Southern Mule Deer Movement Study





North County Coastal Population and Movement Poorly Understood

Road Kill and Public Safety issue

Deer located north of Palomar Airport stranded?

How many deer?

Primary movement patterns?

Gene flow?

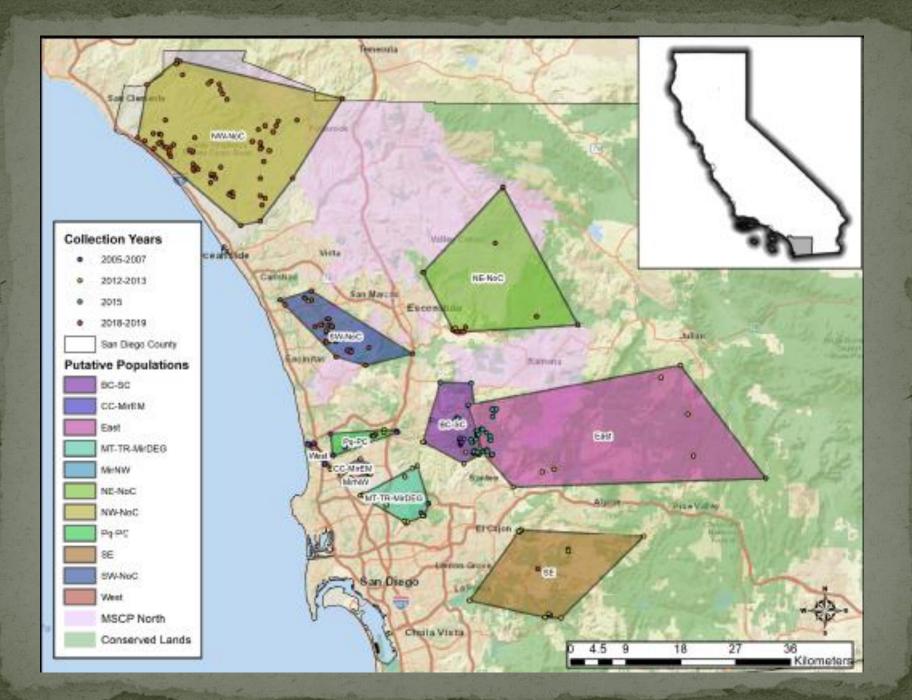
Engaged in Regional Study with SDMMP/USGS

10/6/2018 12:09 AM

Regional Study

- Primary focus on deer movement and gene flow across North County
- Secondary focus was to assess genetic structure across
 San Diego
- <u>Methods</u>: Scat collections and tissue, genetic analysis
 Sampled April-June, 2018 and February 2019

 ~354 scat/tissue samples used, of which 205 came from Carlsbad group! No region sampled as intensely as Carlsbad!!



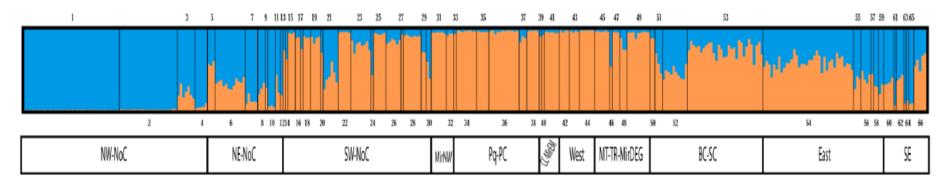


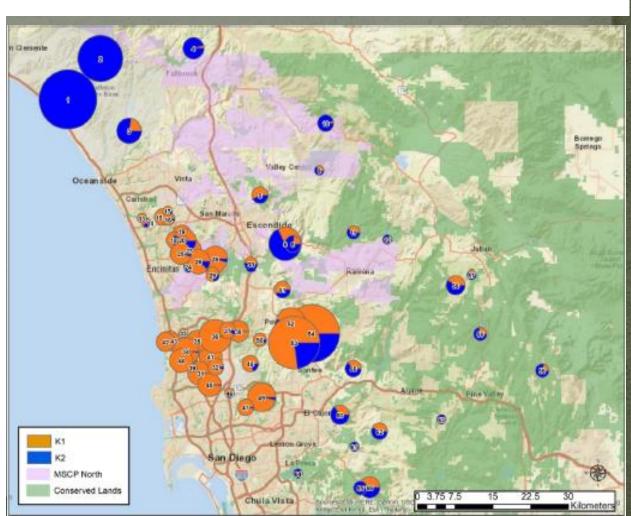
Table 1. Regional sites represented by Southern mule deer successfully genotyped between 2005 and 2019 in San Diego County

[Sites added during 2018-19 include 1-6, 8-30, 59, and 61. Samples were also added to site 36 as part of 2018-19 collections]

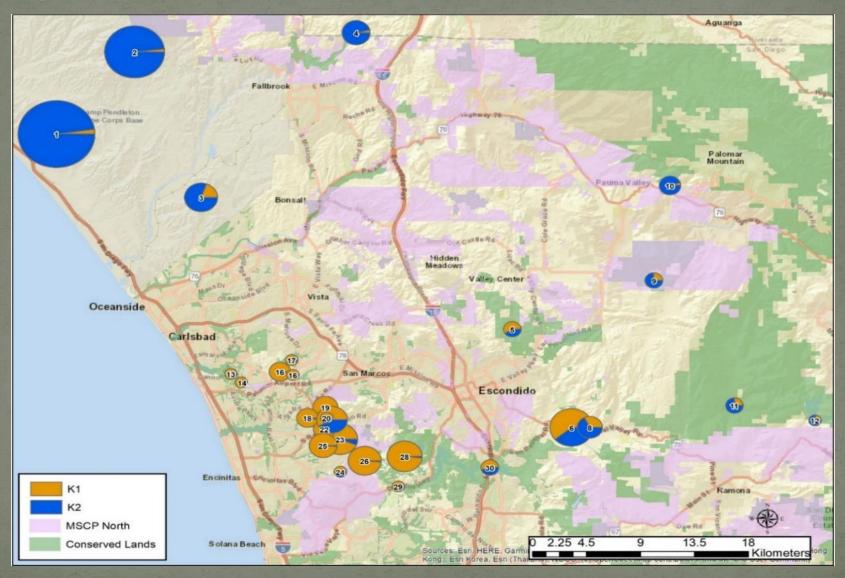
	Putative geographic population ¹	Site name	Site number	Putative geographic population ¹	
	NW-NoC	Marine Corps Base Camp Pendleton -	1	CC-MirEM	Mirama
		Coastal		CC-MirEM	Carrol O
	NW-NoC	Marine Corps Base Camp Pendleton - North	2	CC-MirEM	Carrol C
	NW-NoC	Marine Corps Base Camp Pendleton - East	3	West	Torrey I
	NW-NoC	Santa Margarita Ecological Reserve	4	West	Los Pen
	NE-NoC	Daley Ranch Preserve	5	West	Sorrento
	NE-NoC	San Diego Zoo Safari Park - Beckman & Tram	6	MT-TR- MirDEG	Mirama
	NE-NoC	San Diego Zoo Safari Park	7	MT-TR- MirDEG	Mirama
	NE-NoC	San Diego Zoo Safari Park - Open Space	8	MT-TR-	Тіептаза
	NE-NoC	Hellhole Canyon (Carter Residence)	9	MirDEG	Livitasa
	NE-NoC	Plaisted Creek Preserve	10	MT-TR-	Mirama
	NE-NoC	Pamo Valley	11	MirDEG	
	NE-NoC	Lake Sutherland	12	MT-TR-	Mission
I	SW-NoC	City of Carlsbad Veterans Park	13	MirDEG BC-SC	Beeler (
I	SW-NoC	City of Carlsbad Crossings Golf Course	14		
1	SW-NoC	Carlsbad Oaks North HCA - North Faraday	D	BC-SC	Poway -
	SW-NoC	Carlsbad Oaks North HCA - South Faraday	16	BC-SC BC-SC	Poway -
	SW-NoC	Dawson Los Monos Canyon Reserve	17		Sycamo
	SW-NoC	Rancho La Costa HCA - Ridgeline	18	East East	East of Lake Jee
	SW-NoC	Rancho La Costa HCA- Meadowlark	19	East	Lake Je: Julian
	SW-NoC	Rancho La Costa HCA - San Marcos Creek	20	East	Clevela
I	SW-NoC	Rancho La Costa HCA - San Elijo Road	21		
1	SW-NoC	Rancho La Costa HCA - Denk	22	East	Cuyama
	SW-NoC	Rancho La Costa HCA - Copper Creek	23	SE	Laguna
I	SW-NoC	Bumann Ranch Preserve	24		South C
1	SW-NoC	Rancho La Costa HCA – Wildlife Corridor	25	SE	Jamul (I
	SW-NoC	Rancho La Costa HCA – Choumas-Pappas	26	SE	Sycuan
	SW-NoC	Bridges and Sante Fe Creek Preserve	27	SE	Japatul
	SW-NoC	Los Cielos Preserve - Cielos Estates	28	SE	San Mig
	SW-NoC	Los Cielos Preserve - Meisha Canyon	29	SE	Rancho
	SW-NoC	Lake Hodges - Bridge	30	SE	Hollenb
	MirNW	Miramar - Rose Canyon	31	Putative ge (2014). We gro	
	MirNW	Miramar - Miramar Road - across Golf Course	32	additional pop 	ulations: (8, west of
	PQ-PC	Del Mar Mesa	33	Pendleton and (2) "Northeast	
	PQ-PC	Los Penasquitos Canyon Preserve - West	34	I-15; compose	d of sampl
	PQ-PC	Carmel Mountain	35	Valley Center,	
	PQ-PC	Los Penasquitos Canyon Preserve - East	36	"Southwest N west of I-15; c	
	PQ-PC	Los Penasquitos Canyon Preserve - East of Black Mountain Rd	37	of I-15. Due to population of	o denser sa Bohonak a
	PQ-PC	Penasquitos Creek	38	the NW-NoC ("NE" populati	

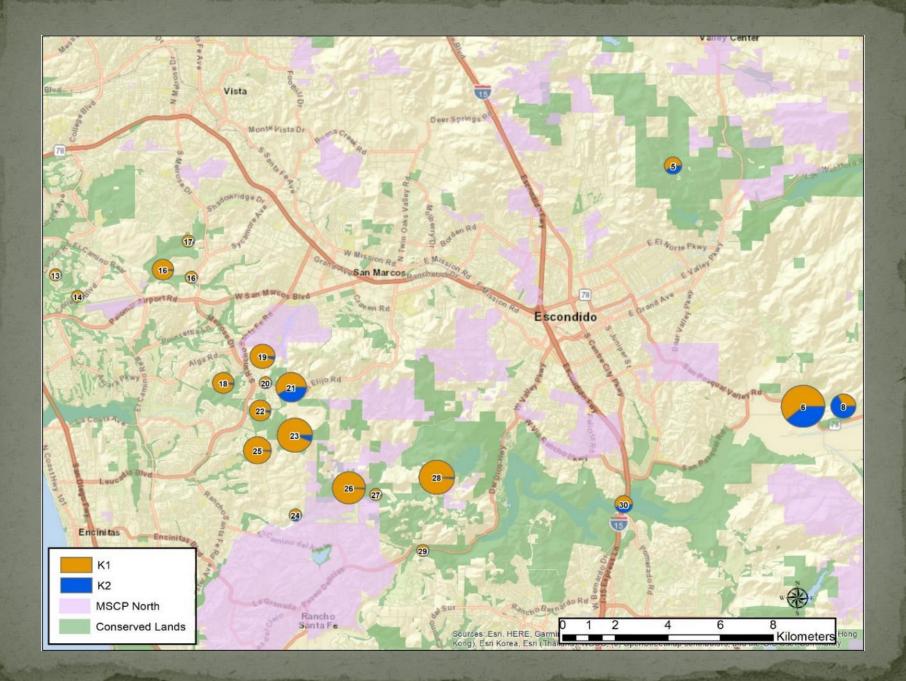
Putative geographic population	Site name	Site number
CC-MirEM	Miramar - Eastgate Mall	39
CC-MirEM	Carrol Canyon - West	40
CC-MirEM	Carrol Canyon - East	41
West	Torrey Pines State Reserve	42
West	Los Penasquitos Marsh	43
West	Sorrento Valley	44
MT-TR- MirDEG	Miramar - Landfill	45
MT-TR- MirDEG	Miramar - Parcel G	46
MT-TR- MirDEG	Tierrasanta	47
MT-TR- MirDEG	Miramar - East	48
MT-TR- MirDEG	Mission Trails Regional Park	49
BC-SC	Beeler Canyon	50
BC-SC	Poway - North	51
BC-SC	Poway - South	52
BC-SC	Sycamore Canyon	53
East	East of SR-67	54
East	Lake Jennings	55
East	Julian	56
East	Cleveland National Forest - north	57
East	Cuyamaca Rancho State Park	58
East	Laguna Mountains	59
SE	South Crest Preserve	60
SE	Jamul (Fisher Residence)	61
SE	Sycuan Peak Ecological Reserve	62
SE	Japatul Valley	63
SE	San Miguel	64
SE	Rancho Jamul Ecological Reserve	65
SE	Hollenbeck Canyon	66

2014). We grouped simples from the North Courth (Yours) area into three additional populations (1), "Northwest North Courth," ("NN-NC") - morth of 1-78, west of 1-15, consisting of Marine Core Base Camp readers and the Samt Magarita Ecological Reserve in Fallbook; 21) "Northeast North Courth," ("NR-NoC") - morth of 1-78, cast of 1-35, composed of anothesis from Ecocodia eart (0-1-5, Panaet 31), and the same of the Samter and the Name Nulley, Alley Contex, and Panno Yalley and Lake Studerland in Rannons, and (3) Studentset North Courth," ("NR-NoC") - worth of 1-76, cast of 1-15, constant of anoty" ("SN-NoC") - worth of 1-76, one of 1-56, sent of 1-15, consisting of samples from Carlthold and Elscondido sites west 471-15. Date I denser sampling in these regions, samples from the "NW" Angulation of Bohoma and Mattheng CO14) have been reassigned to other he WW-NoC or the SN-NoC group of dees, and for clarity, the original TKP population of Bohoma and Mattheng CO14) and sement as "East".



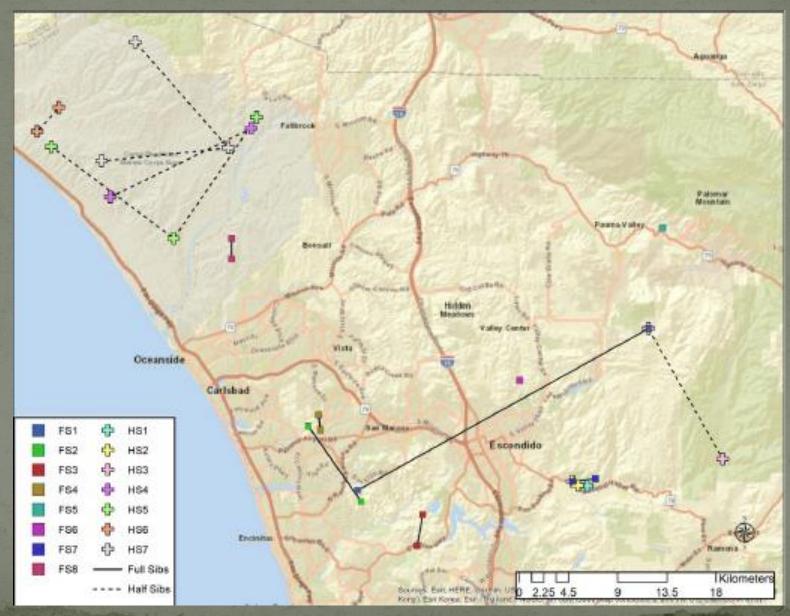
2 genetic clusters







Siblings/Half Siblings







Other Results and Summary

- Less Genetic Diversity in Coastal Cluster than other regions of San Diego
- Movement mostly restricted within sub-geographic areas
- Deer Totals
 - 24 deer in Carlsbad
 - 48 deer from Crossings east to Elfin Forest/Bridges
 10 deer North of Palomar Airport Road
- 59 Individuals Found in the SWNoC with Effective Population Size of 45.1 (range 31-69)
 <u>Ne above threshold of 100 to avoid genetic inbreeding</u>

Future work

- Signage (i.e.RSF Road others)
- Collections
 - More Collections needed to further study gene flow and movement (CHER-EncCreek-LC Glen)
- Radio Collaring
- Undercrossing Management

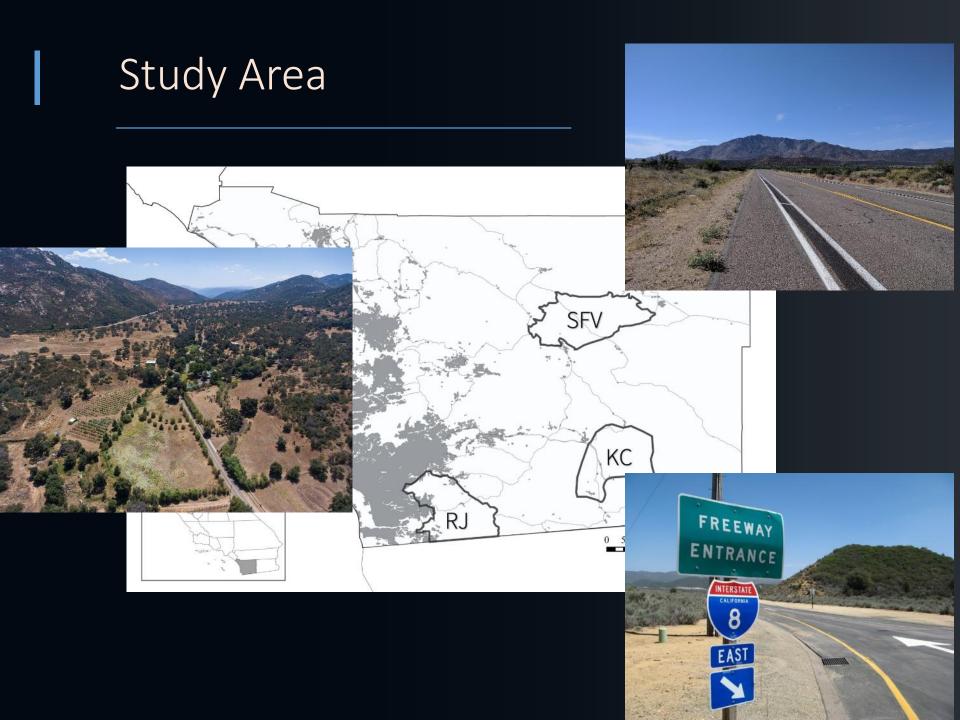
CDFW-SDSU Deer Study

SFV

RI

KC

Randy Botta, Megan Jennings, Kylie Curtis, Emma Tomaszewski, Becca Lewison, & Janene Colby



Captured and collared 139 deer

SR-79

1-8

SR-94

20 Miles

60 Kilometers

30

10

15

SR-78

0

- 111 Females (orange)
- 28 males (green)
- Measurements
- Genetic samples
- Disease testing



Telemetry data

- Up to ~3 yrs of data
- Home range analysis
- Disease analysis
- Aerial survey estimation
- Capture-recapture with fecal DNA

SR-79

1-8

5

10

15

SR-94

20 Miles

60 Kilometers

30

SR-78

• Mortality investigation (n=41)



E. Tomaszewski

Home Range – Seasonal Selection and Size

Local Convex Hull (Getz et al. 2006) San Felipe Hills D014 San Felipe Valley D009 D084 D012 D016 Km 0 2 D107 HWY 78



Monitoring Period: May 2018 – March 2020

E. Tomaszewski

Disease Analysis

Hemorrhagic Disease Viruses



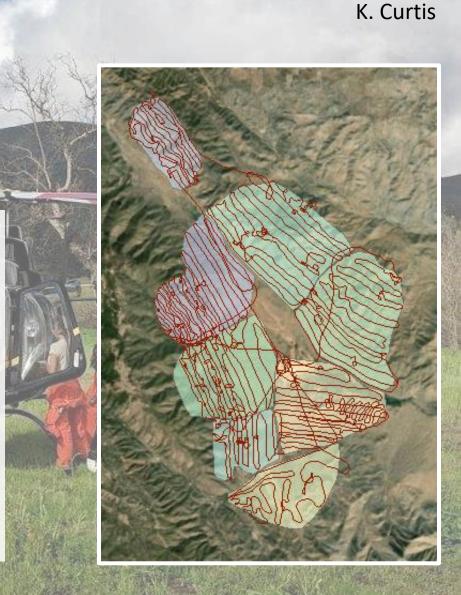
Odocoileus hemionus Adenovirus (OdAdV)

Bluetongue Virus (BTV)

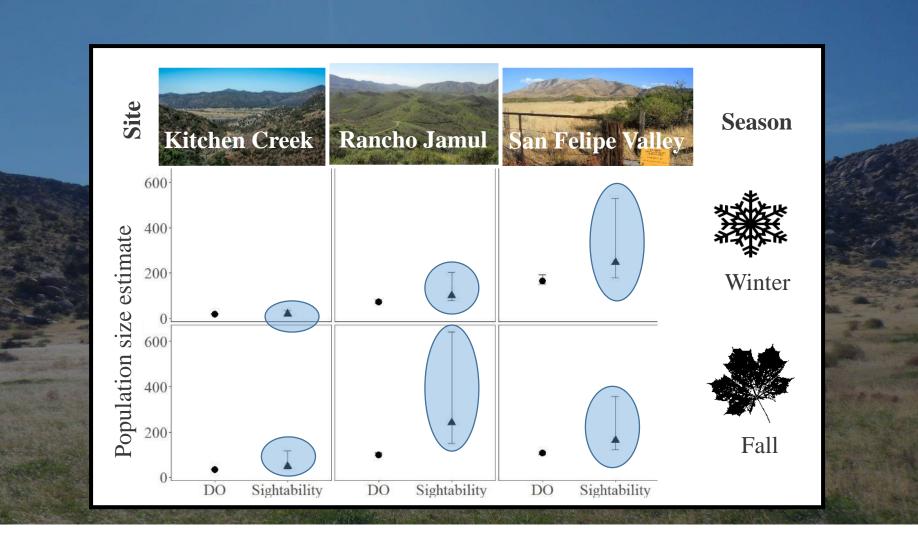
Epizootic Hemorrhagic Disease Virus (EHDV)

Aerial Surveys

- 2 seasonal survey periods (Wal et al. 2011):
 - March 2019 \rightarrow "Winter"
 - October 2019 \rightarrow "Fall"
- Total count survey design
 - Polygons
 - Transects spaced 300-m

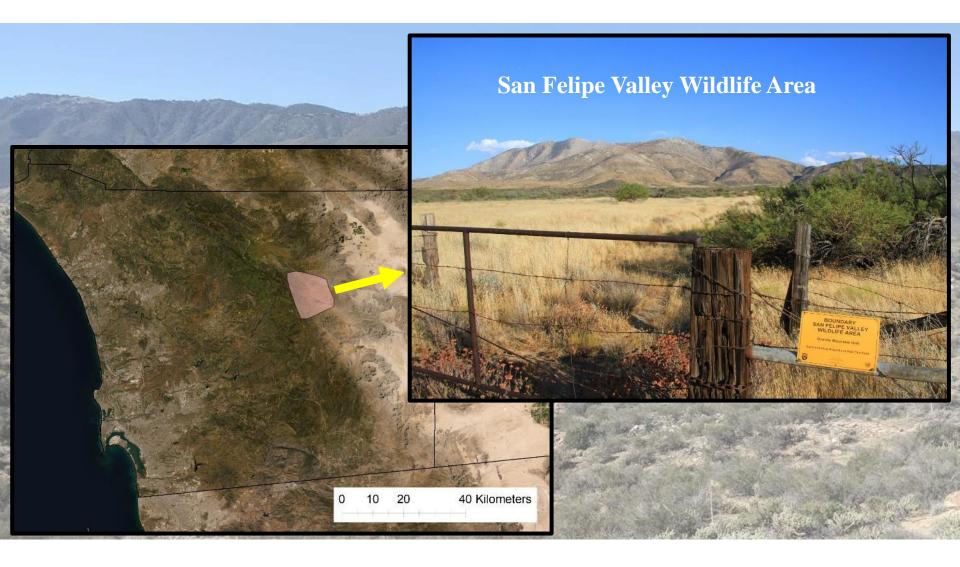


Preliminary Abundance Estimates



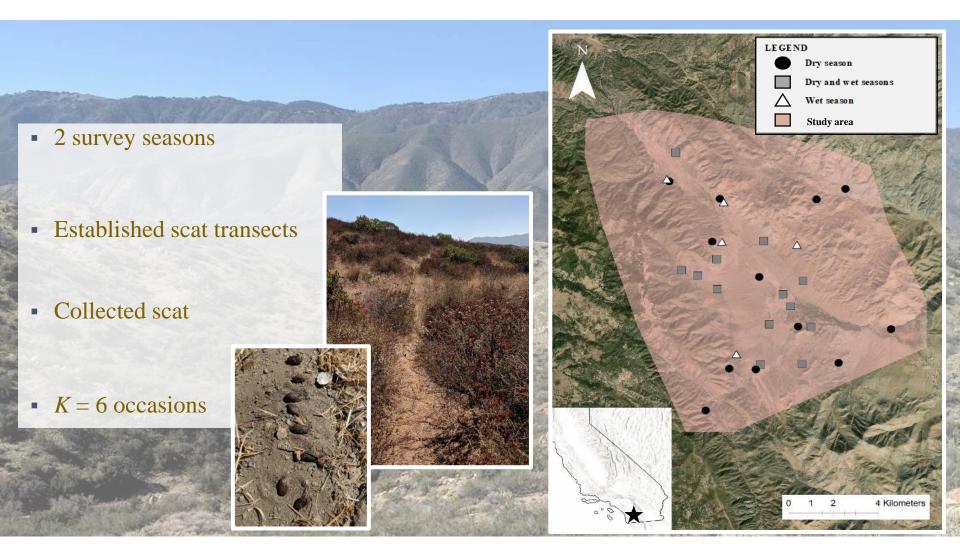
K. Curtis

Spatial Capture Recapture Comparison



K. Curtis

Non-invasive Sample Collection



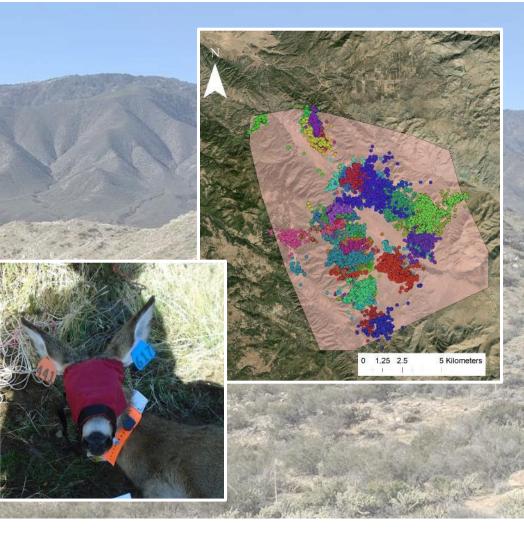
K. Curtis

Telemetry Data Collection & Processing

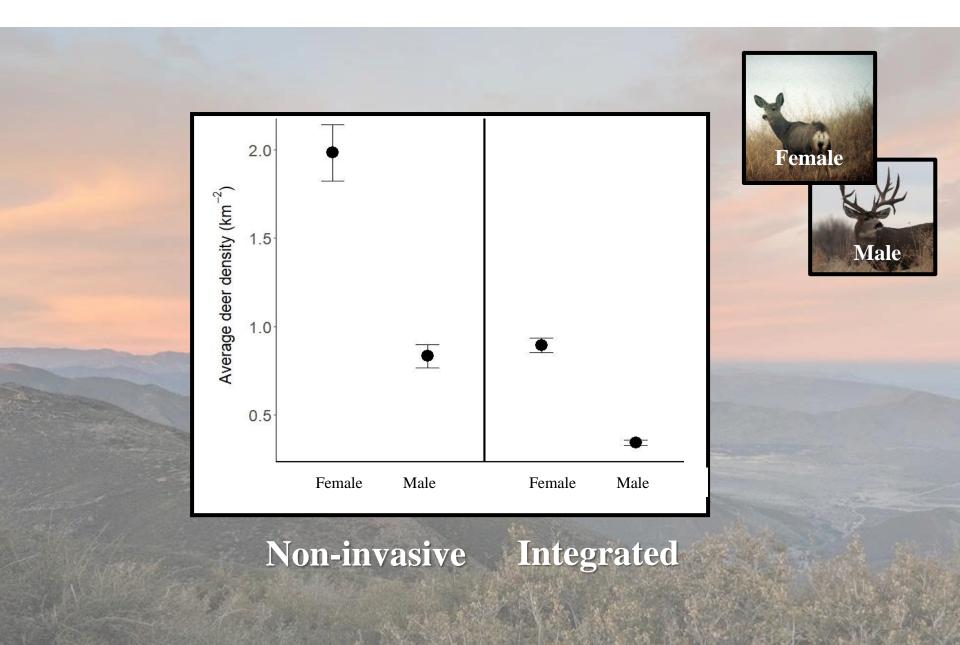
• GPS collared deer in 2018 / 2019

- Subset to study periods and thinned to one location / deer / day
- 1,026 GPS locations from 34 deer across both survey seasons

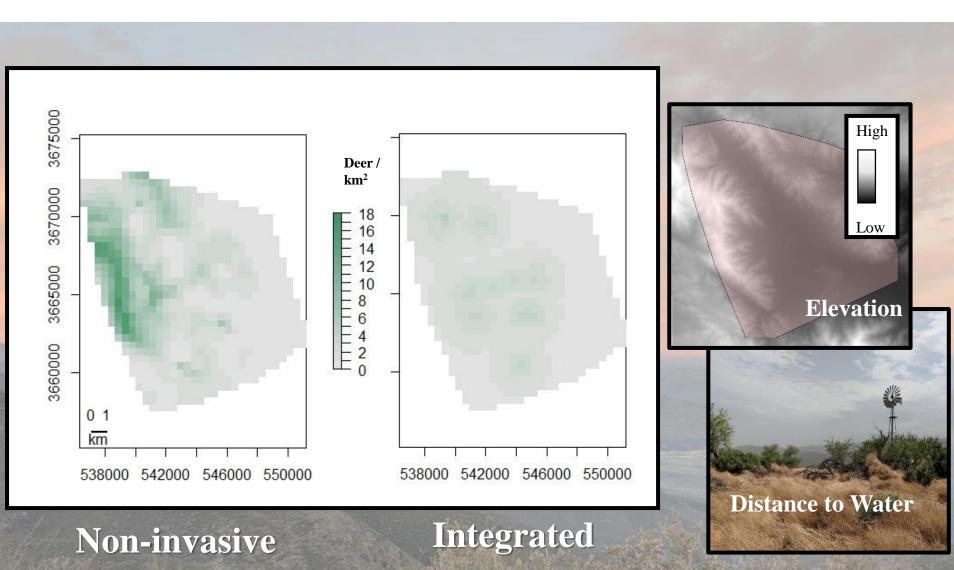




Density



Density



Population size

