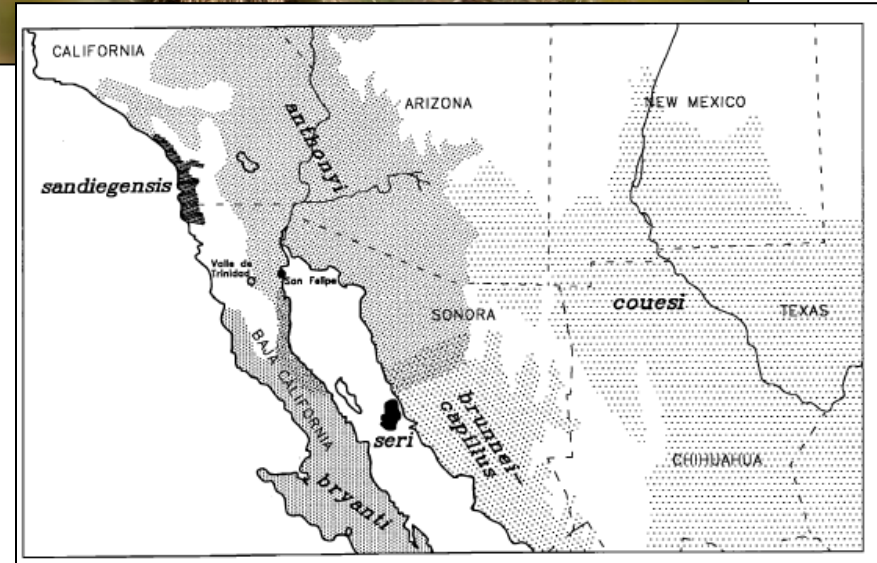
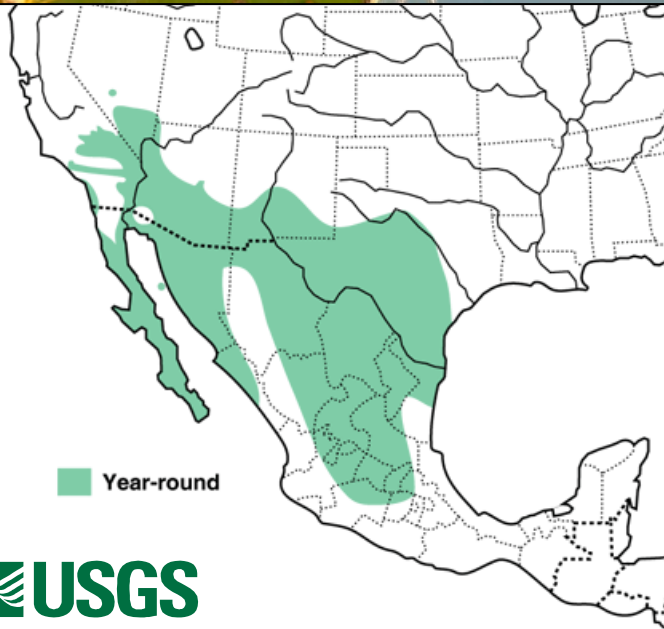


Genetic Structure in the Cactus Wren in Southern California: Subspecies Delineations and Implications for Population Management

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San Diego Field Station**

Coastal Cactus Wren



Project Objectives

Goal:

To evaluate the degree of connectivity among coastal Cactus Wren populations in southern California

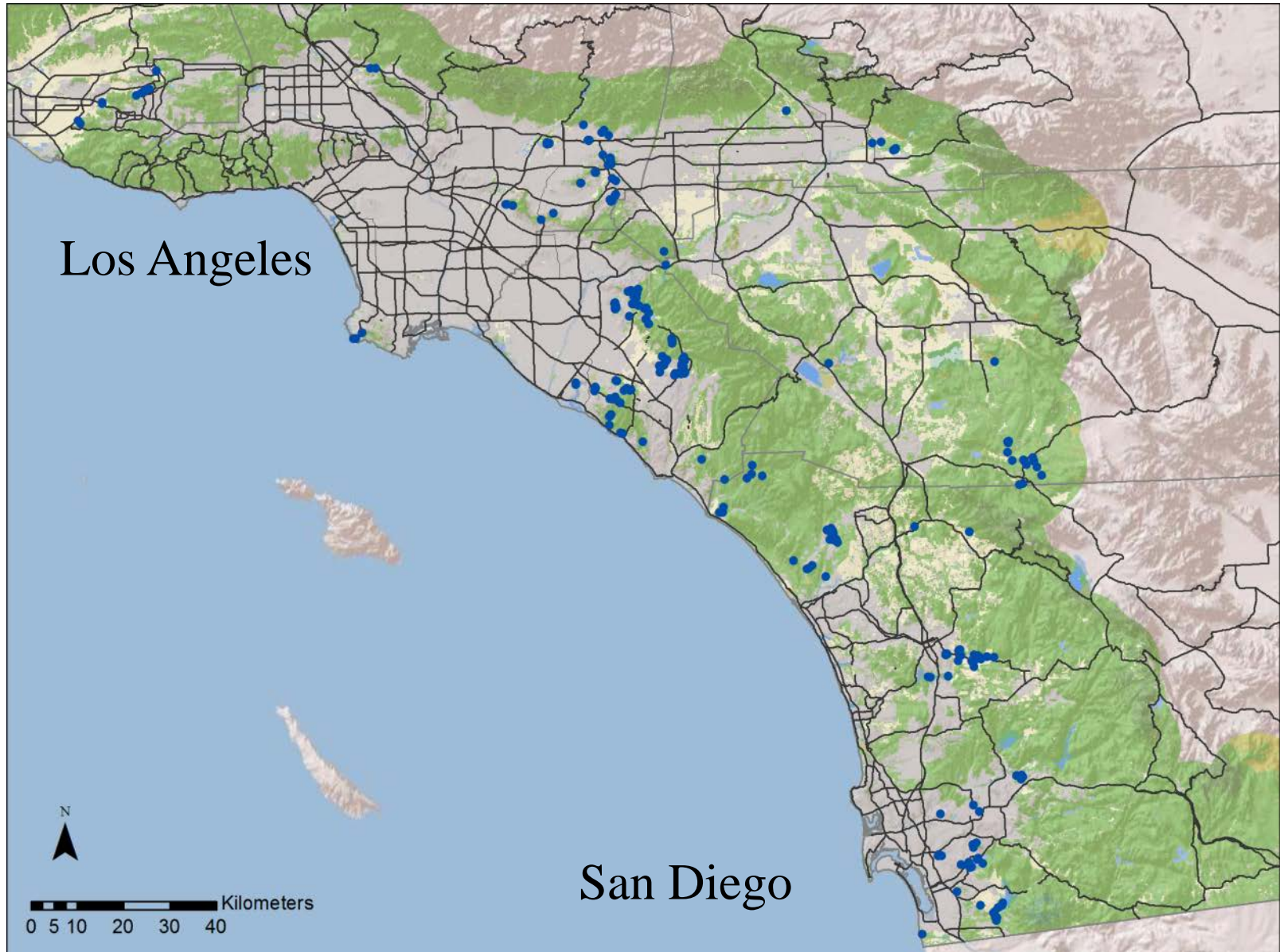
Objectives:

- Use microsatellite markers to evaluate within- and among-population genetic variability of coastal Cactus Wrens
- Color banding/resighting of Cactus Wren nestlings/fledglings to investigate juvenile dispersal patterns and behavior

Methods: Sample Collection and Banding



Collection Locations



Genetic Analyses

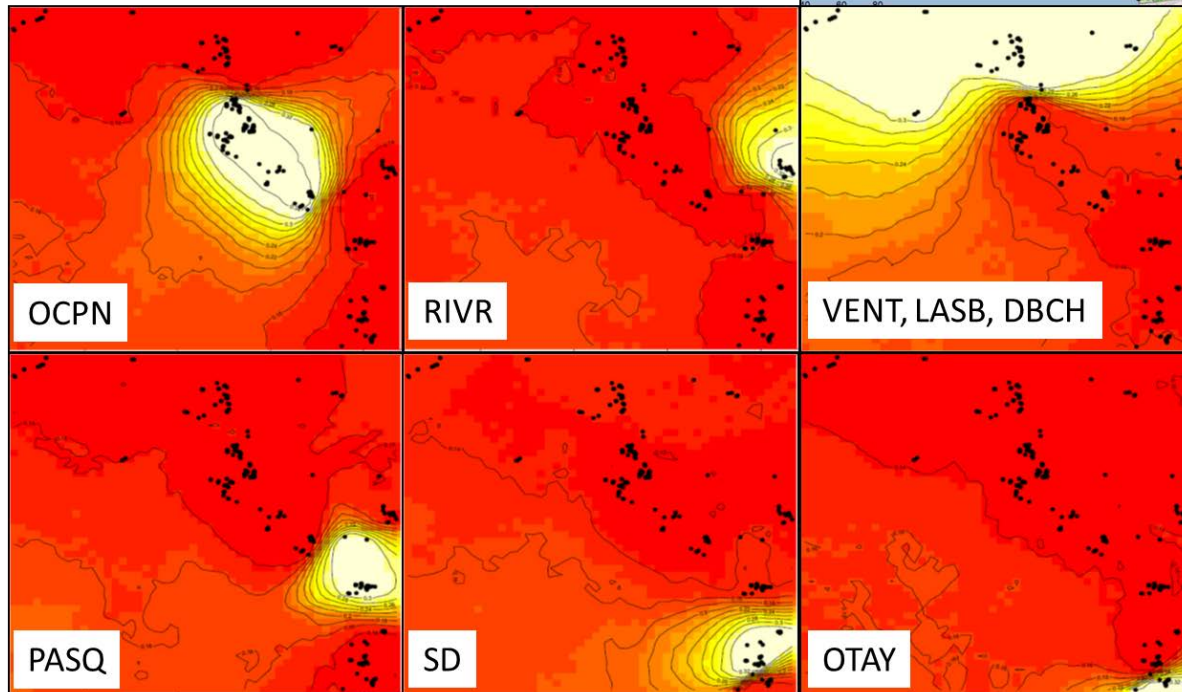
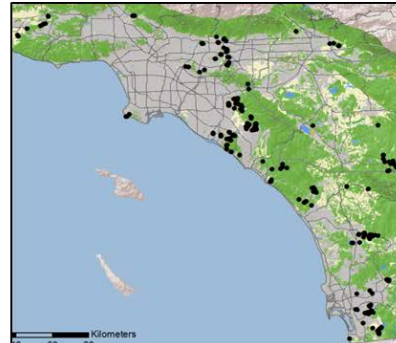
- Developed 26 microsatellite loci, genotyped 349 individuals
1. Identify gene pool/population boundaries.
 2. Are there limitations to movement and gene flow?
 3. Measure the genetic diversity within aggregations, test for recent reductions in population size, environmental correlates.
 4. Assess whether there is a genetic break concordant with *sandiegensis* subspecies boundary.



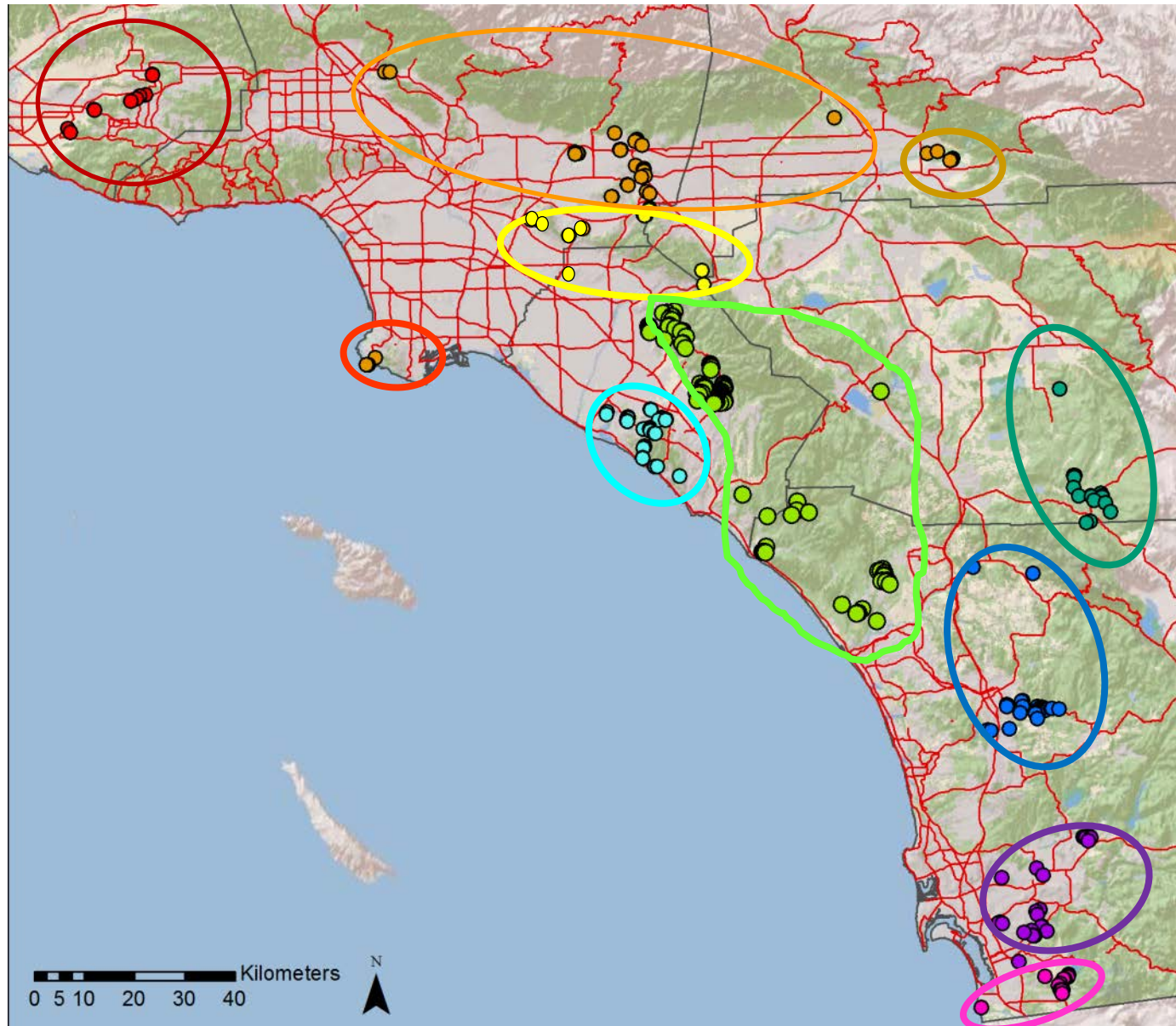
Genetic Clusters

Individual-based clustering methods (Geneland and Structure)

- 6 major clusters
- Further structuring within LA and OC



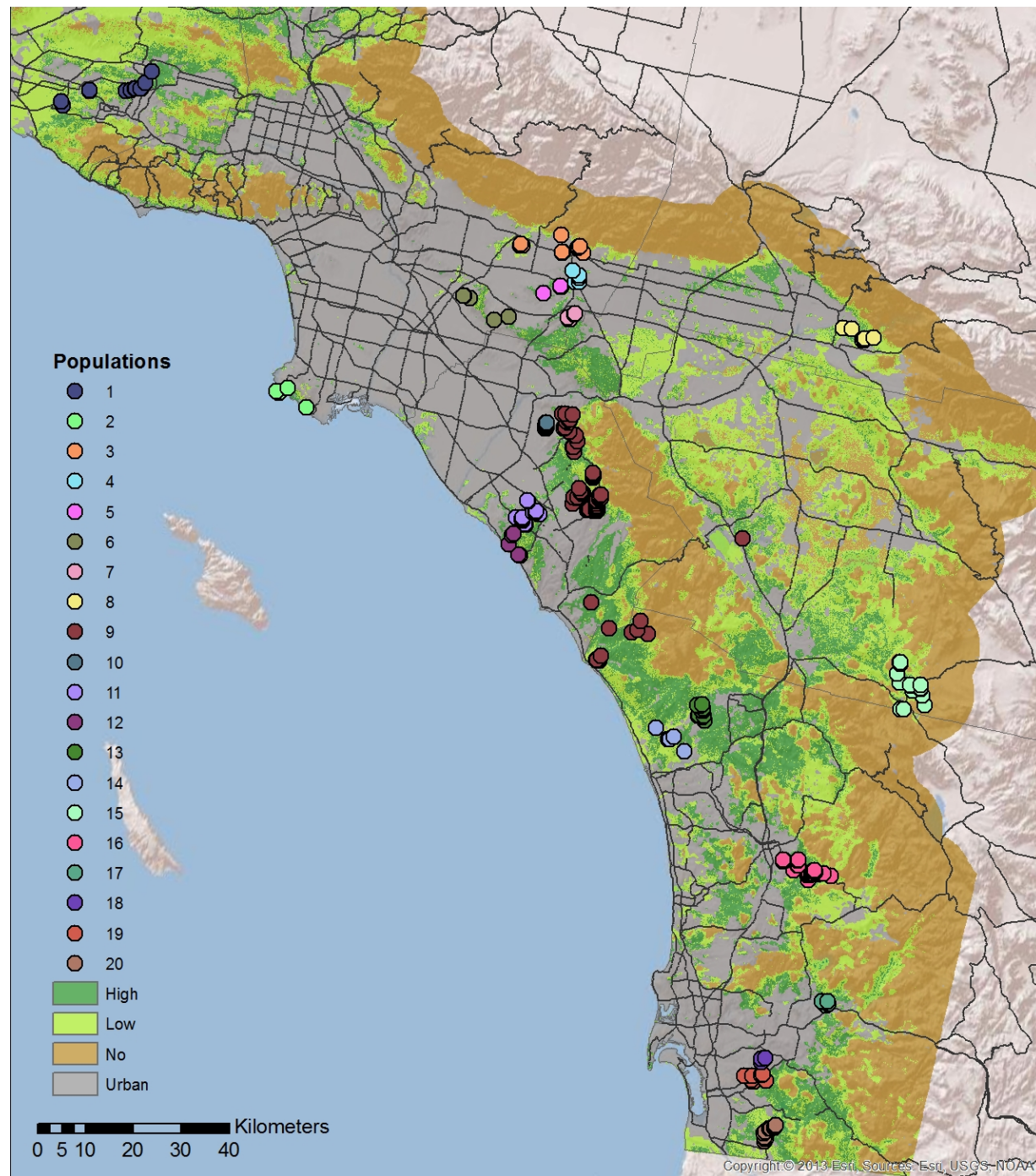
11 Genetic Clusters



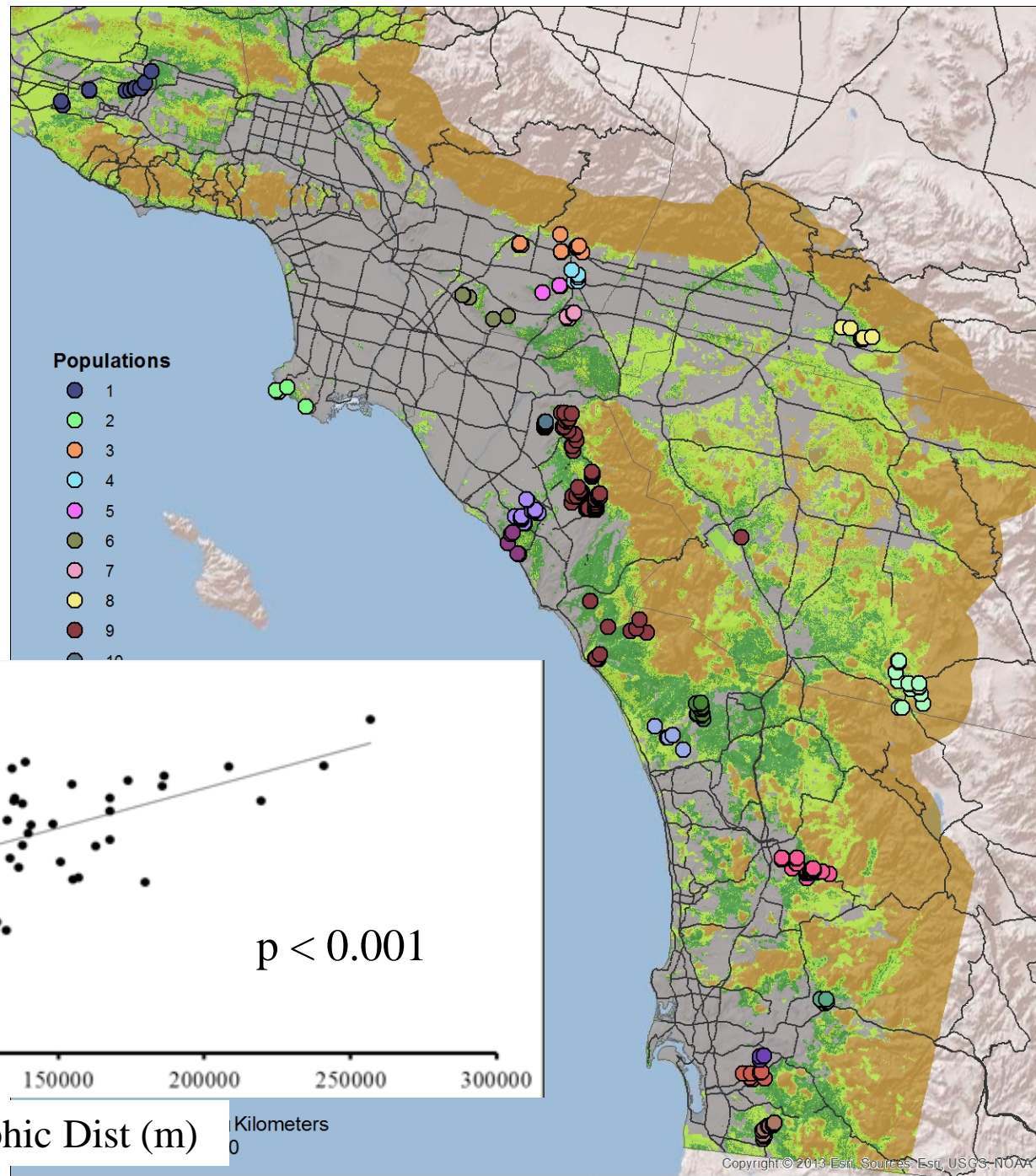
Ventura
PalosVerdes
Los Angeles
Puente/Chino
San Bernardino
Central OC
Coastal OC
Riverside
San Pasqual
San Diego
Otay

Population Differentiation

- Aggregations of 5 or more individuals
- Exact X^2 test for population differentiation
- 20 populations



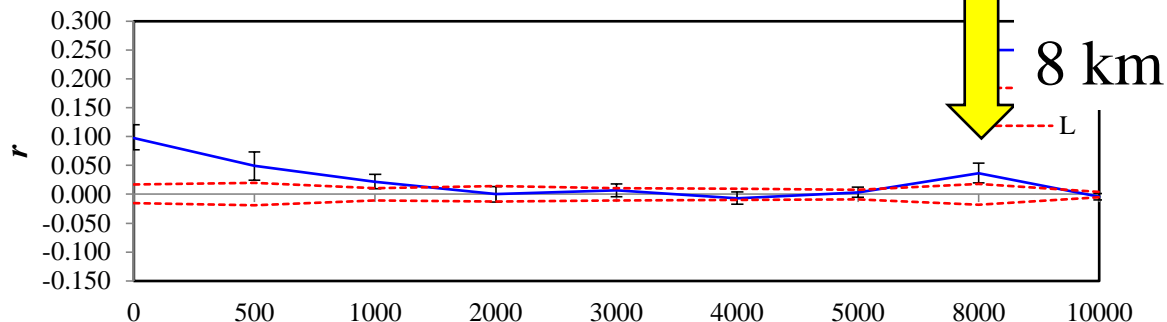
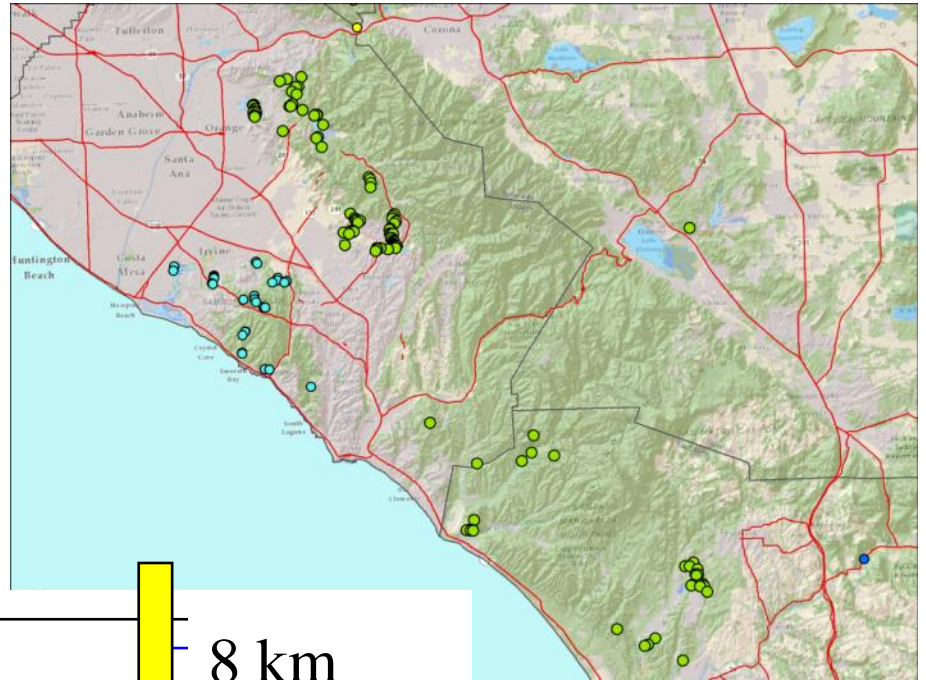
Stepping Stone Gene Flow



Spatial Autocorrelation Analysis:

- Plot the genetic relatedness among individuals grouped at different distance classes
- Positive observed values (blue) indicate that individuals are more similar genetically than by chance alone (red dashed lines)

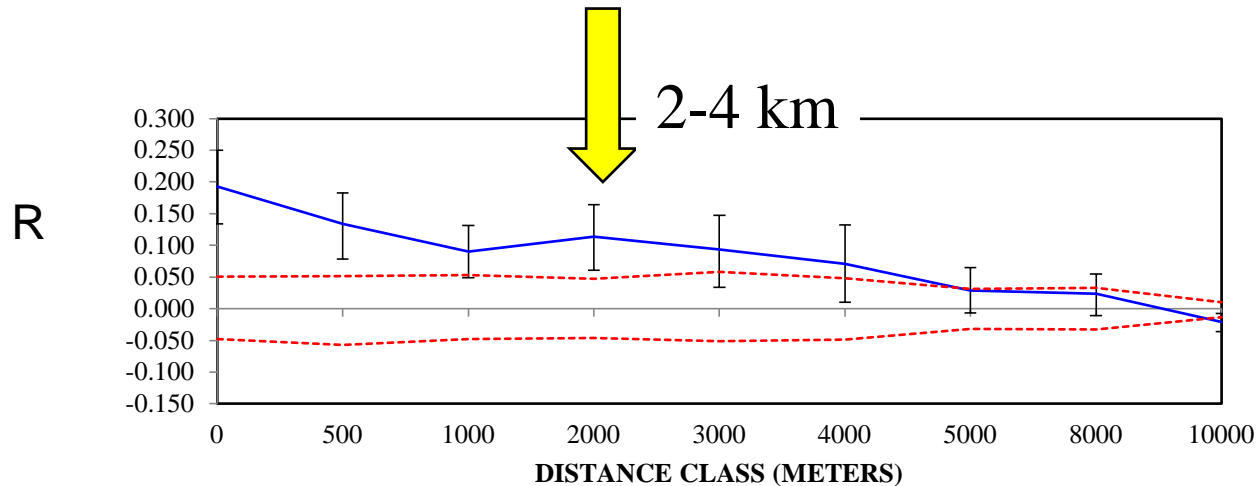
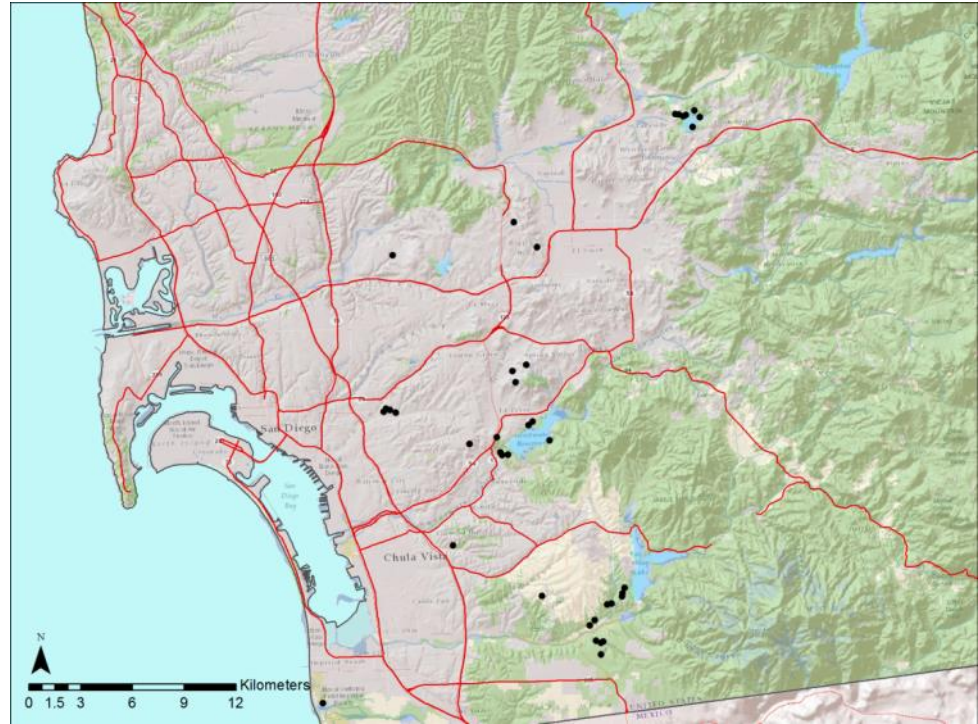
Central OC



Spatial Autocorrelation Analysis

San Diego

***relatedness
values twice as
high**



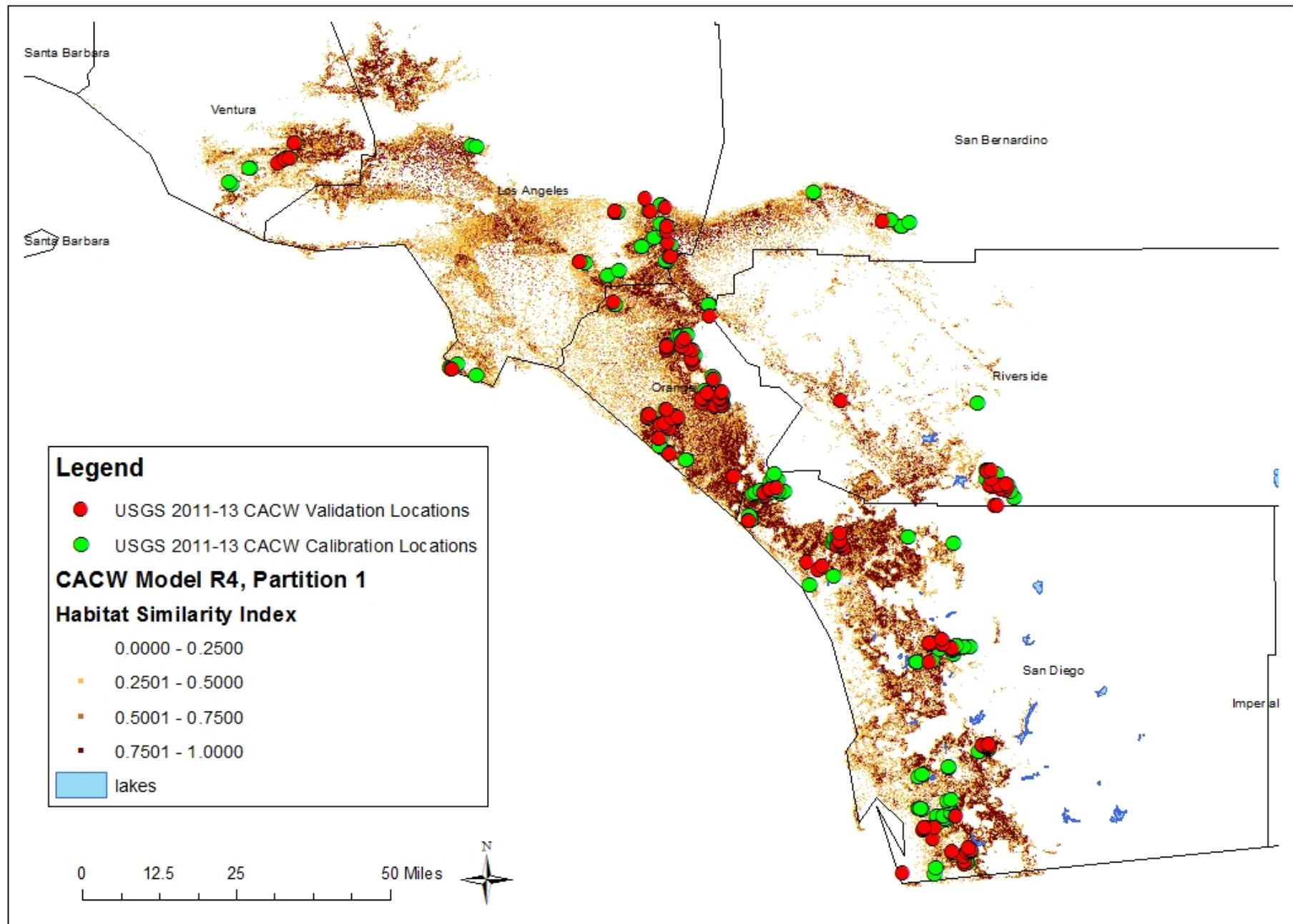
Cactus Wren Dispersal



Photo by Steve Brad



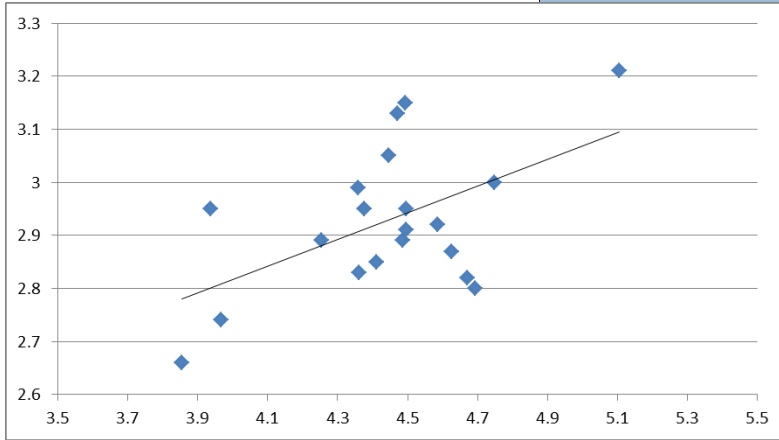
- Relatedness distances match well with dispersal of banded nestlings and adults.
 - Shorter in San Diego fragments (< 1km)
 - Longer in Camp Pendleton and central Orange County (up to 8-10 km)



Cactus Wren Modeled Habitat Suitability in Southern California (Model Run 4b, P1)

Genetic Diversity

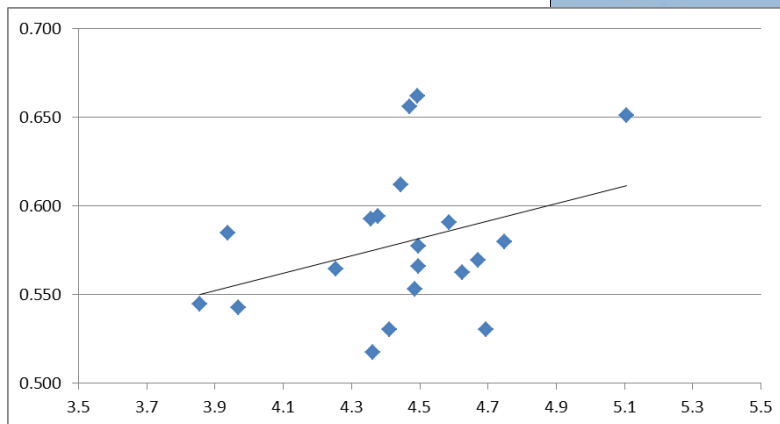
A_r



Log Area

- 10
- 11
- 12

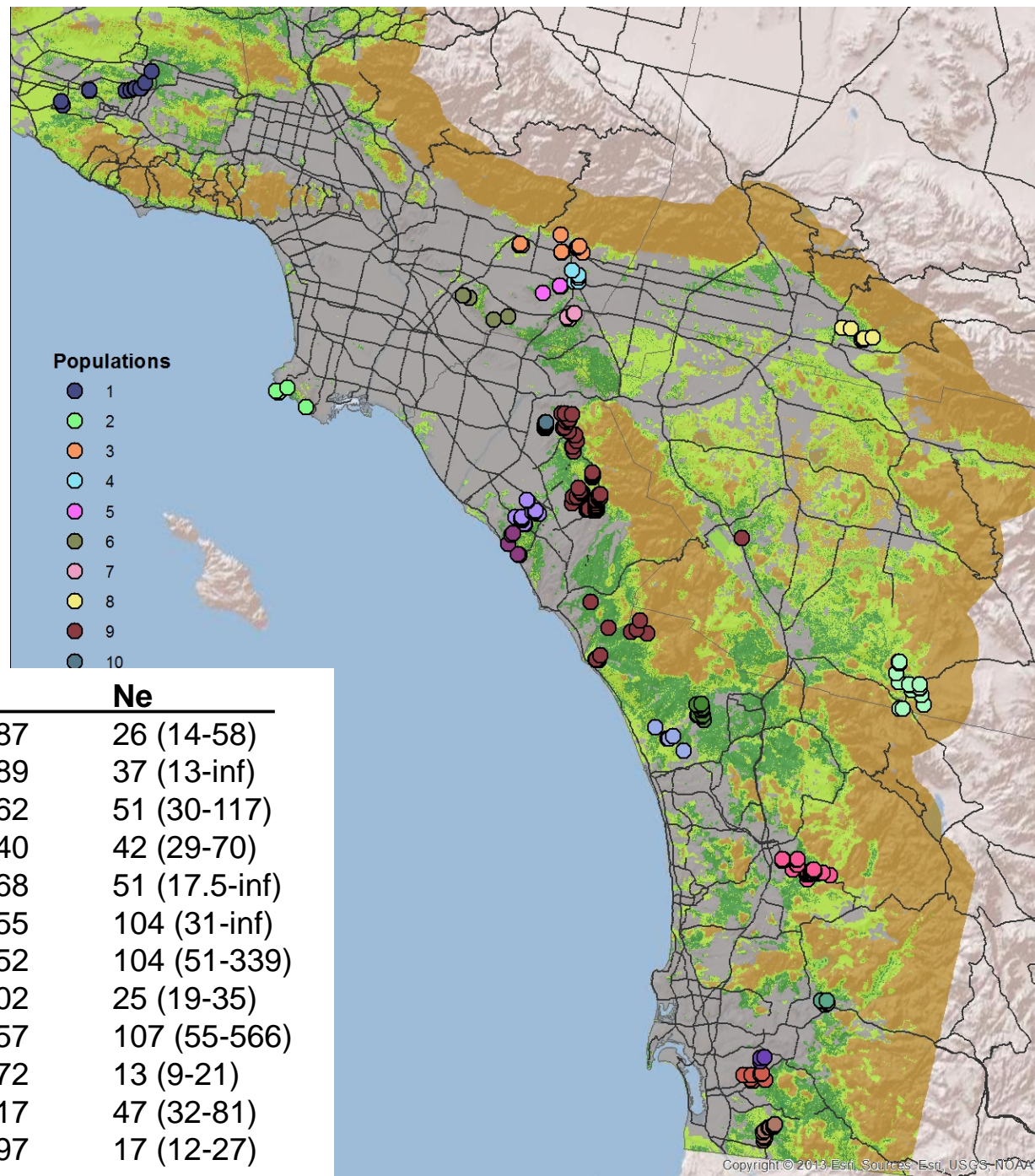
H_e



Log Area

0 5 10 20 30 40 Kilometers

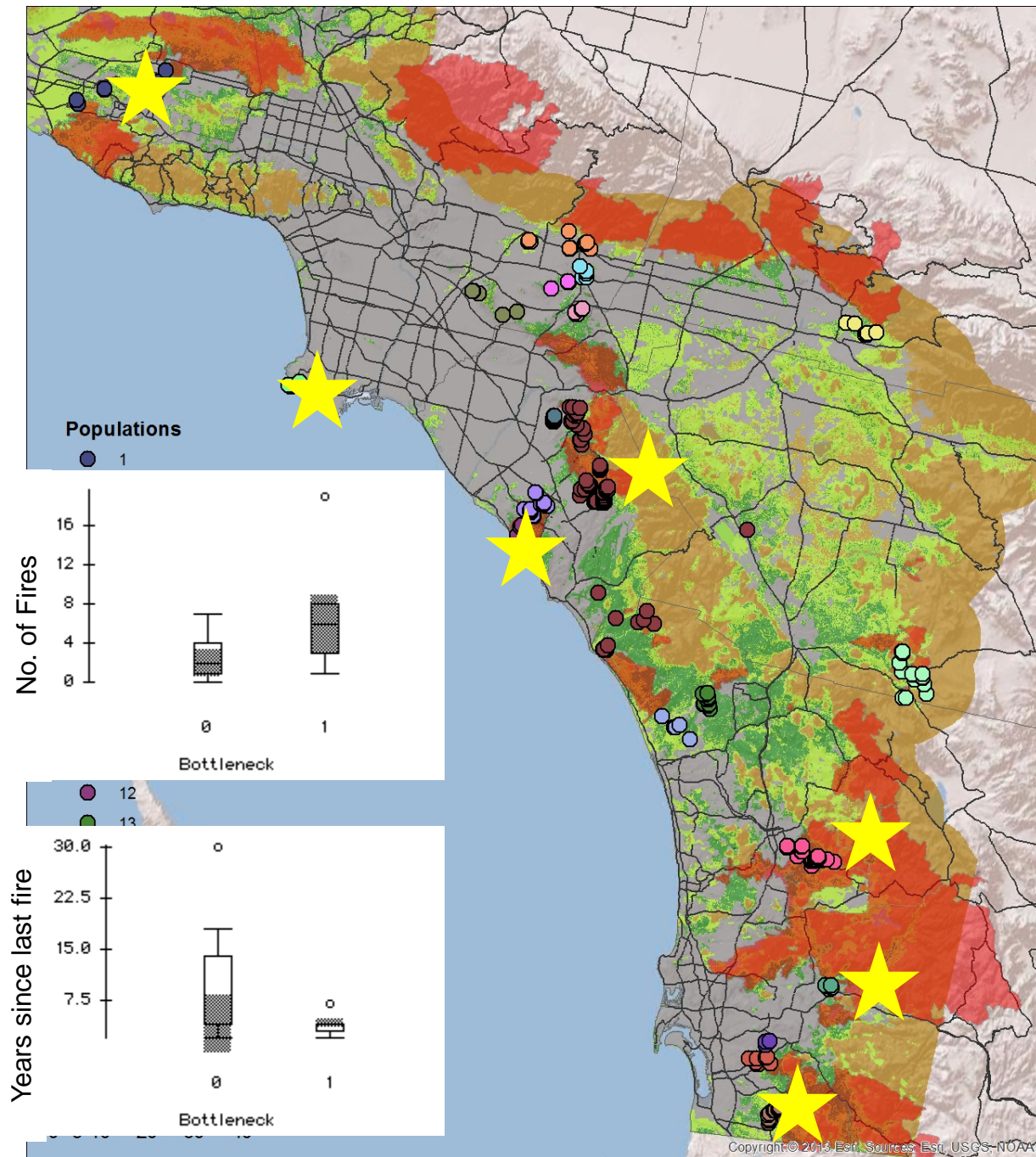
Genetic Diversity



Cluster	N	Ar	H	Ne
Vent	15	3.75	0.587	26 (14-58)
PV	8	3.34	0.589	37 (13-inf)
LA	30	4.26	0.562	51 (30-117)
PUE/CHI	22	4.38	0.640	42 (29-70)
SB	8	3.65	0.568	51 (17.5-inf)
RIV	15	4.1	0.555	104 (31-inf)
Cent. OC	141	4.66	0.652	104 (51-339)
Coast OC	31	4.27	0.602	25 (19-35)
PASQ	35	4.31	0.657	107 (55-566)
Jennings	12	4.05	0.572	13 (9-21)
SD	21	4.47	0.617	47 (32-81)
OTAY	15	4.24	0.697	17 (12-27)

Recent Genetic Bottlenecks and Wildfire

- Measured habitat loss and demographic declines.
- Bottlenecked sites associated with more fires and more recent fires



CAWR36PV USA - California Palos Verdes
CAWR39PV USA - California Palos Verdes
CAWR37PV USA - California Palos Verdes
CAWR12CA USA - California Imperial Co. 3 mi SW Calipatria
CAWR11CA USA - California Imperial Co. 3 mi SW Calipatria
See: 1503, 1503.054, 890.

- (ND2 and



- 1811

Eggert, L.S. 1996. Master's Thesis. San Diego State Univ.

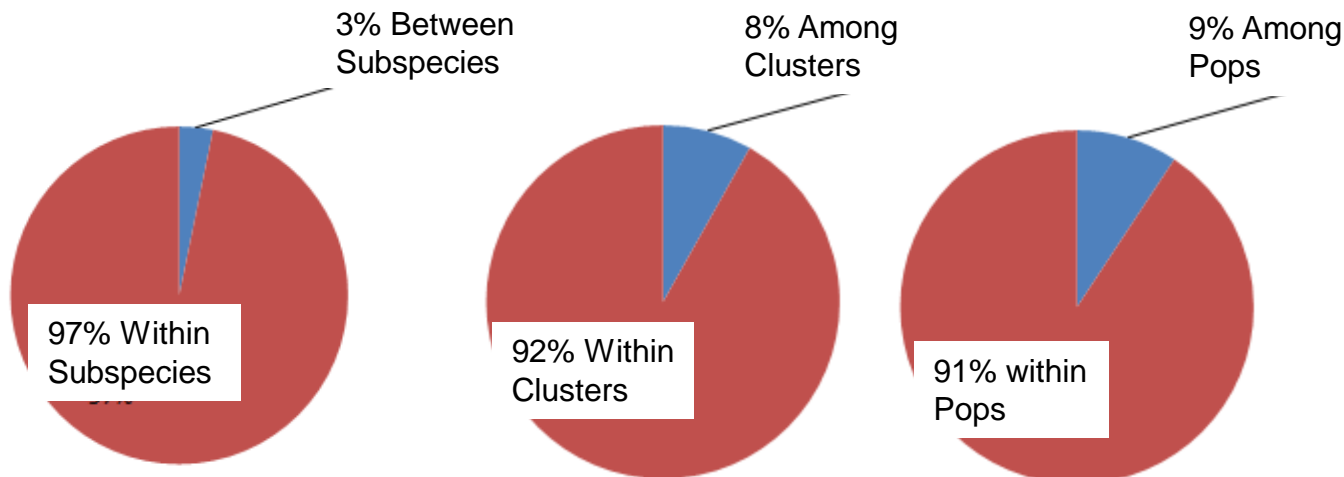
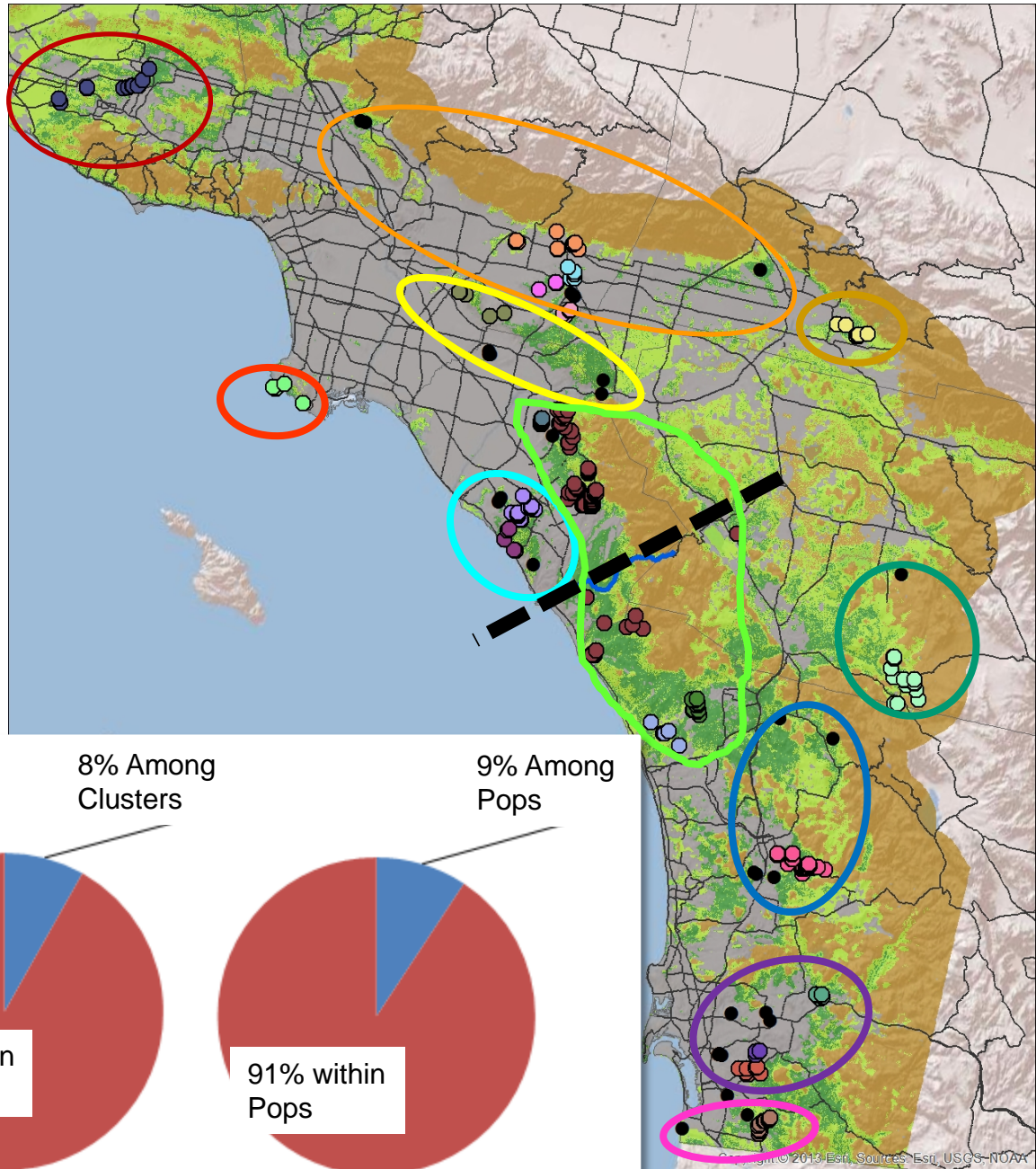
Teutimez, MR. 2012. Masters Thesis. Cal. State Long Beach.

IF (1),

Baja

Microsatellites and *C. b.* *sandiegensis*

- No desert populations sampled.
- Putative boundary at San Juan Creek (Rea and Weaver 1990)



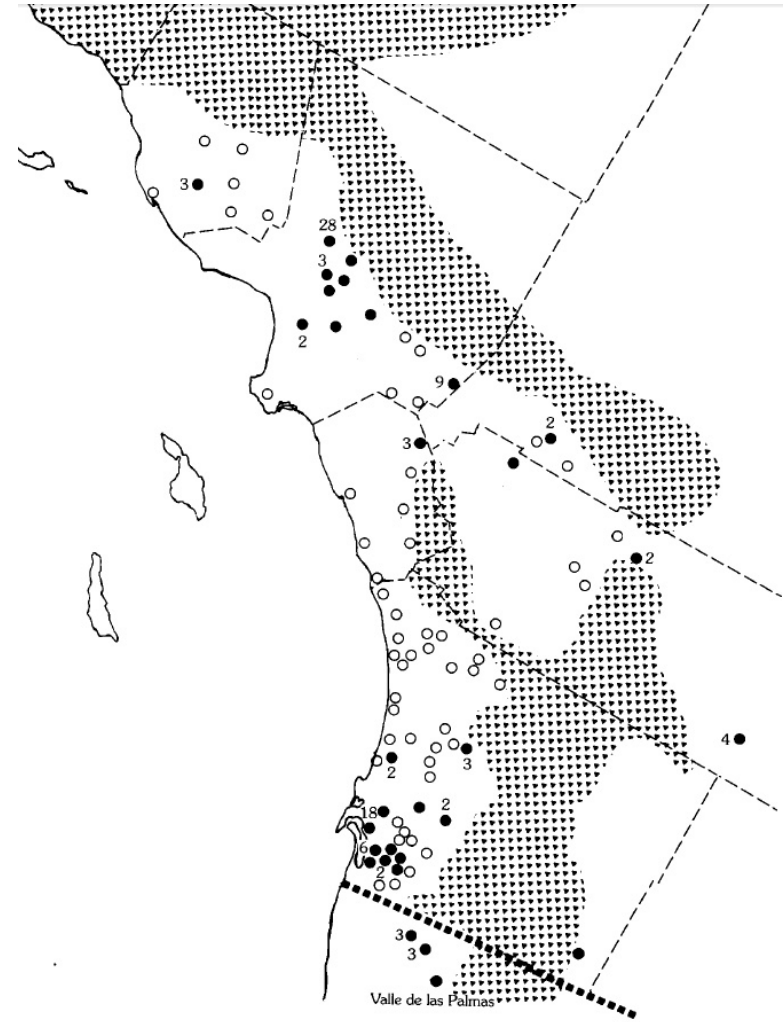
C. b. sandiegensis: Morphological Evidence?

Rea & Weaver 1990

- Sampling gap through middle range
- ~40% “Northern Samples and ~40% “southern” samples each from 1 location
- 7 characters distinguished between pure *anthonyi* and *bryanti*, coastal birds intermediate.

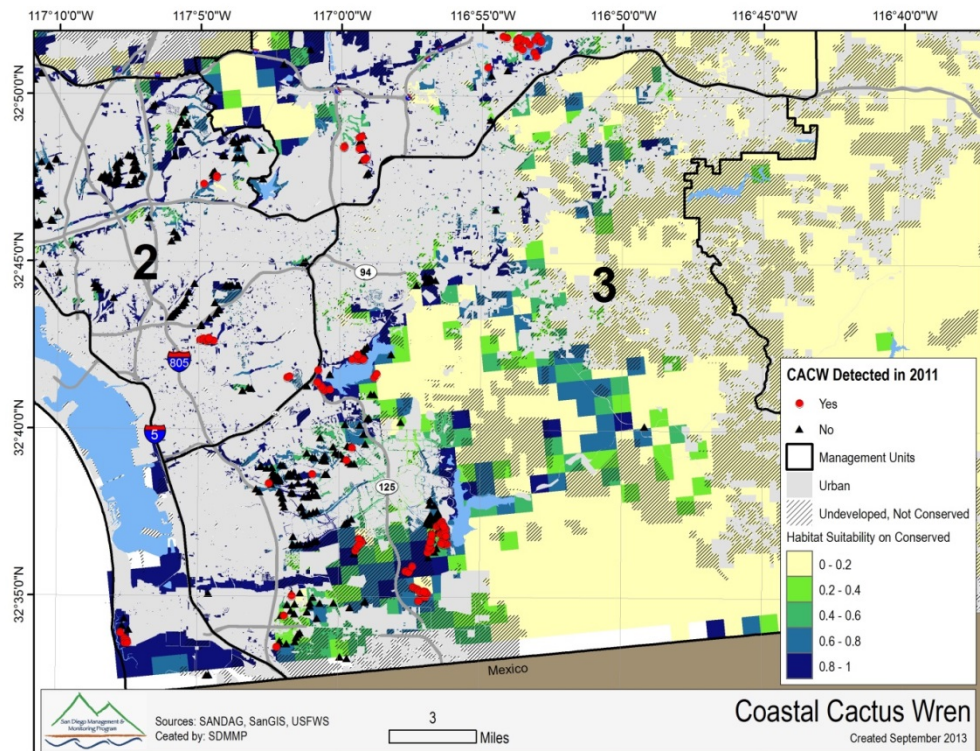
Eggert 1996

- Phylogenetic analysis of 7 morphological characters
- 3 clades, overlapped geographically
- Every clade contained northern and southern coastal birds



Summary

1. Coastal cactus wrens are genetically structured by geographic distance and habitat availability.
2. Sensitive to habitat loss, perturbation and fragmentation, with impacts to genetic connectivity and diversity.
3. Management: retain connectivity through central Orange County; restoration of corridors between aggregations where possible.



ACKNOWLEDGMENTS

San Diego Monitoring and Management Program
US Fish & Wildlife Service
California State Parks & Recreation
California Department of Fish & Wildlife
CalTrans
CACW Working Group
Conservation Biology Institute
The Nature Conservancy
Center for Natural Lands Management
Bureau of Land Management
AECOM
City of San Diego
County of San Diego
City of Chula Vista
San Diego Gas & Electric
San Dieguito River Park
San Dieguito River Valley Conservancy
Pala Band of Mission Indians
Helix Water District
San Diego National Wildlife Refuge
San Diego Zoo Institute for Conservation Research
Fallbrook Naval Weapons Station
Marine Corps Base Camp Pendleton
San Diego Audubon Society
Sweetwater Authority
City of Carlsbad
City of Escondido
Santa Ana Watershed Association
Many Private Landowners

Riverside County Parks
W. Riverside Co. Regional Conservation Authority
Riverside Co. Habitat Conservation Authority
Riverside Co. Economic Development Agency
W. Riverside Co. MSHCP
Outdoor Resorts Rancho California, Inc.
Audubon California Starr Ranch Sanctuary
City of Irvine
Irvine Ranch Conservancy
Crystal Cove State Park
Orange County Parks
Southern California Edison Viejo Conservation Easement
UC-Irvine Ecological Preserve
City of Fullerton
Orange Co. Water District
San Bernardino Co. Flood Control District
San Bernardino Co. Water Conservation District
San Bernardino Co. Dept. of Public Works
San Bernardino Valley Municipal Water District
Vulcan Materials Company
North Etiwanda Preserve
City of Los Angeles, Dept. of Recreation and Parks
County of Los Angeles, Dept. of Parks and Recreation

Palos Verdes Peninsula Land Conservancy
Puente Hills Habitat Preservation Authority
City of Glendora
City of Diamond Bar
City of San Dimas
City of Whittier
California State Polytechnic University, Pomona
California State University, Channel Islands
City of Moorpark
Cooper Ecological Monitoring, Inc.
Western Foundation for Vertebrate Zoology
Conejo Open Space Conservation Authority
City of Thousand Oaks
Conejo Recreation and Parks District

Field Crew

NROC: K. Moore & D. Kamada
USGS: K. Allen, L. Allen, K. Ferree, A. Houston, S. Howell, S. Lynn, M. Madden, R. Pottinger, T. Dixon, P.J. Falatek, A. Gallagher, M. Lipshutz, S. Nichols, J. Pietrzak, A. Shipley, A. Winters

