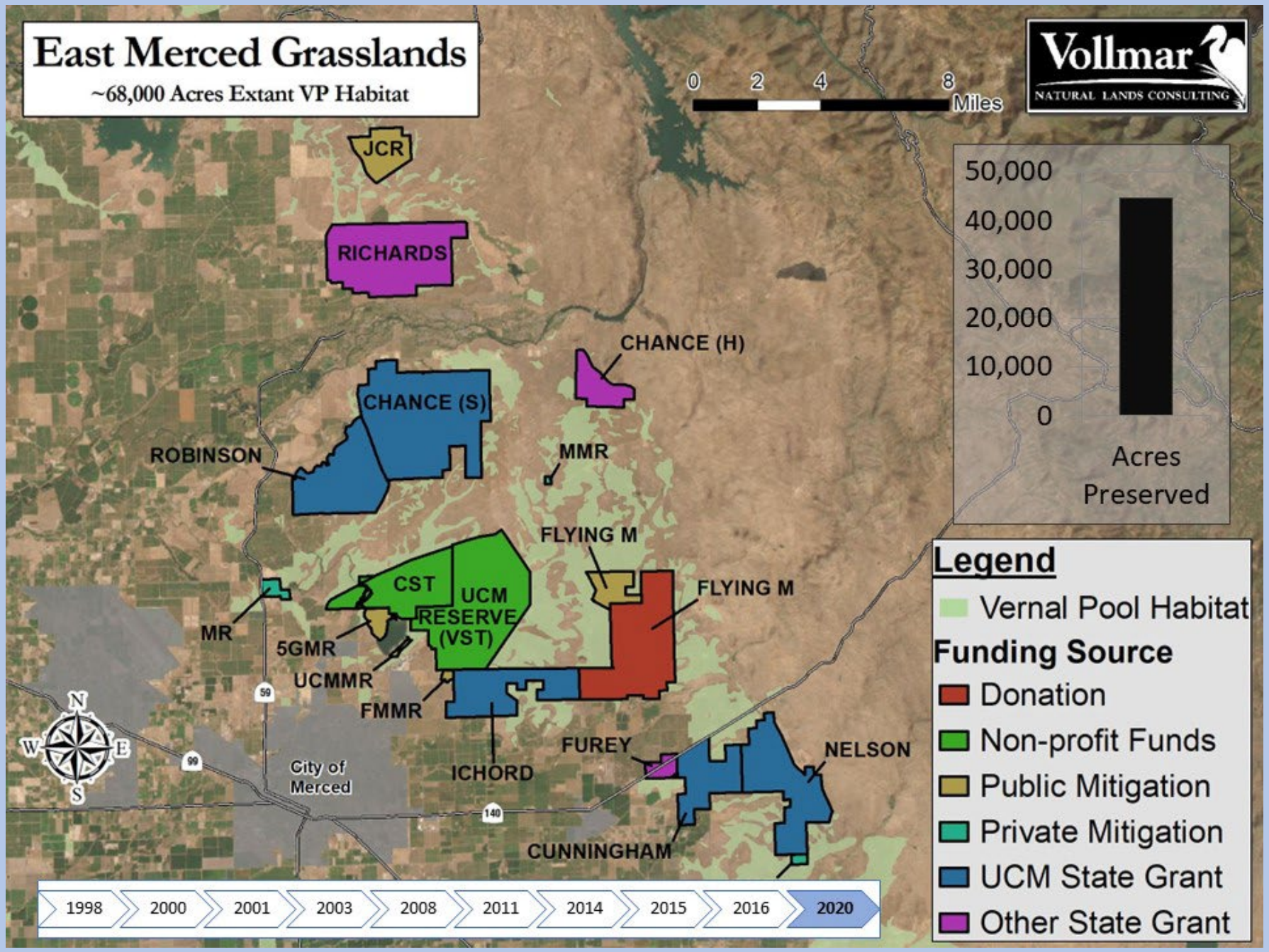
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BACKCOUNTRY PRESS

CONSERVATION OF CALIFORNIA'S GREAT VALLEY VERNAL POOL LANDSCAPES

USER'S GUIDE AND REFERENCE MANUAL

John Vollmar, Kristen Chinn, Eric Smith, Henry Hwang, and Anton Bokisch

Ad Hoc Conservation Process Steps:

Step 1: Develop Basic Biodiversity Data to Identify Target Conservation Areas

Step 2: Foster Broad Public Awareness and Interest in the Target Areas

Step 3: Cultivate Individuals Dedicated to Conserving the Target Areas

Ad Hoc Conservation Process Steps:

Step 1: Develop Basic Biodiversity Data to Identify Target Conservation Areas

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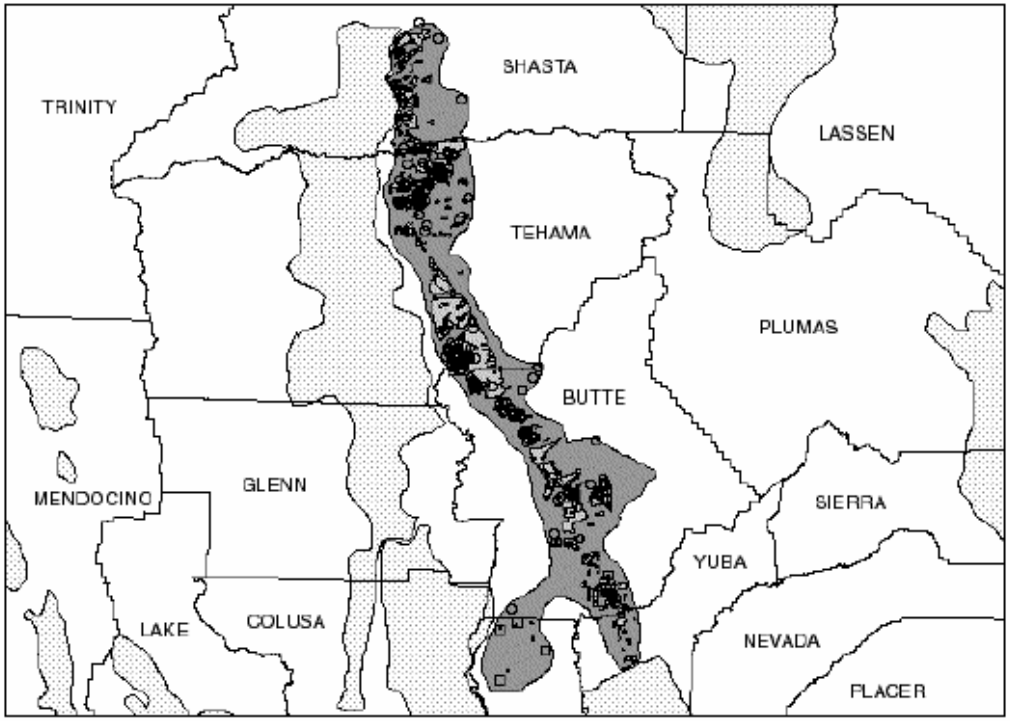
Northeastern Sacramento Valley Vernal Pool Region



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- Vernal Pool Species
- Vernal Pool Community
- Vernal Pool Complex
- County Boundary
- Region Boundary
- Adjacent Vernal Pool Regions

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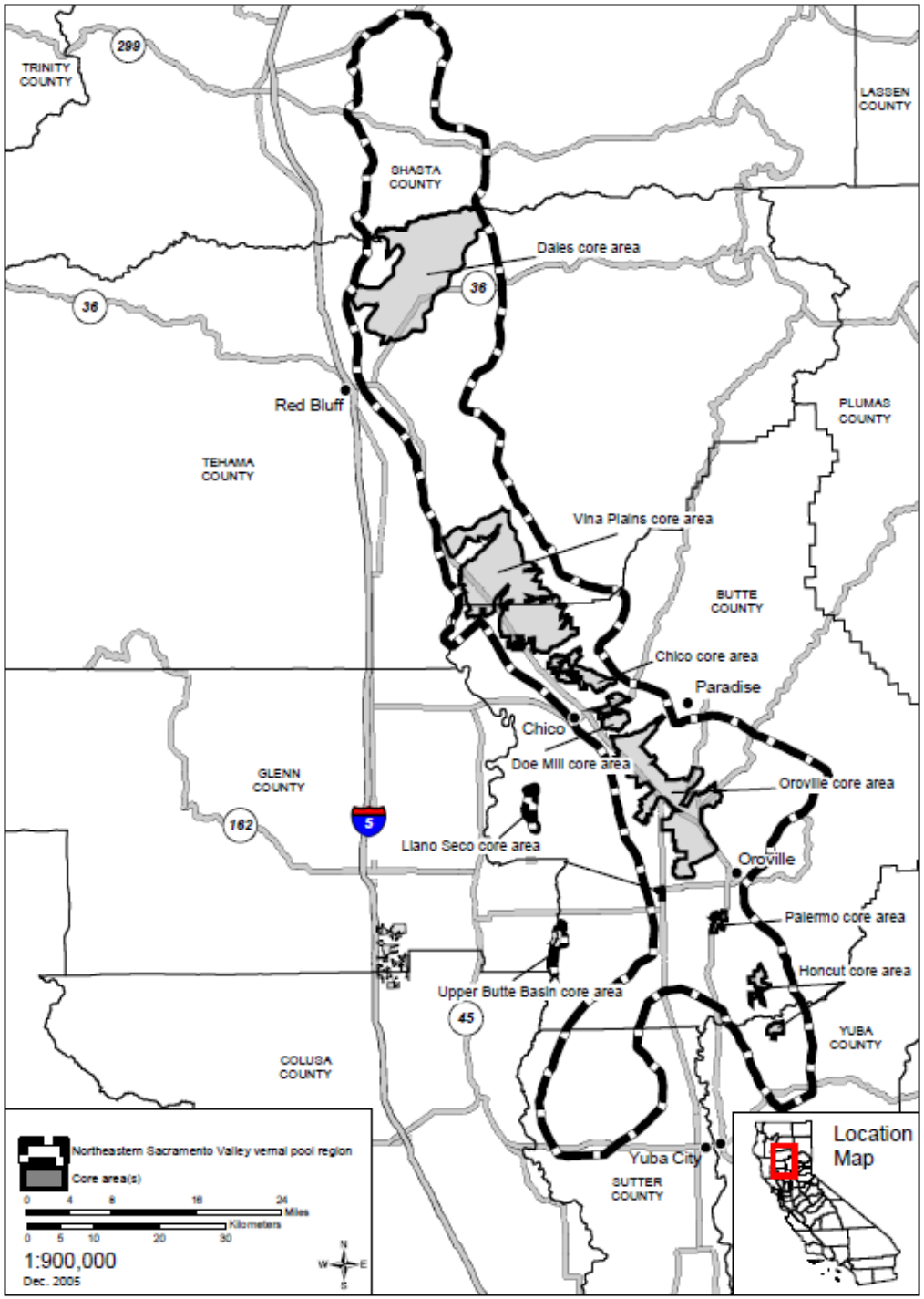
TRINITY COUNTY
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LASSEN COUNTY
SHASTA COUNTY
Dales core area
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Red Bluff
PLUMAS COUNTY
TEHAMA COUNTY
Vina Plains core area
BUTTE COUNTY
Chico core area
Paradise
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Doe Mill core area
Oroville core area
GLENN COUNTY
162
5
Llano Seco core area
Oroville
Palermo core area
Honcut core area
Upper Butte Basin core area
45
YUBA COUNTY
COLUSA COUNTY
Yuba City
SUTTER COUNTY
Location Map
Northeastern Sacramento Valley vernal pool region
Core area(s)
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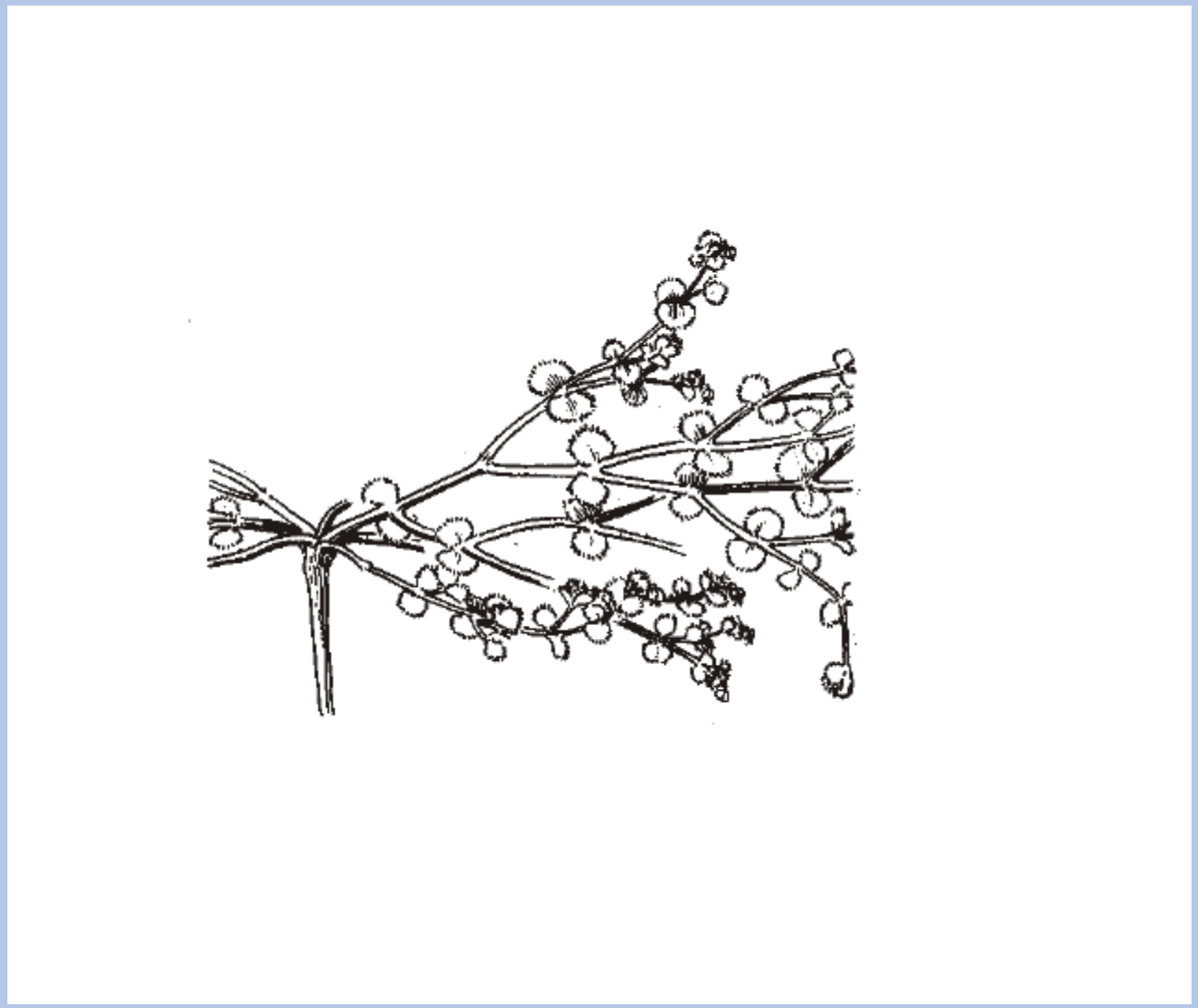
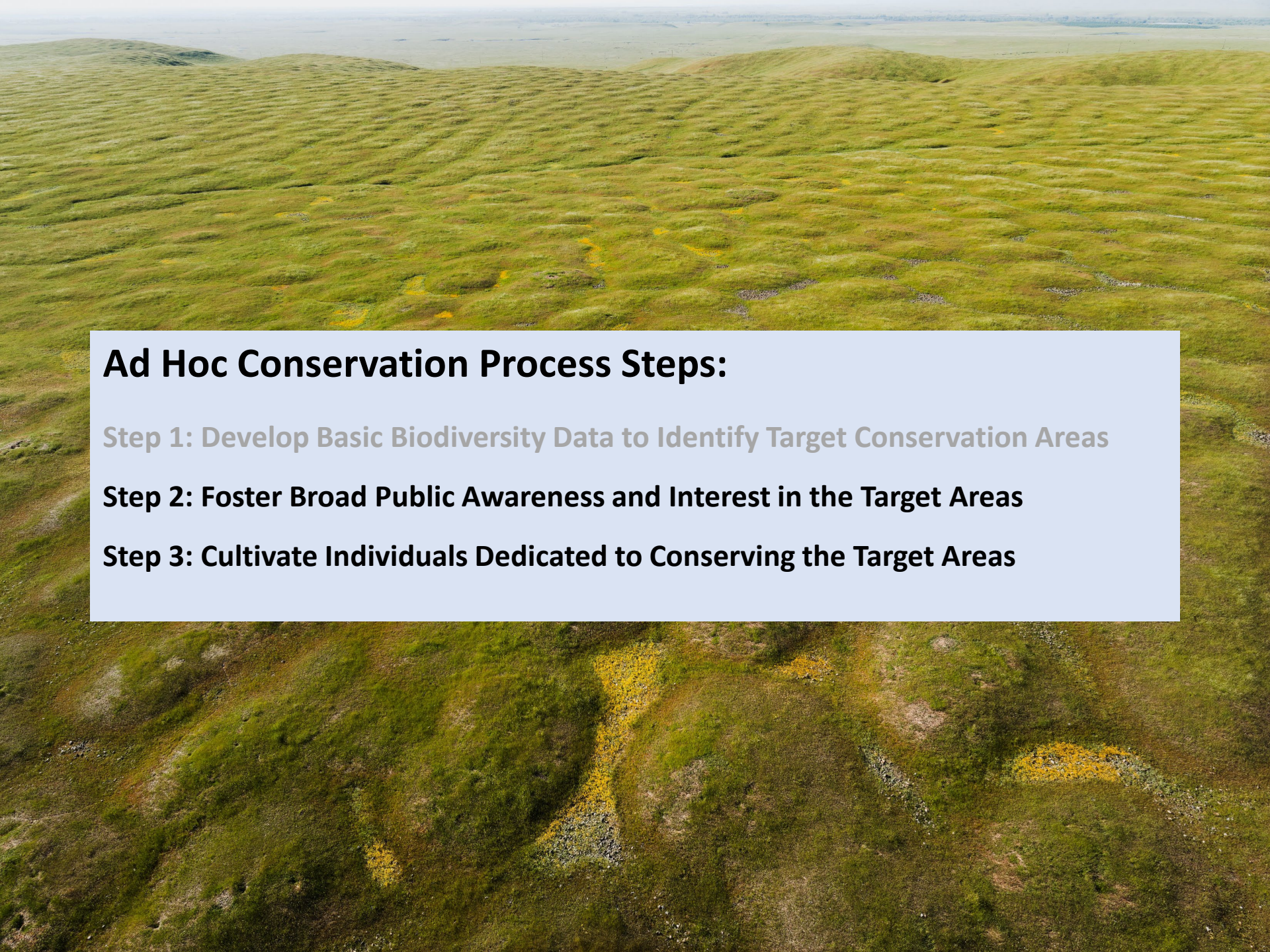
Illustration of Hoover's Spurge from VP Recovery Plan





Ad Hoc Conservation Process Steps:

Step 1: Develop Basic Biodiversity Data to Identify Target Conservation Areas

Step 2: Foster Broad Public Awareness and Interest in the Target Areas

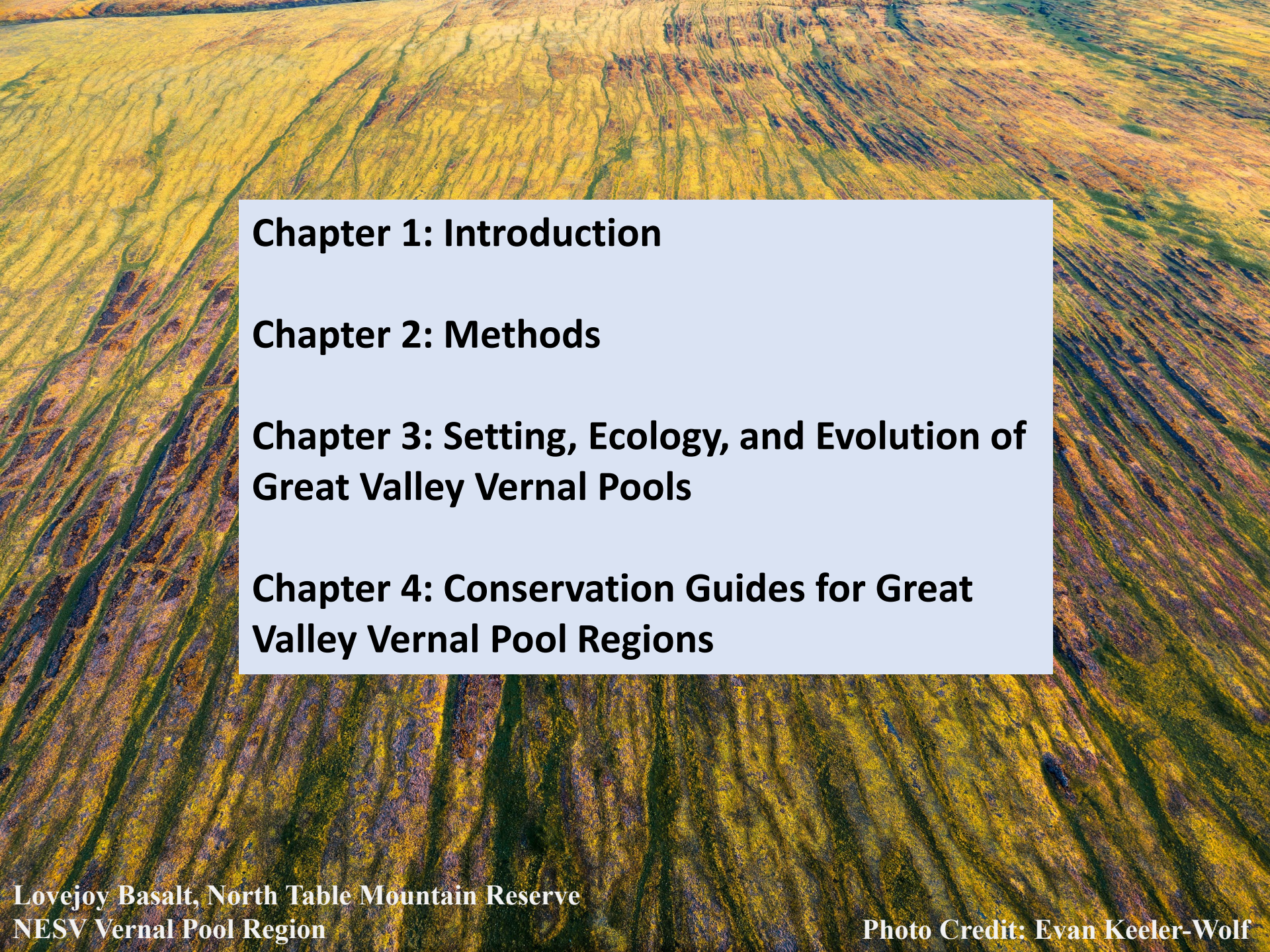
Step 3: Cultivate Individuals Dedicated to Conserving the Target Areas

Hoover's Spurge (*Euphorbia hooveri*)

Photo Credit: Neal Kramer

Tuscan Formation
NESV Vernal Pool Region

Photo Credit: Evan Keeler-Wolf



Chapter 1: Introduction

Chapter 2: Methods

Chapter 3: Setting, Ecology, and Evolution of Great Valley Vernal Pools

Chapter 4: Conservation Guides for Great Valley Vernal Pool Regions

Lovejoy Basalt, North Table Mountain Reserve
NESV Vernal Pool Region

Photo Credit: Evan Keeler-Wolf

CHAPTER 3

SETTING, ECOLOGY, AND EVOLUTION OF GREAT VALLEY VERNAL POOLS

This section presents background information on the ecology, evolution, and other aspects of vernal pool habitats and species, and on the origins and current setting of the Great Valley as they relate to vernal pools. These concepts underlie the analyses that we used to identify the target habitat blocks. While an enthusiasm for vernal pool habitats often begins with field visits, a deeper appreciation can be gained by learning about their deep evolutionary and earth history and the forces that create and maintain them. This understanding also improves an individual's ability to make decisions regarding which lands to target for conservation and why. This section provides a good primer on these concepts. Numerous references are included for those interested in delving deeper into specific topics.

Vernal Pool Habitat Characteristics and Concepts

Definition and Characteristics of Vernal Pool Habitat

As a basic definition, vernal pools are ephemeral wetlands filled primarily by direct rainfall that pond continuously or intermittently for a few weeks to months during the rainy season in an average rain year. These pools dry down during late winter and spring and remain desiccated until the onset of the next rainy season (Jain 1976; Holland and Jain 1988; Keeley and Zedler 1998). The period of inundation for an individual pool varies annually, depending on pool size, depth, and the amount and timing of rainfall. Vernal pools occur along a spectrum of seasonal wetland types, ponding longer than more transient rain pools (Preston 2010), but shorter than seasonal marshes. This brief wet period, followed by months of desiccation, creates a unique habitat that is home to a suite of endemic plants and animals adapted to these difficult hydrological conditions. Maximum ponding depth typically ranges from 2-15 inches, though there are occasional deeper pools up to 24 inches (Barbour et al. 2007a; Vollmar 2002b). Beyond this depth, the habitat typically functions as a seasonal marsh, due to more prolonged ponding, with a different, less unique, suite of associated plants and animals.

Vernal pool-swale complex with surrounding annual grasslands in winter. (Photo Credit: Evan Keeler-Wolf, January 2022)

Vernal pools exist within a matrix of upland habitat, typically grasslands but sometimes scrub or savanna. Individual pools also generally occur in a network with interconnecting swales. For the purposes of this guide, 'vernal pool habitat' is defined as the complex of pool basins and swales along with the surrounding upland habitat that form local pool watersheds, and together supports the overall ecology of vernal pools (Witham et al. 2014). Wetland density within vernal pool habitat typically varies from 2-15% cover, with higher densities in some unique settings. Below 2% density, individual pools may occur, but the overall habitat does not generally appear or function as vernal pool habitat.

Exceptionally large vernal pools (typically greater than one acre in size) are often called playa pools. These pools are rare across the landscape and have unique soil, vegetation, and hydrology characteristics. They often harbor multiple rare species including many listed as threatened or endangered under the Federal or State Endangered Species Acts and as such are a high priority for conservation (USFWS 2005).

Several playa pools on Vina Plains Preserve in eastern Tehama County, Northeastern Sacramento Valley Vernal Pool Region. (Photo Credit: Evan Keeler-Wolf, January 2022)

Vernal pool habitats occur in a very limited number of regions in the world, where the right combination of climate, soils, and slope support their formation. They are concentrated in regions with a Mediterranean climate (Keeley and Zedler 1998) (**Figure 3.1**). These areas have cool, wet winters and hot, dry summers that produce the rainfall cycle and hydrologic regime required for vernal pools. Vernal pool-like habitats can also form in non-Mediterranean climates with wet winters and dry summers, such as Washington state and the northeastern U.S. (Keeley and Zedler 1998) but these habitats are not the focus of this discussion. Mediterranean climate areas are quite restricted on a global level and include the western edge of North America from southern Oregon to northern Baja and some arid areas to the east (excluding areas from central Oregon north shown on **Figure 3.1** which have a 'modified' Mediterranean climate and generally lack vernal pools), the

The artistry of vernal pools
Their strange and sinuous shapes
Their colorful and unexpected life forms
The feeling of immense time and landscape
Their quiet meditations in the winter
and joyful raptures in the spring
Are what draws us to them
Again and again

Tales of Evolution in Great Valley Vernal Pools

Vernal pools are renowned for their abundance of species. Within the Great Valley, a single, medium-sized pool measuring 30 to 40 feet across can support more than 30 to 40 plant species, a few different amphibian and shrimp species, and numerous other aquatic invertebrates. In total, Great Valley vernal pools support more than 100 native plant species, ten fairy and tadpole shrimp species, and four amphibian species (Holland 1976; Eriksen and Belk 1999; Stebbins and McGinnis 2012). Most of the plant and shrimp species are ve
marily in the
rare ones, are
occurring in
Appendix A)
relatively new
few million y
years old. Ver
their annual fluctuations between short-term inundation and long-term desiccation and periodic years-long droughts. So where did all these new species come from? And why are there so many?

As it turns out, evolution found several different pathways to populate these new and difficult habitats. In fact, the combination of newness and difficulty were fundamental drivers of new species development as life struggled and adapted to occupy vernal pools (Hoover 1937; Raven and Axelrod 1978). The high species diversity was further encouraged by the high landform and geologic diversity within the Great Valley as well as the dramatic climate fluctuations that have occurred over the past four million years with several alternating glacial and inter-glacial periods (Raven and Axelrod 1978, Axelrod 1973, Howard 1979, Harden 2004). Individual pools also vary significantly in ponding depth and duration, both within and across pools, creating distinct niches. All of these conditions provided the foundation for rapid and abundant new species development since vernal pools first began to form in the Great Valley. The tales of evolution below exemplify different evolutionary pathways exploited by life across these variable conditions to yield the high species diversity and regional distribution patterns that we see in the Great Valley today.

Tales of Evolution of Great Valley Vernal Pools

Adaptive Radiation: Calicoflowers

Adaptive radiation is a common term in evolutionary biology that describes the proliferation of a single ancestral species into numerous new species in response to the development of a set of new, closely-related habitats or microhabitats. The formation of vernal pools in the Great Valley, with distinct, lo- and intra-pool
ng for adaptive
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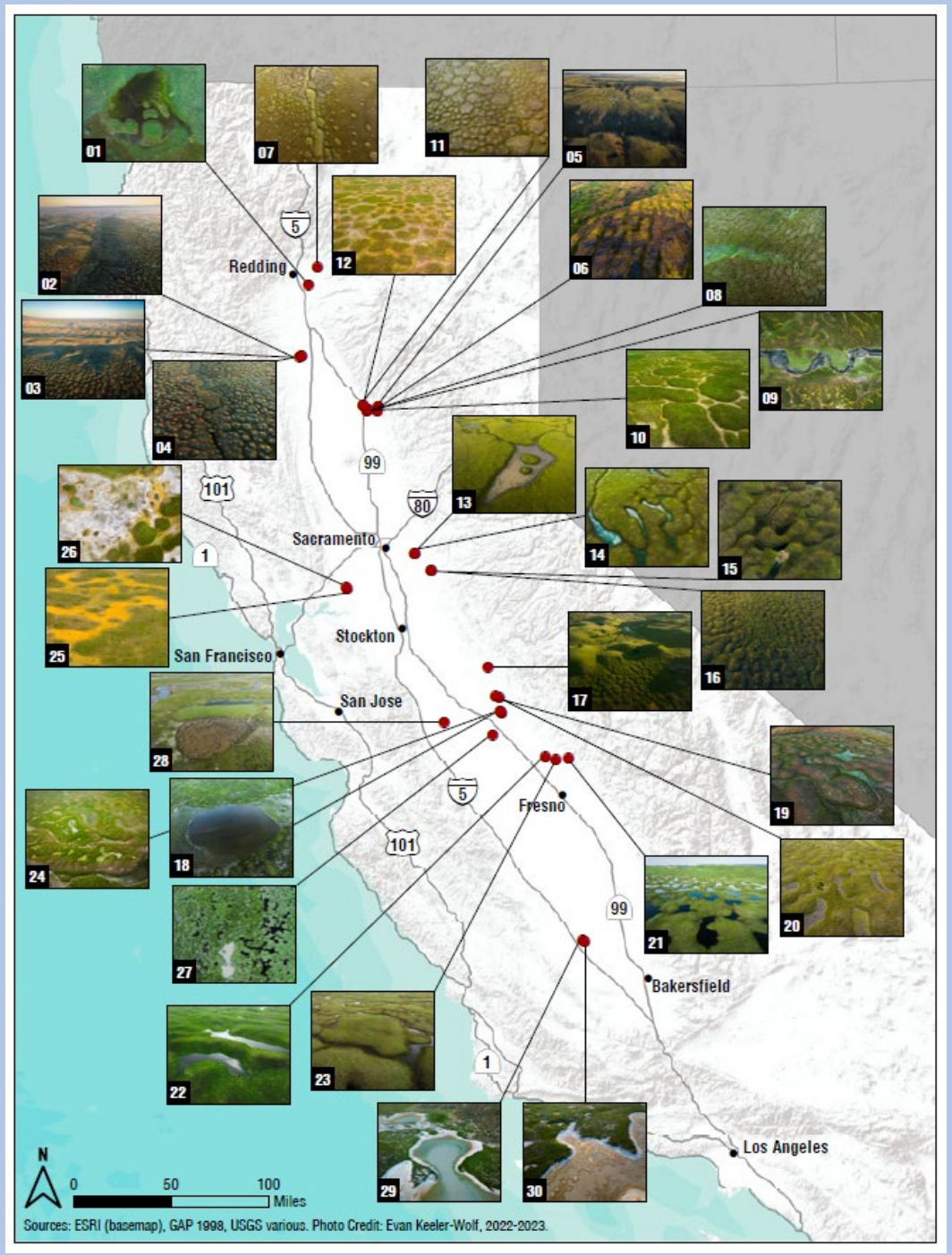
s with different
ore noteworthy
ldfields (*Lasthe-*
owfoams (*Lim-*
folium), and annual saltbushes (*Atriplex*) (Jepson Online 2021). All of these genera have rare species, some of which are local endemics such as Butte County meadowfoam (*Limnanthes floccosa* ssp. *californica*), Jim's clover (*Trifolium jokerstii*), and Earlimart orache (*Atriplex cordulata* var. *erecticaulis*). Many others are mostly restricted to only one or two Vernal Pool Regions (**Table 3.6**).

An interesting aspect of the evolution of these species is that they generally derived from terrestrial ancestors (Crampton 1954; Ornduff 1966; Spencer and Riesberg 1997). Indeed, many of the genera listed above still have terrestrial species in proximity to vernal pools such as common goldfields (*Lasthenia californica*) and numerous terrestrial clover and saltbush species.

The calicoflowers offer a good representative example of the adaptive radiation that has occurred in vernal pool plants. This genus has a total of 13 annual species, many with named varieties (Jepson Online 2021). The flowers are striking and vary by species in terms of shape, color, and size (see photos below). All of these species are associated with ephemeral to seasonal wetlands, including many that are strictly associated with

Representative floral variation in calicoflowers found in Great Valley vernal pools (from left to right): harlequin calicoflower (*Downingia insignis*), maroon-spotted calicoflower (*D. concolor*), and dwarf calicoflower (*D. pusilla*). (Photo Credits: Vernon Smith, Doug Wirtz, and Doug Wirtz, respectively)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Bakersfield
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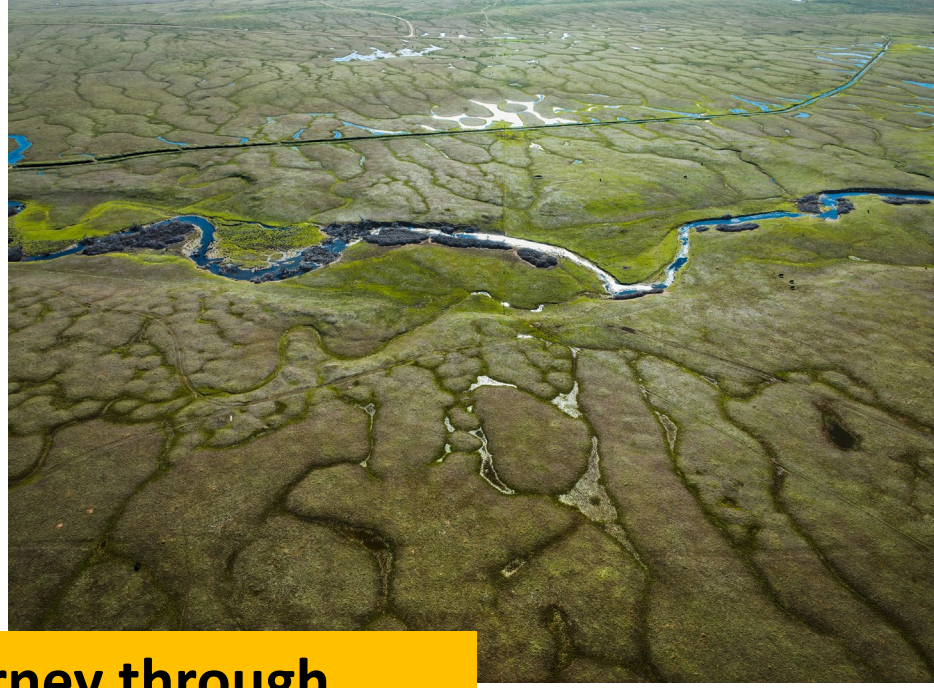
Sources: ESRI (basemap), GAP 1998, USGS various. Photo Credit: Evan Keeler-Wolf, 2022-2023.

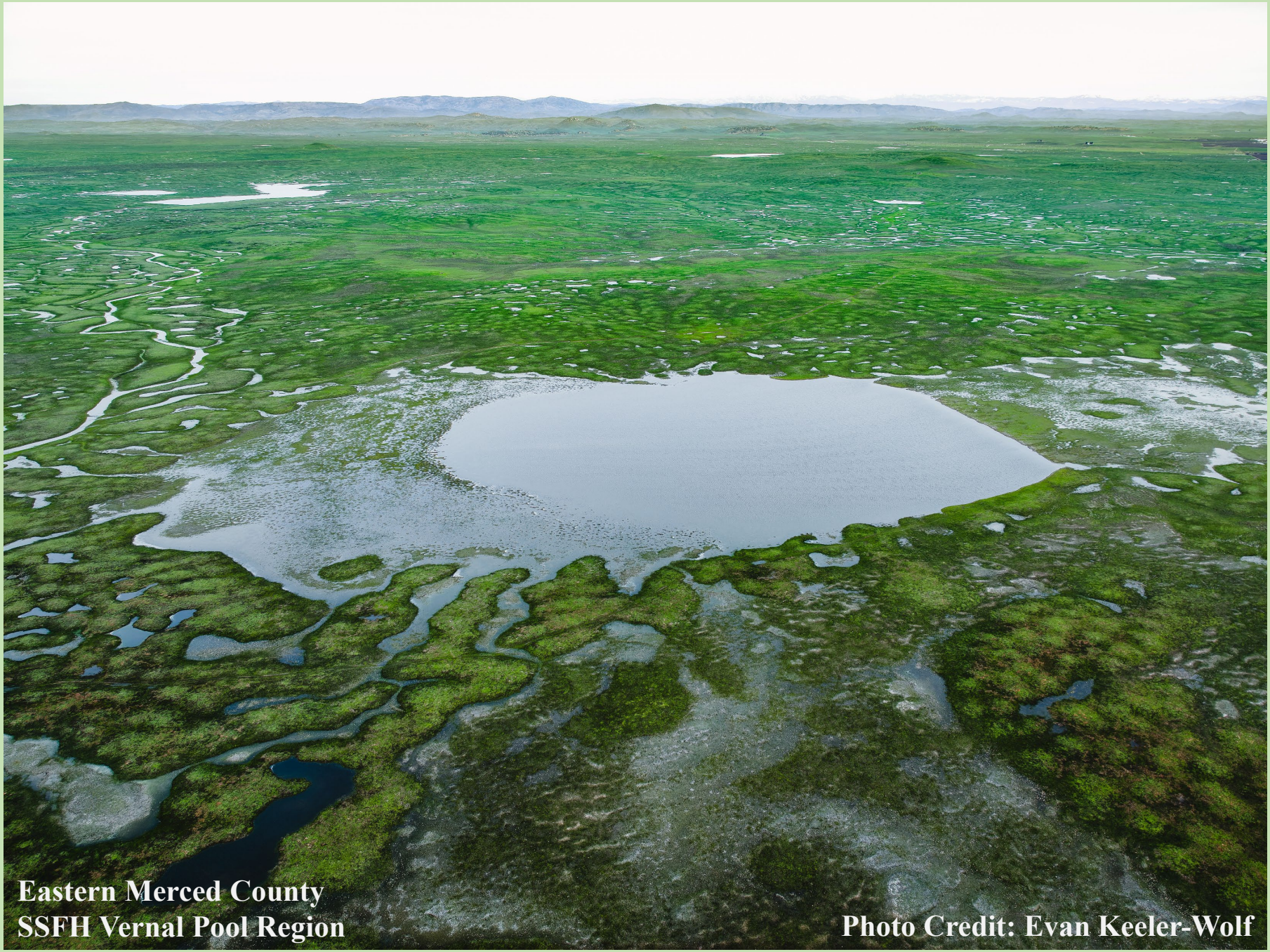


Geological Journey through Great Valley Vernal Pool Landscapes

Table 3.4. Primary Vernal Pool-bearing Geologic Formations of the Great Valley - Presence by Vernal Pool Region.

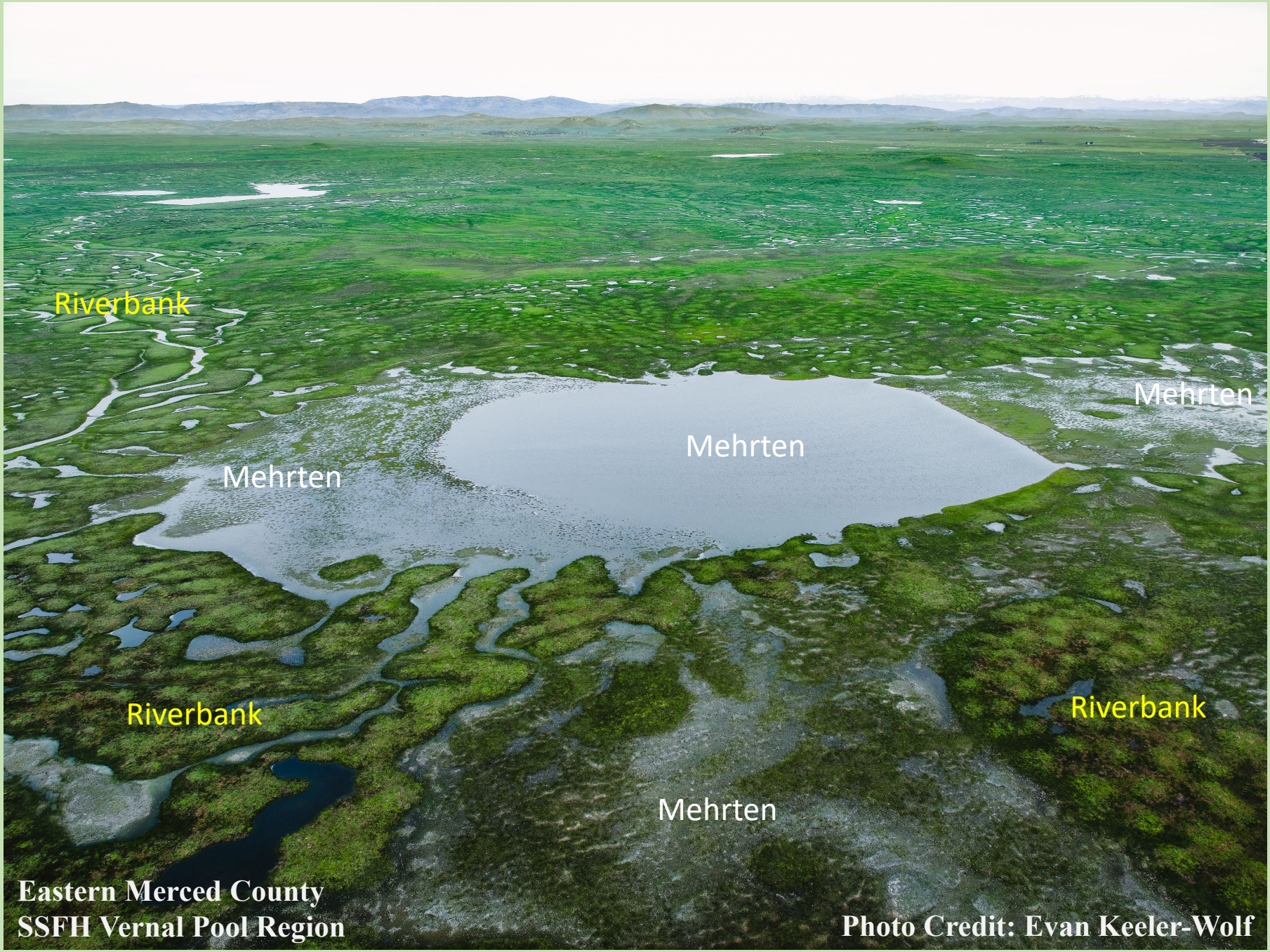
Geologic Formation	Presence in Vernal Pool Region[1]							
	NWSV	NESV	SESV	SSFH	SOCO	SJQV	LVMR	CCGV
Recent (Quaternary) Basin Deposits	X	X	X		X	X		
Recent Marsh Deposits					X			
Recent Bay Mud Deposits					X			
Recent Basalt Flows	X	X						
Recent Alluvial Deposits	X	X	X	X	X	X	X	X
Dos Palos Alluvium						X		
Patterson Alluvium						X		X
San Luis Ranch Alluvium						X		X
Los Banos Alluvium						X		X
Modesto	X	X	X	X	X	X	X	
Riverbank	X	X	X	X				
Turlock Lake		X	X	X				X
Red Bluff	X	X						
North Merced Gravel			X	X				
Montezuma					X			
Tehama	X				X		X	
Laguna		X	X	X				
Tuscan		X						
Lovejoy Basalt		X						
Other Miocene Volcanic Rocks				X				
Mehrten (alluvium)			X	X				
Mehrten (mudflow)			X					
Valley Springs			X	X				
Ione		X	X	X				
Panoche								X
Tertiary Sedimentary Rocks							X	
Cretaceous Sedimentary Rocks							X	
Jurassic-Cretaceous Rocks	X	X	X	X				

1. Vernal Pool Regions: NWSV = Northwestern Sacramento Valley; NESV = Northeastern Sacramento Valley; SESV = Southeastern Sacramento Valley; SSFH = Southern Sierra Foothills; SOCO = Solano-Colusa; SJQV = San Joaquin Valley; LVMR = Livermore; CCGV = Central Coast (Great Valley portion).


Eastern Merced County
SSFH Vernal Pool Region
Photo Credit: Evan Keeler-Wolf

Colusa grass
Neostapfia colusana

San Joaquin Orcutt grass
Orcuttia inaequalis


Riverbank
Mehrten
Mehrten
Mehrten
Riverbank
Riverbank
Mehrten
Eastern Merced County
SSFH Vernal Pool Region
Photo Credit: Evan Keeler-Wolf


Valley Springs Formation
SSFH Vernal Pool Region
Photo Credit: Evan Keeler-Wolf


Valley Springs Formation
SSFH Vernal Pool Region
Photo Credit: Evan Keeler-Wolf

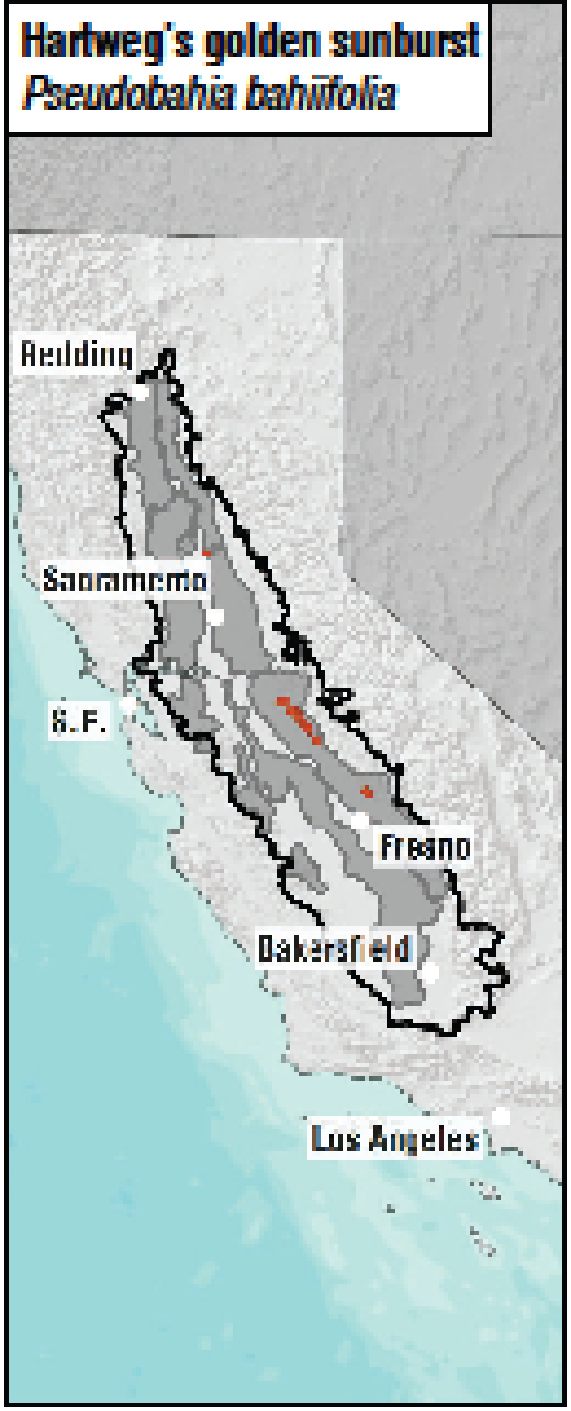
Photo Credit: Charles Patterson

Pincushion navarretia
(*Navarretia myersii*)

Photo Credit: Matt Berger

Hartweg's golden sunburst
(*Pseudobahia bahiifolia*)


pincushion navarretia
Navarretia myersii ssp. myersii
Redding
Sacramento
S.F.
Fresno
Bakersfield
Los Angeles
San Diego


Hartweg's golden sunburst
Pseudobahia bahiifolia
Redding
Sacramento
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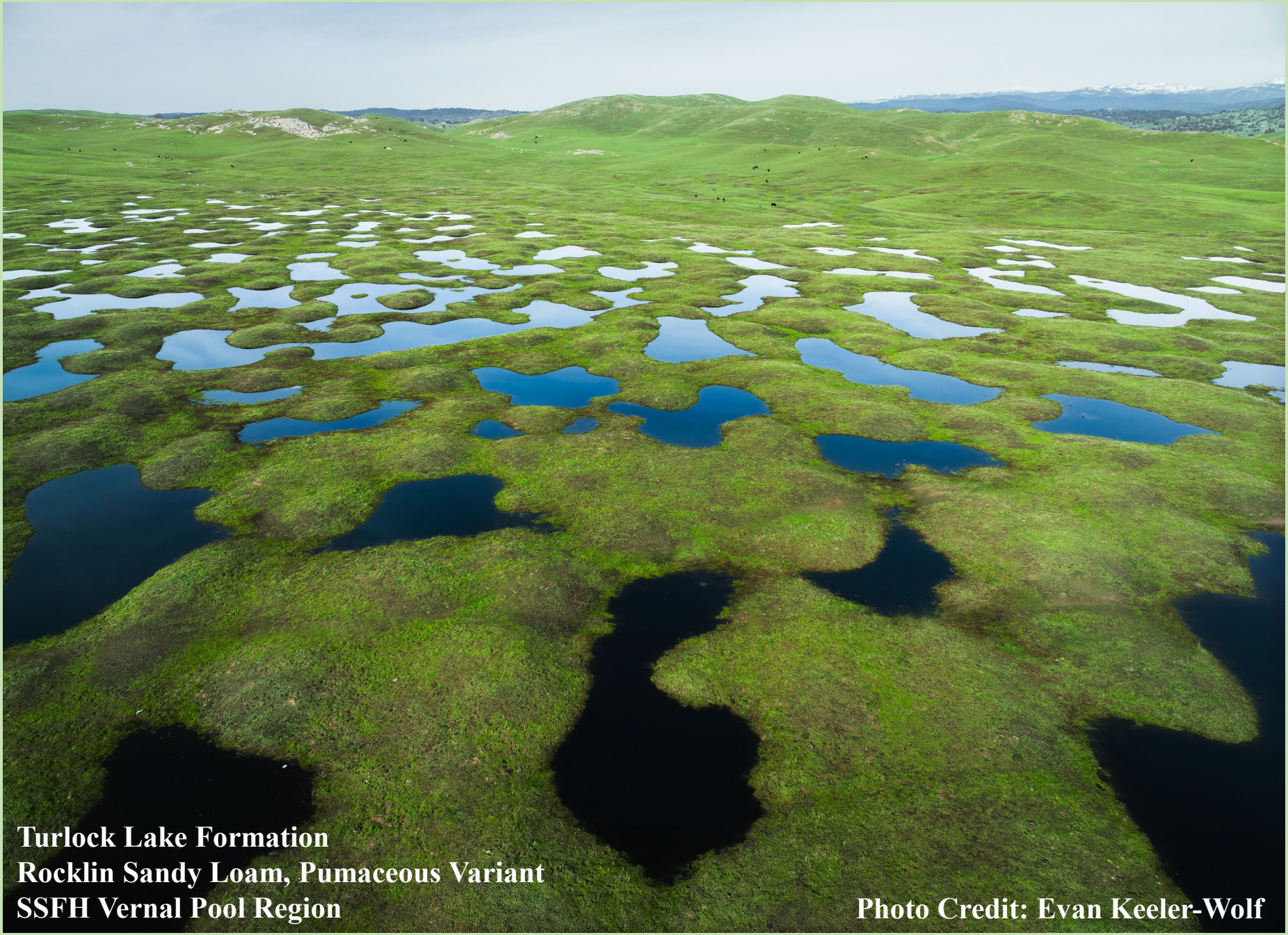
Los Angeles


Turlock Lake Formation
Rocklin Sandy Loam, Pumaceous Variant
SSFH Vernal Pool Region
Photo Credit: Evan Keeler-Wolf

NORTHEASTERN SACRAMENTO VALLEY VERNAL POOL REGION

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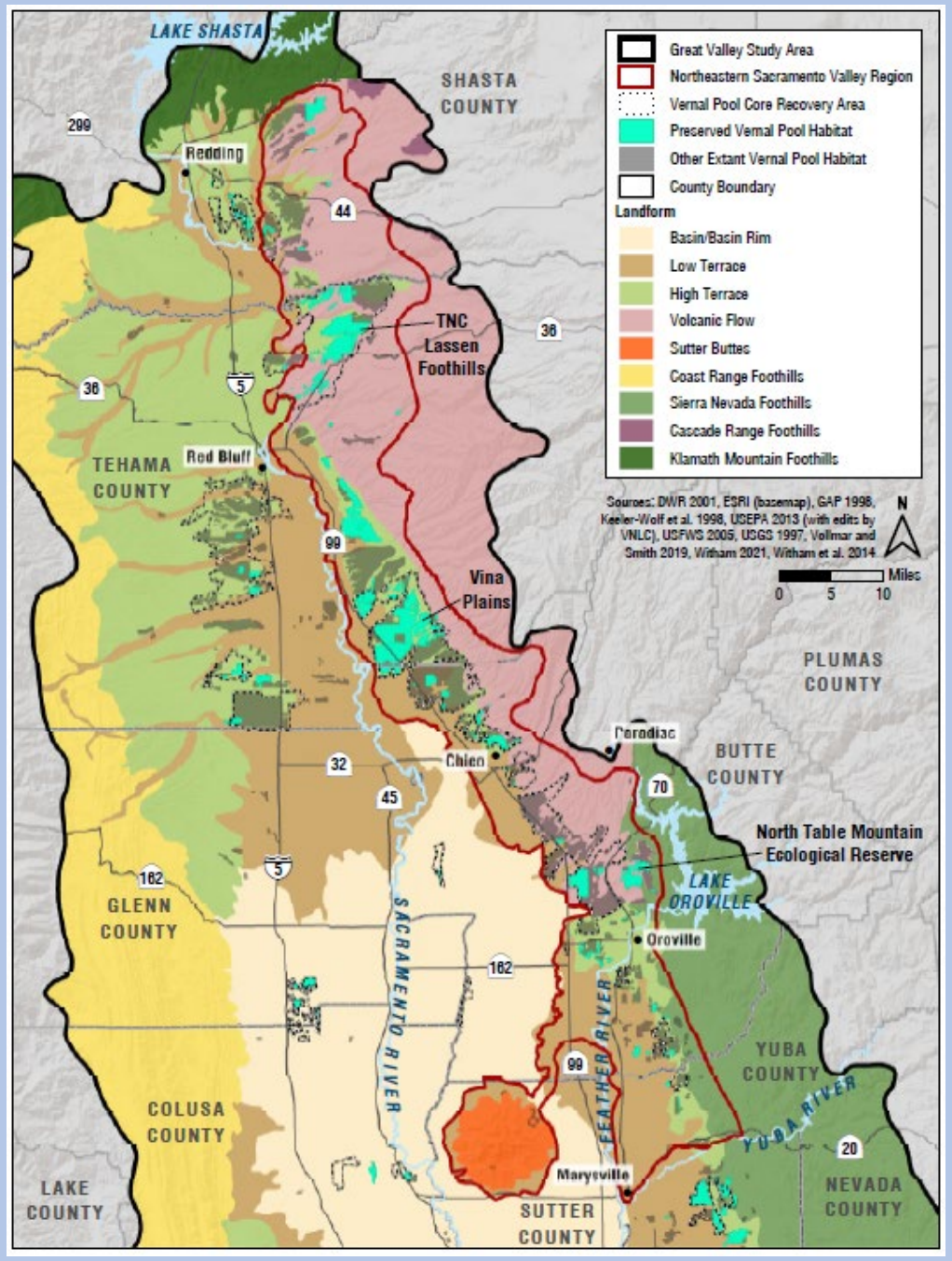
LAKE SHASTA
SHASTA COUNTY
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Redding
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TNC Lassen Foothills
36
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Red Bluff
TEHAMA COUNTY
99
Vina Plains
PLUMAS COUNTY
Paradise
Chico
32
45
70
BUTTE COUNTY
North Table Mountain Ecological Reserve
LAKE OROVILLE
162
GLENN COUNTY
Oroville
SACRAMENTO RIVER
FEATHER RIVER
YUBA COUNTY
YUBA RIVER
COLUSA COUNTY
20
Marysville
NEVADA COUNTY
LAKE COUNTY
SUTTER COUNTY
Great Valley Study Area
Northeastern Sacramento Valley Region
Vernal Pool Core Recovery Area
Preserved Vernal Pool Habitat
Other Extant Vernal Pool Habitat
County Boundary
Landform
Basin/Basin Rim
Low Terrace
High Terrace
Volcanic Flow
Sutter Buttes
Coast Range Foothills
Sierra Nevada Foothills
Cascade Range Foothills
Klamath Mountain Foothills
Sources: DWR 2001, ESRI (basemap), GAP 1998, Keeler-Wolf et al. 1998, USEPA 2013 (with edits by VNLC), USFWS 2005, USGS 1997, Vollmar and Smith 2019, Witham 2021, Witham et al. 2014
N
Miles
0 5 10

Vernal pool habitat on North Table Mountain, Lovejoy Basalt, southeast NESV Region, supporting populations of Butte County meadowfoam (*Limnanthes floccosa* ssp. *californica*), Jim's clover (*Trifolium jokerstii*), and Red Bluff dwarf rush (*Juncus leiospermus* var. *leiospermus*). (Photo Credit: Evan Keeler-Wolf, January 2023)

Vernal pool habitat on Tuscan Formation in early spring, traversed by a stream corridor. (Photo Credit: Evan Keeler-Wolf, March 2023)

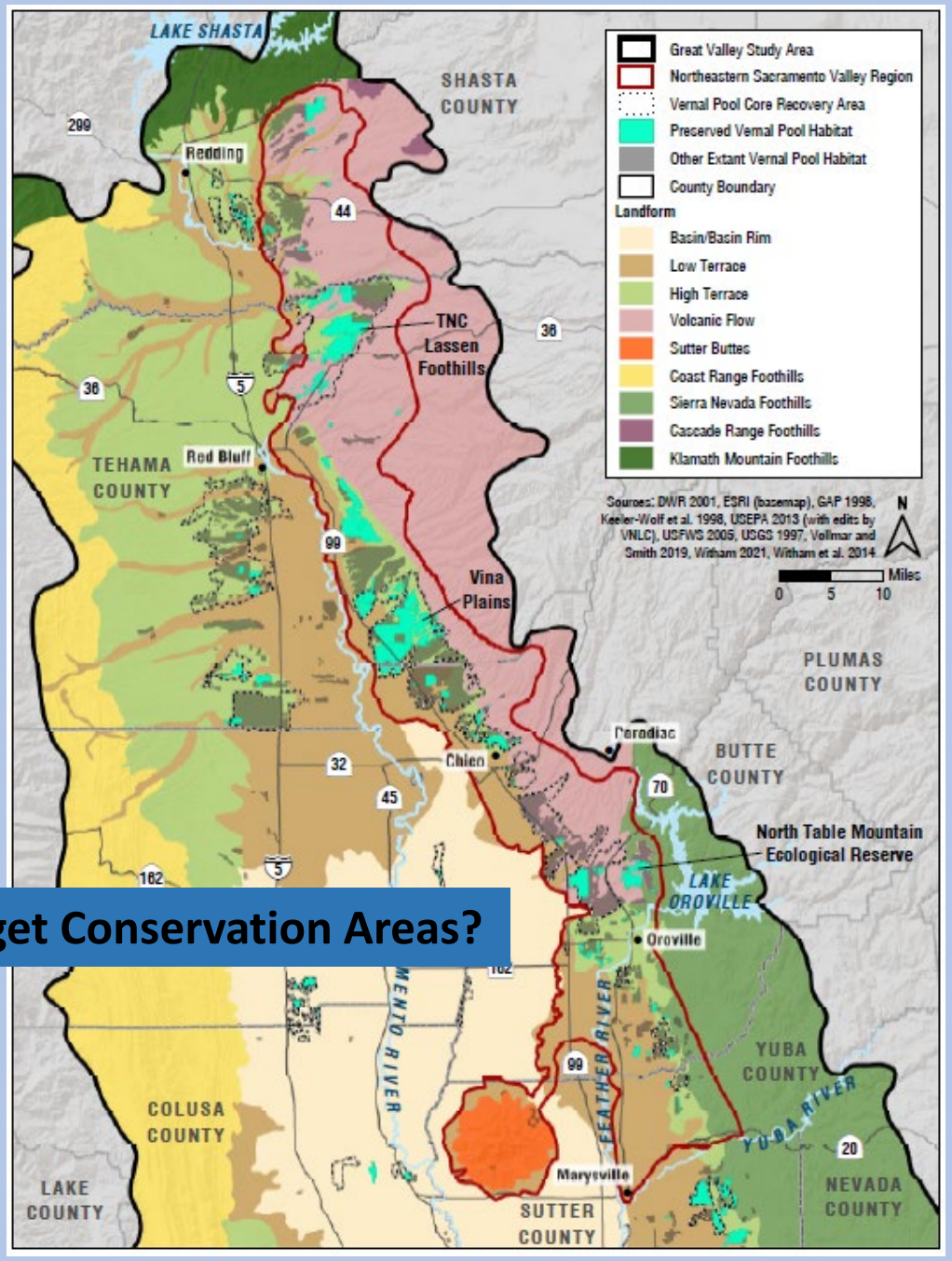
Ahart's dwarf rush (*Juncus leiospermus* var. *ahartii*), highly restricted to the Sierran-derived terraces in the south of the NESV Region, with most documented occurrences on Turlock Lake Formation. (Photo Credit: Carol Witham)

Jim's clover (*Trifolium jokerstii*), endemic to volcanic formations in the southern NESV Region with nearly half of known occurrences on the table mountains formed of Lovejoy Basalt. (Photo Credit: George Hartwell)

Hoover's spurge (*Euphorbia hooveri*), a Great Valley endemic with key populations on the Vina Plains in the NESV Region, where it inhabits playa pools with turbid waters. (Photo Credit: Neal Kramer)

Butte County meadowfoam (*Limnanthes floccosa* ssp. *californica*), endemic to volcanic formations in the central-southern NESV Region. (Photo Credit: Jeb Bjerke)

How to Select Target Conservation Areas?



Process for Selection of Target Conservation Blocks by Region:

- Develop GIS Layer of Geologic Formations
- Develop GIS Layer of Predicted Habitat for Key Rare Species
- Identify the 20 Largest Remaining Blocks of Contiguous VP Habitat
- Use Core Recovery Areas as Foundation
- Select a Subset of 5-10 Blocks as Conservation Targets
- Prepare Profiles of Each Target Block to Guide Ongoing Conservation

Turlock Lake Formation (Variant)
SSFH Vernal Pool Region

Photo Credit: Evan Keeler-Wolf

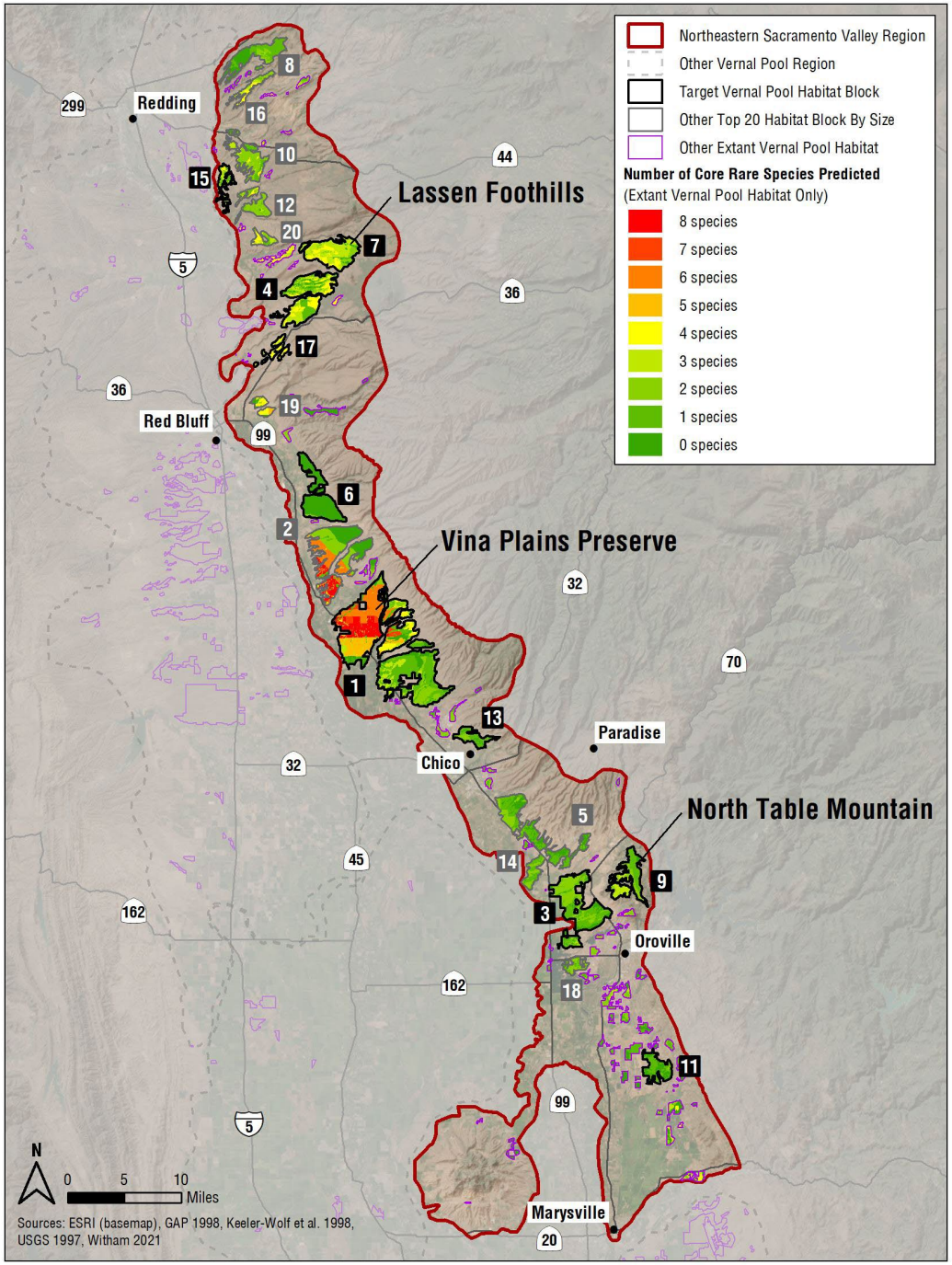

Northeastern Sacramento Valley Region
Other Vernal Pool Region
Target Vernal Pool Habitat Block
Other Top 20 Habitat Block By Size
Other Extant Vernal Pool Habitat
Number of Core Rare Species Predicted
(Extant Vernal Pool Habitat Only)
8 species
7 species
6 species
5 species
4 species
3 species
2 species
1 species
0 species
Lassen Foothills
Vina Plains Preserve
North Table Mountain
Redding
Red Bluff
Chico
Paradise
Oroville
Marysville
299
44
36
99
32
70
45
162
5
20
N
0 5 10
Miles
Sources: ESRI (basemap), GAP 1998, Keeler-Wolf et al. 1998, USGS 1997, Witham 2021

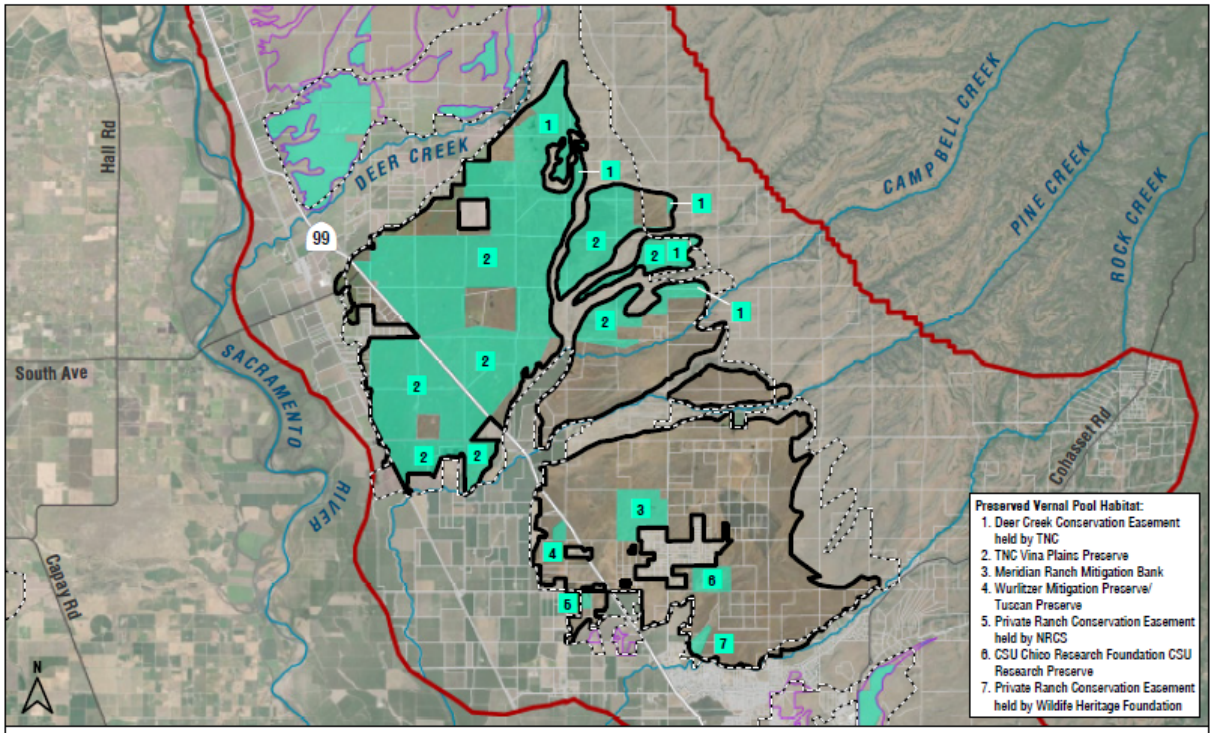
Table B-5. Mapped Vernal Pool Habitat by Geologic Formation within 20 Largest Habitat Blocks, Northeastern Sacramento Valley Vernal Pool Region, Great Valley, California. Highlighted rows indicate blocks selected as conservation targets.

Vernal Pool Habitat Block	Mapped Vernal Pool Habitat by Geologic Formation (ac.)[1]															Total Size (ac.)	Conserved Habitat (ac.)	Conserved Habitat (%)
	Cascade Volcanic Rock Sources								Sierran Mixed Granitic/Metamorphic Rock Sources						Other			
	Lovejoy Basalt	Tuscan	Red Bluff	Riverbank	Modesto	Recent Basalt Flow	Quaternary Basin Deposits	Other Formations	Laguna	Red Bluff	Turlock Lake	Riverbank	Modesto	Other Formations	Ione			
1	0	1,377	19,571	8,398	1,627	0	807	0	0	0	0	0	0	0	0	31,781	14,074	44%
2	0	0	10,476	490	322	0	268	161	0	0	0	0	0	0	0	11,718	1,969	17%
3	110	7,550	2	0	304	0	257	0	1,099	22	0	3	0	0	284	9,632	2,620	27%
4	0	99	6,589	0	585	1,019	0	0	0	0	0	0	0	0	0	8,292	6,900	83%
5	0	6,879	0	0	1,199	0	0	0	0	0	0	0	0	0	0	8,078	184	2%
6	0	1	4,557	144	311	0	1,331	0	0	0	0	0	0	0	0	6,343	5,669	89%
7	0	256	3,632	0	0	2,028	0	354	0	0	0	0	0	0	0	6,270	1,019	16%
8	0	2,564	2,260	0	0	0	0	0	0	0	0	0	0	0	0	4,823	1,556	32%
9	4,679	0	0	0	0	0	0	8	0	0	0	0	0	0	0	4,687	2,216	47%
10	0	136	3,583	496	27	136	0	10	0	0	0	0	0	0	0	4,387	0	0%
11	0	0	0	0	0	0	0	0	477	228	592	1,011	116	475	0	2,897	276	10%
12	0	690	71	106	1	1,713	0	0	0	0	0	0	0	0	0	2,581	101	4%
13	0	1,102	552	0	324	0	0	0	0	0	0	0	0	0	0	1,979	1,195	60%
14	0	634	0	0	1,195	0	27	0	0	0	0	0	0	0	0	1,857	0	0%
15	0	294	448	1,011	0	0	0	0	0	0	0	0	0	0	0	1,753	269	15%
16	0	1,337	0	0	0	286	0	0	0	0	0	0	0	0	0	1,622	207	13%
17	0	737	0	0	0	673	0	0	0	0	0	0	0	0	0	1,411	1,386	98%
18	0	0	0	0	0	0	0	0	1,354	0	0	0	0	0	0	1,354	437	32%
19	0	0	899	32	244	0	0	37	0	0	0	0	0	0	0	1,213	0	0%
20	0	3	1,104	0	0	0	0	0	0	0	0	0	0	0	0	1,107	16	1%
Total All Selected Blocks	4,789	11,415	35,352	9,554	3,150	3,720	2,396	362	1,575	250	592	1,014	116	475	285	75,045	35,625	47%
% of Region Total	93%	43%	62%	87%	48%	59%	89%	46%	28%	31%	31%	29%	22%	20%	98%	57%	81%	-
Region Total[1]	5,158	26,582	56,783	10,927	6,496	6,272	2,693	785	5,691	813	1,923	3,471	521	2,391	289	131,280[2]	43,790	33%

1. Extant mapped vernal pool habitat only. Geology types derived from Sutter Buttes Volcanic Rock Sources are excluded from this table (see **Table B-1**), as they do not support any mapped vernal pool habitat within the 20 largest vernal pool habitat blocks. Note: slight discrepancies may be present due to rounding.

2. Total mapped vernal pool habitat includes rock sources/geology types which have been excluded from this table (see **Table B-1**).

Habitat Block 1. This is by far the largest contiguous block of vernal pool habitat remaining in the Region. At more than 31,000 acres, it is about three times larger than the next largest block. This block encompasses the Vina Plains and surrounding lands. This area has multiple playa pools and a high diversity and abundance of numerous rare species including key populations of Conservancy fairy shrimp, vernal pool tadpole shrimp, hairy Orcutt grass, Greene's tuctoria, and Hoover's spurge. It primarily encompasses volcanic Red Bluff and Riverbank formations. It also has predicted habitat for numerous core rare species. Nearly half (14,074 acres) of this block is conserved, due in large part to efforts by The Nature Conservancy over the past several decades. Most conserved habitat is in the northern half of the block which is also where many of the documented rare species occur. The southern half includes many smaller parcels and so may be more difficult to conserve. Also, this area is primarily on Riverbank Formation and may not have the same high diversity and abundance of rare species. One roughly 500-acre parcel near the center of the southern half with a number of Conservancy fairy shrimp occurrences is conserved as well as several smaller blocks to the south and west. The Nature Conservancy can probably provide the best insight into the feasibility and value of conserving additional lands in this southern area.



Habitat Block 1

Central NESV Region; 31,781 acres

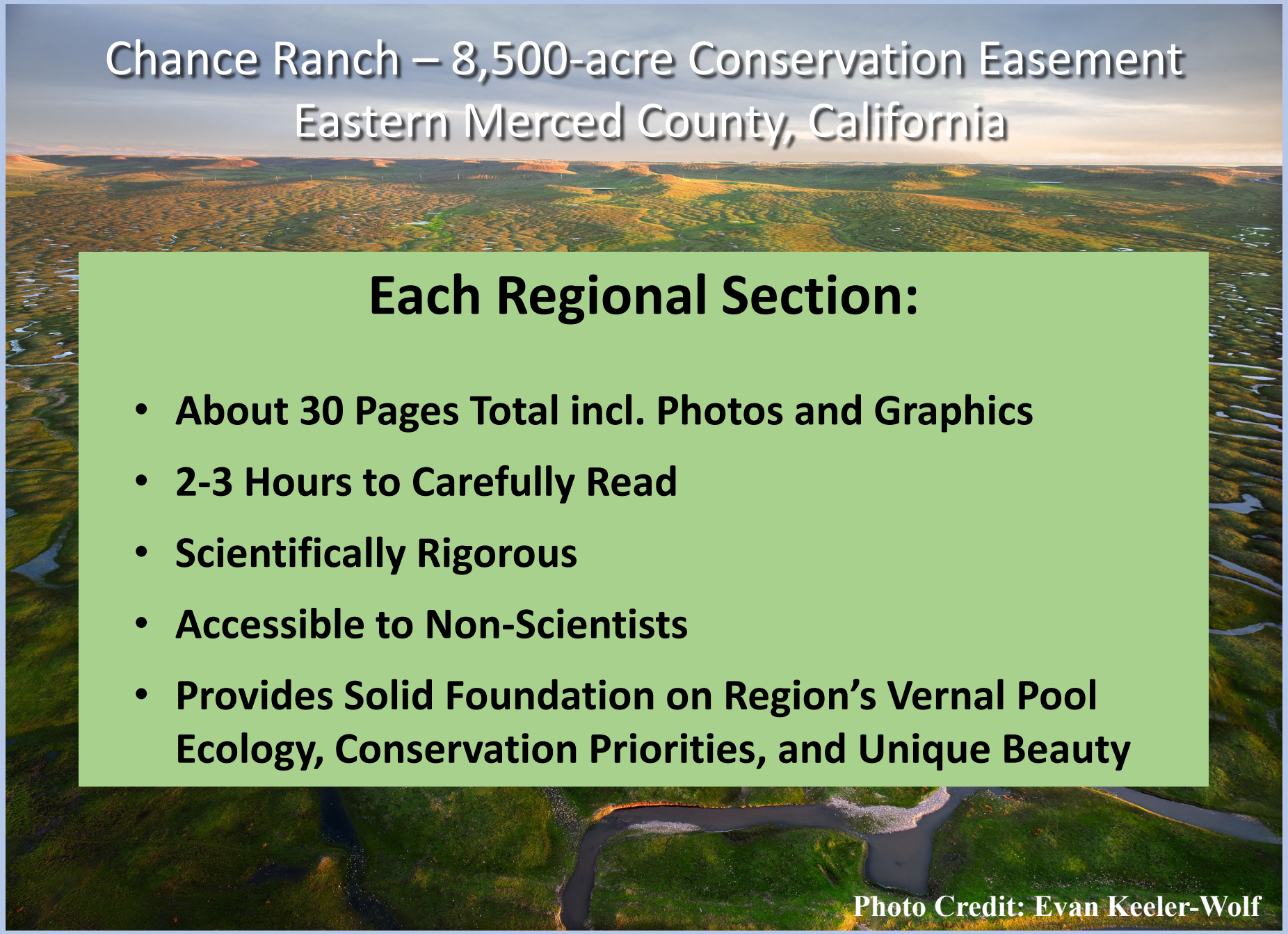
Target Vernal Pool Habitat Block
Other Vernal Pool Habitat
Vernal Pool Core Recovery Area
Preserved Vernal Pool Habitat*
County Assessor Parcel
Northeastern Sacramento Valley Region

Acres
1,000
200

Miles
0 0.75 1.5 3

*Note: Preserved vernal pool habitat shown on this map may not represent the most up-to-date information. Conservation status of lands within the block should be confirmed as part of ongoing conservation efforts. Preserved land may extend past the boundaries of vernal pool habitat, but is not shown on this map.

Sources: Butte County 2018, ESRI (basemap), GAP 1998, Keeler-Wolf et al. 1998, Tehama County 2019, TIGER 2021, USFWS 2005, USGS various, Vollmar and Smith 2019, Witham 2021


Chance Ranch – 8,500-acre Conservation Easement
Eastern Merced County, California
Each Regional Section:
• About 30 Pages Total incl. Photos and Graphics
• 2-3 Hours to Carefully Read
• Scientifically Rigorous
• Accessible to Non-Scientists
• Provides Solid Foundation on Region's Vernal Pool Ecology, Conservation Priorities, and Unique Beauty
Photo Credit: Evan Keeler-Wolf

Chance Ranch – 8,500-acre Conservation Easement
Eastern Merced County, California

Final Step: Dissemination of Results

- 1,000 Printed Copies
- Searchable E-Book Available
- Delivery of Shapefiles to Agencies, Non-profits, Mitigation Bankers, Etc.
- Presentations
- Possible College Course

The Goal: Target Habitat Blocks become a Common Reference for Ongoing Conservation

Photo Credit: Evan Keeler-Wolf


Chance Ranch – 8,500-acre Conservation Easement
Eastern Merced County, California
The Heart of Conservation
Working to Help Permanently
Conserve a Natural Place that You Love
Photo Credit: Evan Keeler-Wolf

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