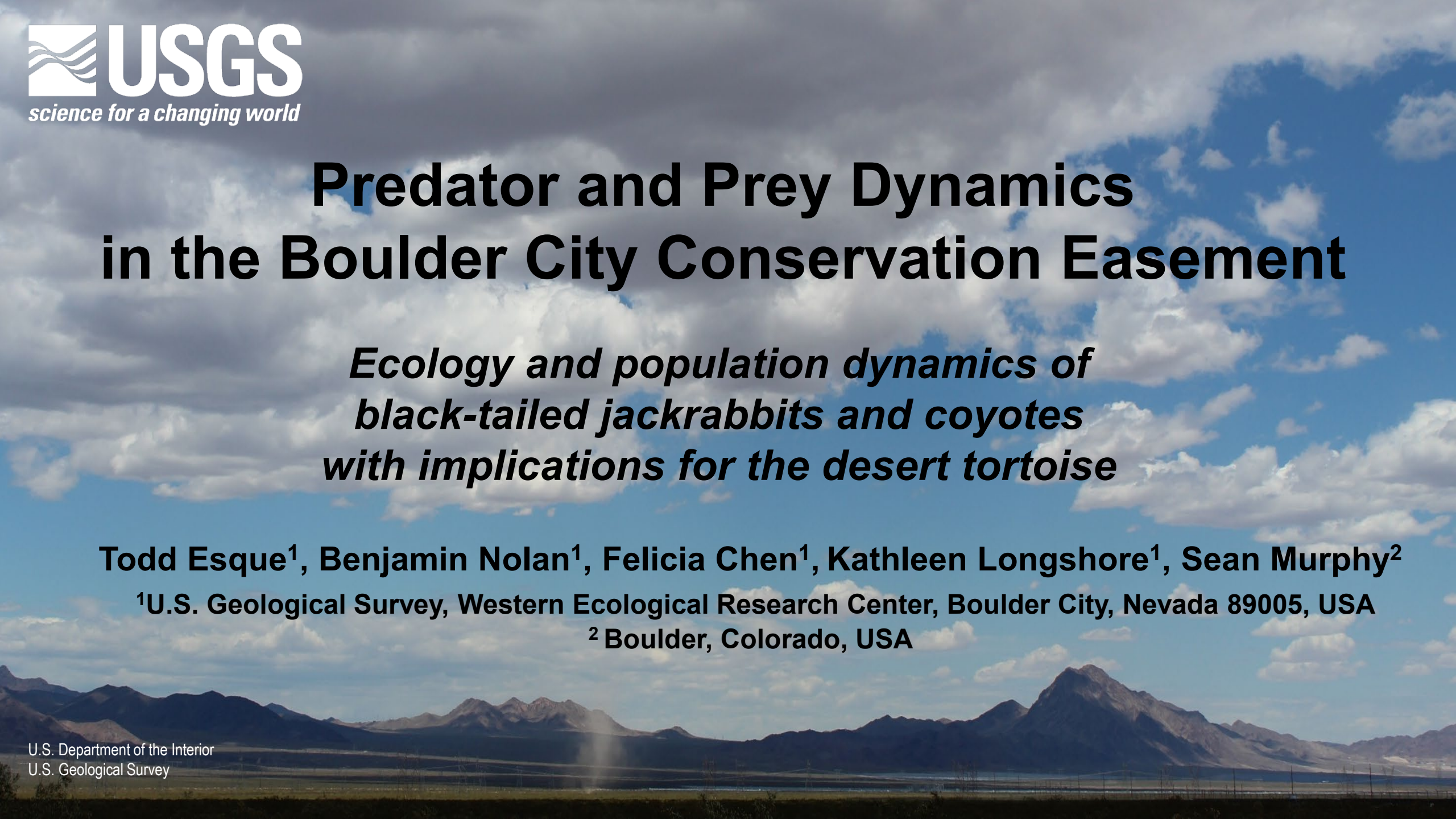

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Predator and Prey Dynamics in the Boulder City Conservation Easement

Ecology and population dynamics of black-tailed jackrabbits and coyotes with implications for the desert tortoise

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U.S. Department of the Interior
U.S. Geological Survey

Background

Increased **concern about presumed coyote predation** on translocated and native populations of the Mojave desert tortoises in the Boulder City Conservation Easement

Declines in jackrabbit populations sometimes causing the coyotes to switch from jackrabbits to desert tortoises can be widespread and locally intensive (Esque et al. 2010)

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Goal & Research Objectives

"The goal of this project is to gain a better understanding of the predator-prey dynamics of one of the desert tortoises' main predator species and develop a strategy to limit translocations from being severely impacted by coyote predation."

- Determine coyote and black-tailed jackrabbit:
  - Demographics
  - Movements, home range, and habitat use patterns
  - Health status and mortality rates
- Develop reliable and cost-effective methods of estimating density
- Analyze black-tailed jackrabbit abundance and predator densities and movement data to inform management

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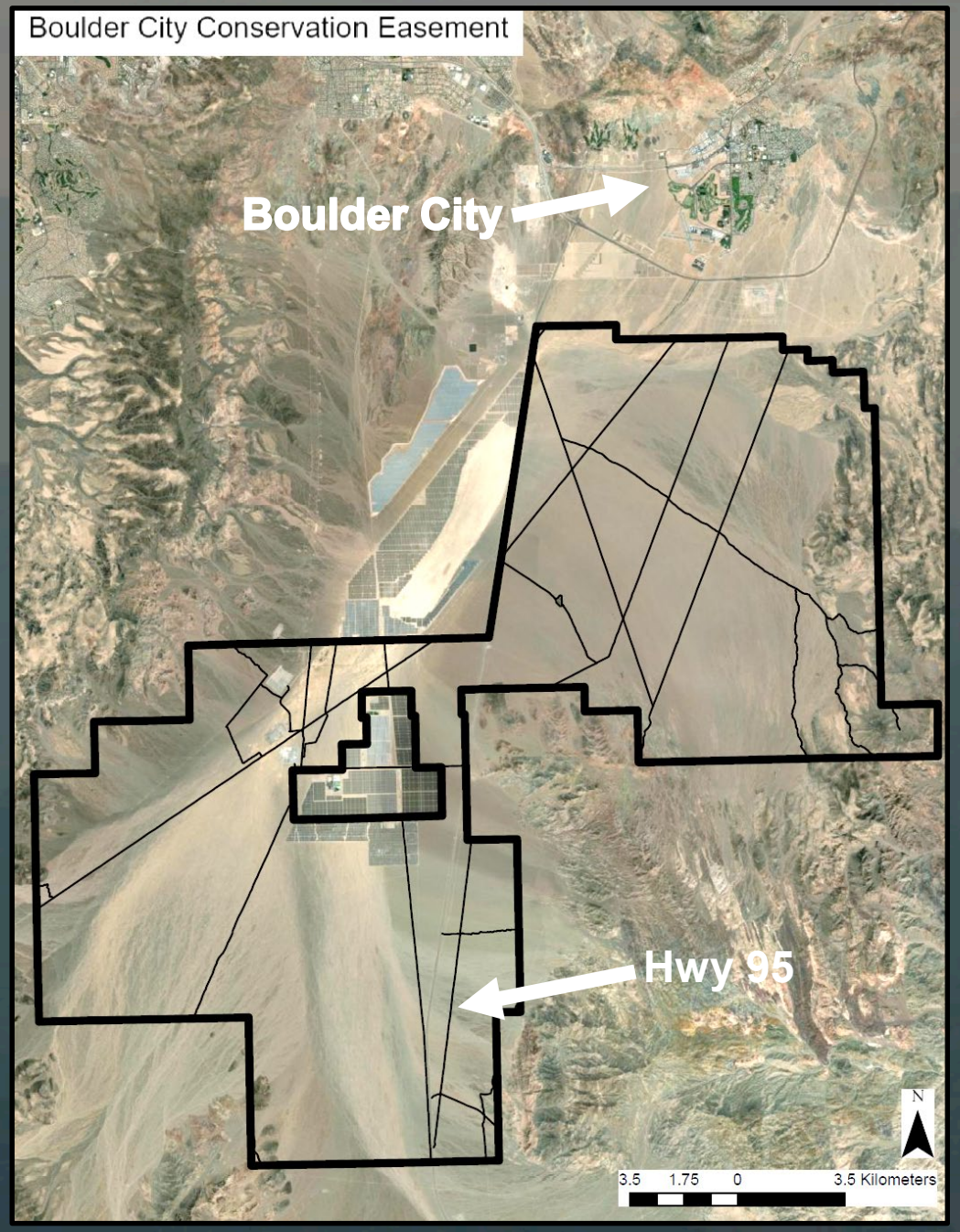
Study Area

BCCE established in 1995 as partial mitigation for the take of desert tortoises and their habitats

~86,500 acres in the Eldorado Valley, south of Boulder City, NV

Currently managed under the Multiple Species Habitat Conservation Plan (MSHCP) for tortoise conservation



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Methods Overview

- Camera traps
- Spotlight surveys
- GPS/VHF collars on coyotes
- GPS/VHF collars on jackrabbits

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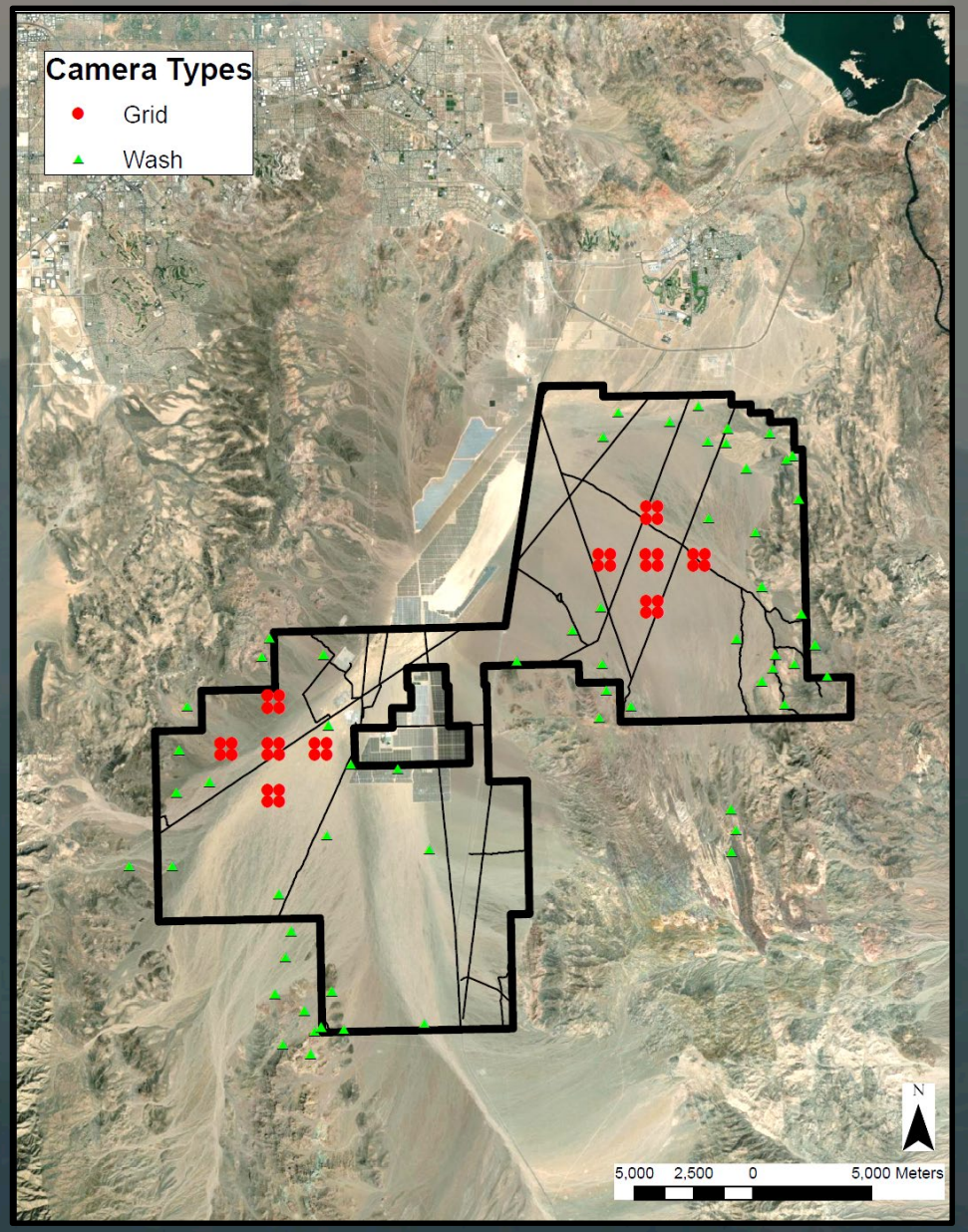
Camera Trap Methods

- Randomly placed in grids (n=40) & washes (n=60)
- Initially dependent on grid cameras for density estimates
  - *Random Encounter Model*
- Transitioning to rely on wash cameras for density estimates
  - *Spatial Mark Resight Model*



Camera Traps - All Species Detected

Species	Scientific Name	MSHCP Status	Wash Cameras	Grid Cameras
Mammals			n	n
American Badger	*Taxidea taxus*	*None*	187	104
Bat	*Unknown species*	*Various*	10	-
Desert Bighorn Sheep	*Ovis canadensis nelsoni*	*None*	61	-
Black-tailed Jackrabbit	*Lepus californicus*	*None*	20924	9618
Bobcat	*Lynx rufus*	*None*	133	4
Coyote	*Canis latrans*	*None*	2546	162
Desert Cottontail	*Sylvilagus audubonii*	*None*	1937	-
Desert Woodrat	*Neotoma lepida*	*None*	369	1220
Domestic Dog*	*Canis familiaris*	*None*	30	6
Domestic Cat	*Felis catus*	*None*	1	-
Domestic Horse	*Equus ferus caballus*	*None*	2	-
Gray Fox	*Urocyon cinereoargenteus*	*None*	126	6
Kangaroo Rat	*Dipodomys spp.*	*Various*	1008	3375
Kit Fox	*Vulpes macrotis*	*HPES*	2329	2011
Ringtail	*Bassariscus astutus*	*None*	5	-
Round-tailed Ground Squirrel	*Xerospermophilus tereticaudus*	*None*	18	57
Spotted Skunk	*Spilogale gracilis*	*None*	28	-
White-tailed Antelope Ground Squirrel	*Ammospermophilus leucurus*	*None*	1661	852
Birds				
Barn Owl	*Tyto alba*	*None*	2	-
Bell's Sparrow	*Artemisiospiza belli*	*None*	1	23
Black-tailed Gnatcatcher	*Polioptila melanura*	*None*	2	-
Black-throated Sparrow	*Amphispiza bilineata*	*None*	34	28
Burrowing Owl	*Athene cunicularia*	*HPES*	18	7
Bullock's Oriole	*Icterus bullockii*	*None*	2	-
Cactus Wren	*Campylorhynchus brunneicapillus*	*WL*	4	7
Common Raven	*Corvus corax*	*None*	162	50
Common Poorwill	*Phalaenoptilus nuttallii*	*None*	69	3
Cooper's Hawk	*Accipiter cooperii*	*None*	4	-
Costa's Hummingbird	*Calypte costae*	*None*	1	-
Crissal Thrasher	*Toxostoma crissale*	*LPES*	8	-
Gambel's Quail	*Callipepla gambelii*	*None*	85	-
Golden Eagle	*Aquila chrysaetos*	*WL*	12	-
Great Horned Owl	*Bubo virginianus*	*None*	6	-
Greater Roadrunner	*Geococcyx californianus*	*None*	869	58
Green-tailed Towhee	*Pipilo chlorurus*	*None*	1	-
Horned Lark	*Eremophila alpestris*	*None*	4	94
LeConte's Thrasher	*Toxostoma lecontei*	*MPES*	438	249
Lesser Nighthawk	*Chordeiles acutipennis*	*None*	86	5
Loggerhead Shrike	*Lanius ludovicianus*	*LPES*	97	9
Mallard	*Anas platyrhynchos*	*None*	2	-
Mourning Dove	*Zenaida macroura*	*None*	84	3
Northern Harrier	*Circus cyanus*	*None*	4	1
Northern Mockingbird	*Mimus polyglottos*	*None*	49	3
Phainopepla	*Phainopepla nitens*	*CS*	17	-
Red-tailed Hawk	*Buteo jamaicensis*	*None*	9	10
Rock Wren	*Salpinctes obsoletus*	*None*	17	5
Sage/Bell's Sparrow	*Artemisiospiza spp.*	*None*	2	3
Sage Thrasher	*Oreoscoptes montanus*	*None*	4	14
Say's Phoebe	*Sayornis saya*	*None*	20	-
Turkey Vulture	*Cathartes aura*	*None*	5	-
western flycatcher	*Empidonax spp.*	*None*	4	-
Western Meadowlark	*Sturnella neglecta*	*None*	2	17
White-crowned Sparrow	*Zonotrichia leucophrys*	*None*	14	1
Verdin	*Auriparus flaviceps*	*None*	-	1
Vesper Sparrow	*Pooecetes gramineus*	*None*	-	1
Reptiles				
Chuckwalla	*Sauromalus ater*	*CS*	5	-
Coachwhip	*Coluber flagellum*	*None*	3	8
Great Basin Collared Lizard	*Crotaphytus bicinctores*	*CS*	1	-
Southern Desert Horned Lizard	*Phrynosoma platyrhinos calidiarum*	*HPES*	1	10
Desert Iguana	*Dipsosaurus dorsalis*	*CS*	101	151
Desert Tortoise	*Gopherus agassizii*	*CS*	25	4
Long-nosed Leopard Lizard	*Gambelia wislizenii*	*CS*	5	31
Sidewinder	*Crotalis cerastes*	*CS*	-	2
Whiptail Lizard	*Aspidoscelis spp.*	*None*	21	262
Yellow-backed Spiny Lizard	*Sceloporus uniformis*	*None*	1	-
Zebra-tailed Lizard	*Callisaurus draconoides*	*None*	168	114
	# of sites		60	40
	# of observed species		63	41

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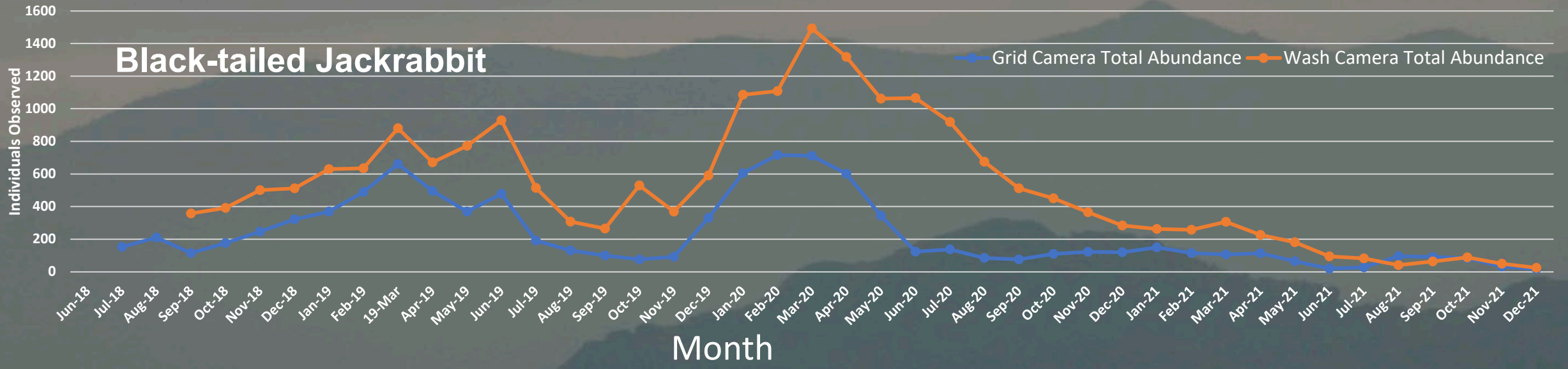
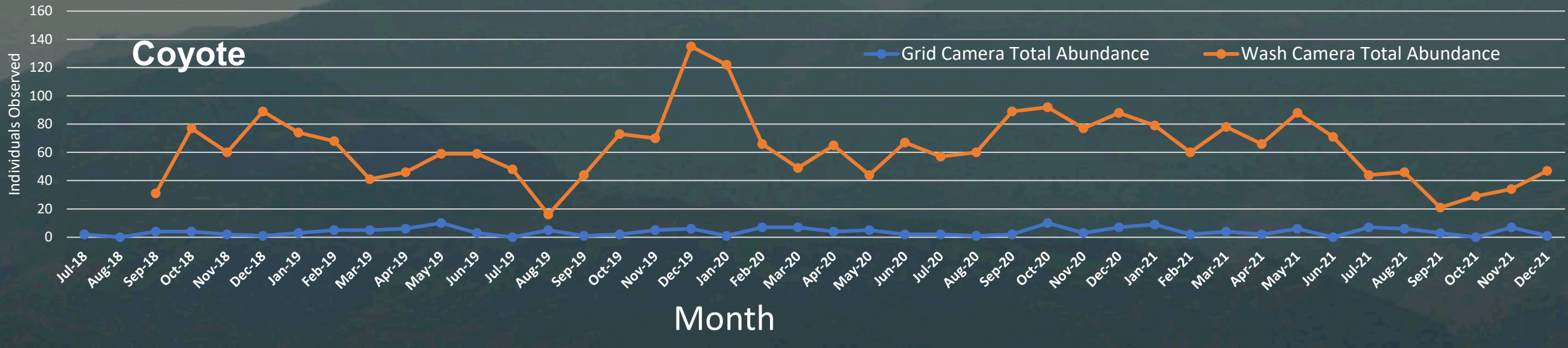
Camera Trap Observations

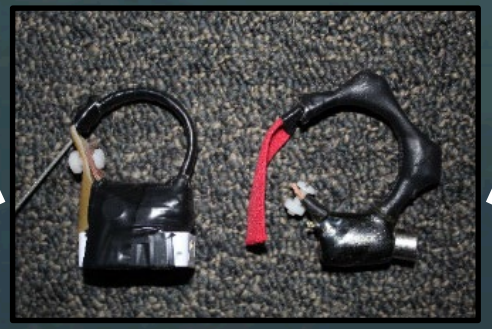




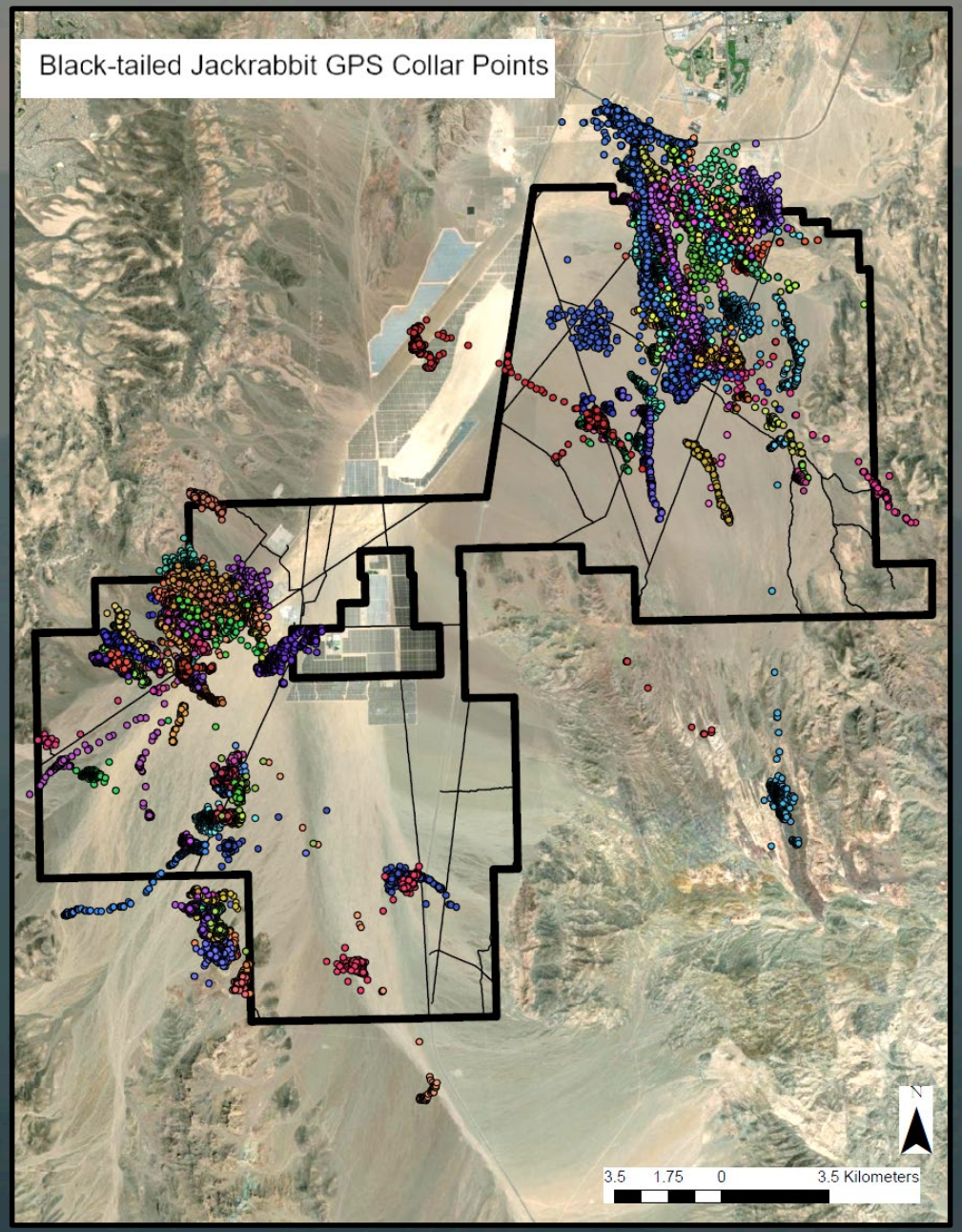
Jackrabbit Methods

- Box traps pre-baited with apples
- Fitted 224 VHF/GPS collars and vinyl ear tags
  - Short-term collars: 30-60 min GPS fix interval, 4-6 weeks of data collection/collar
  - Long-term collars: 3-4 hr GPS fix interval, 1 year of data collection/collar

Short-term collar



Long-term collar



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Jackrabbit Survival

- Included 82 collared individuals in analyses
- 37 (45%) died before collar drop-off

Cause of death

- Predation
  - Coyote (6)
  - Kit fox (6)
  - Unknown carnivore (17)
- Unknown cause (8)

Assumed alive annual survival probability

2019	2020	2021
0.75	0.45	0.22

Assumed dead annual survival probability

2019	2020	2021
0.45	0.35	0.24

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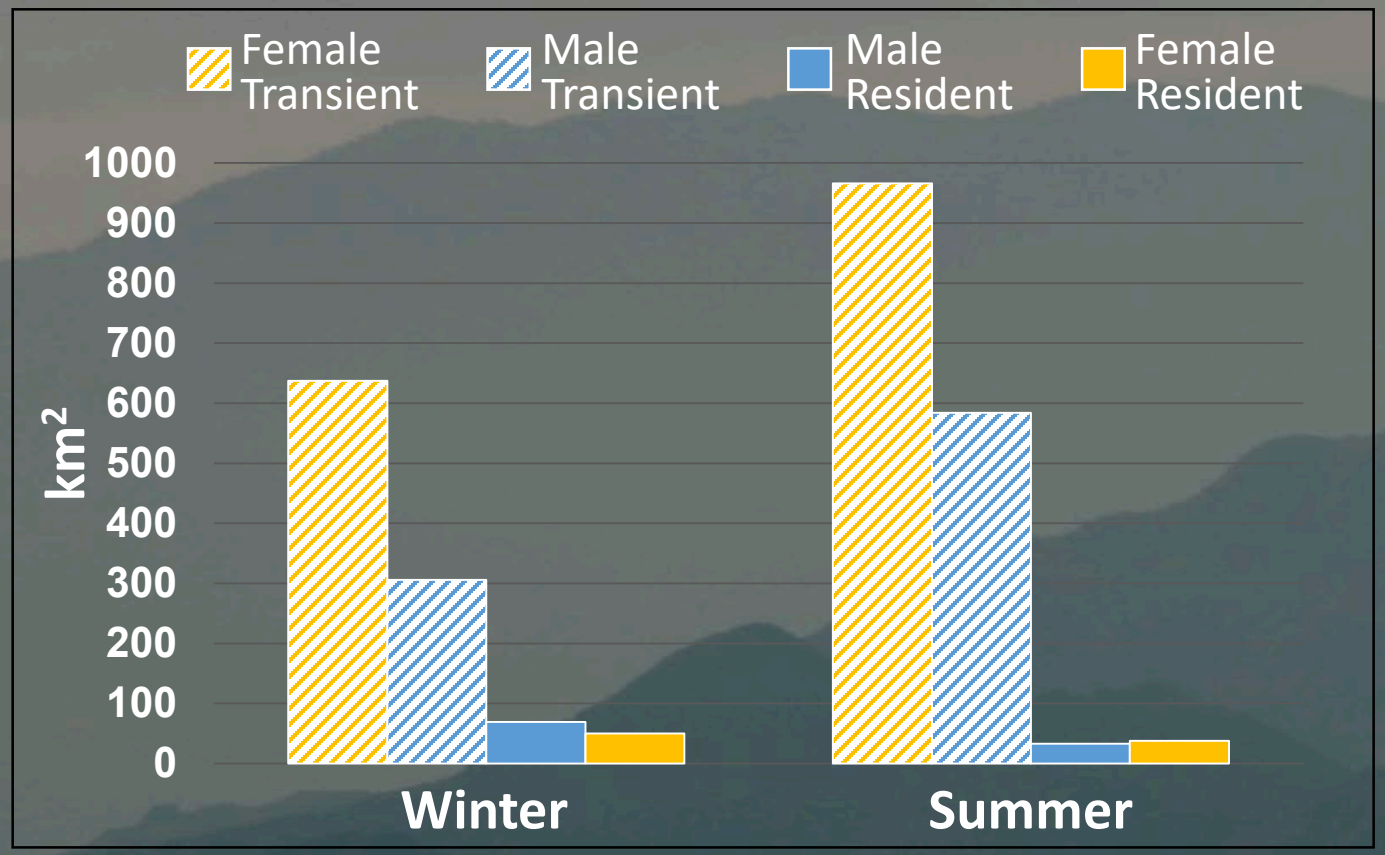
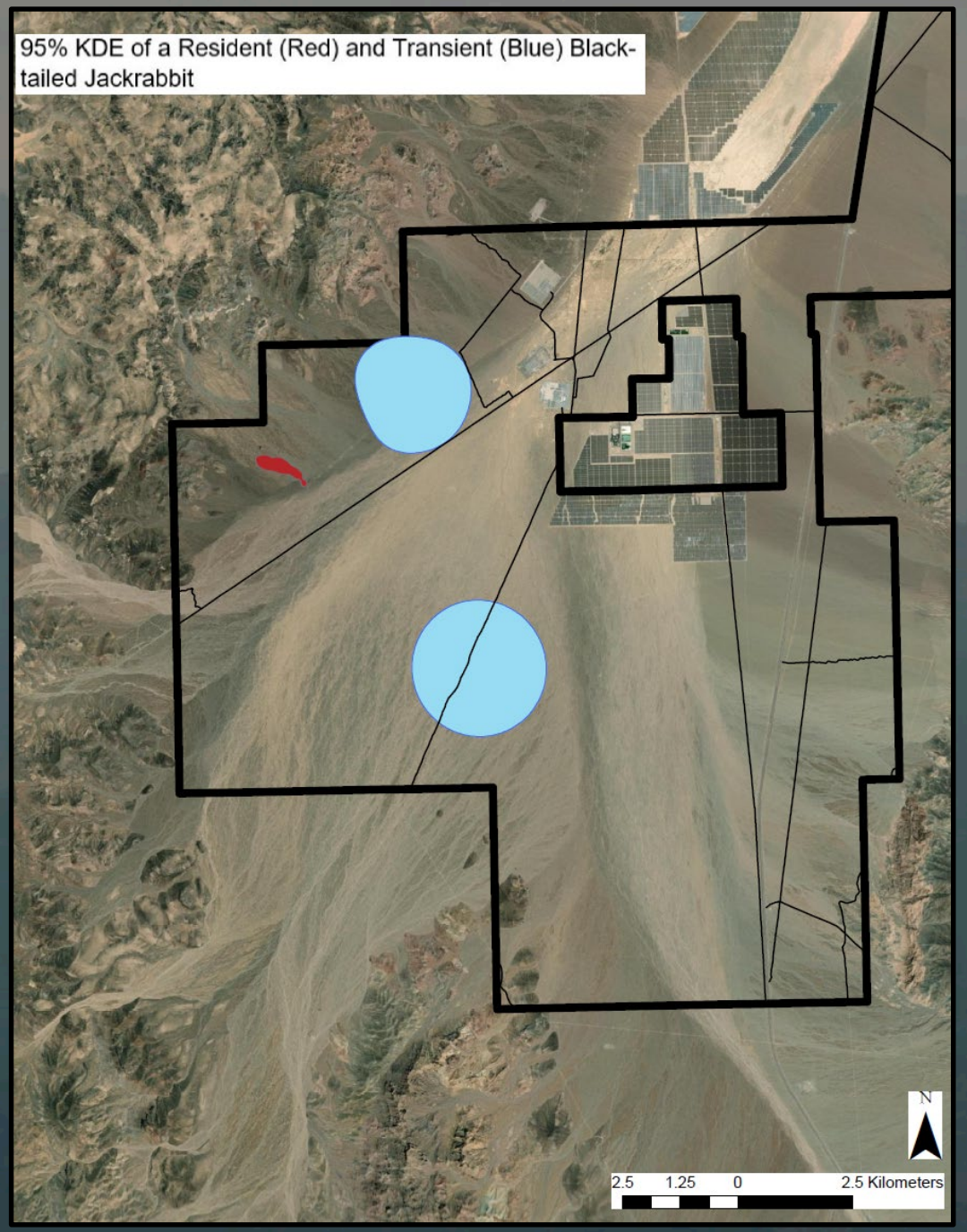
Jackrabbit Home Range Size



Sex	Status	Winter Mean (ha)	Winter 95% CI	Summer Mean (ha)	Summer 95% CI
Female	Transient	637	37-1090	966	416-1709
Female	Resident	50	32-69	38	22-53
Male	Transient	306	86-447	584	108-989
Male	Resident	69	28-103	33	19-45



Coyote Methods

Outfitted 27 individuals (15 males;12 females) with VHF/GPS collars and ear tags

- 1-3 hr GPS fix interval
- 1.5 to 2 yr data collection/per collar

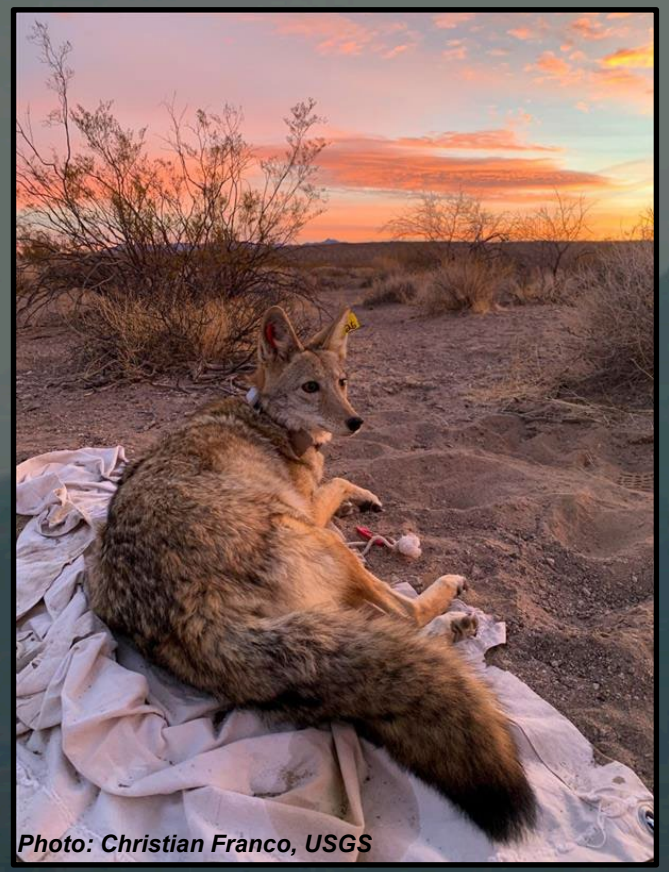
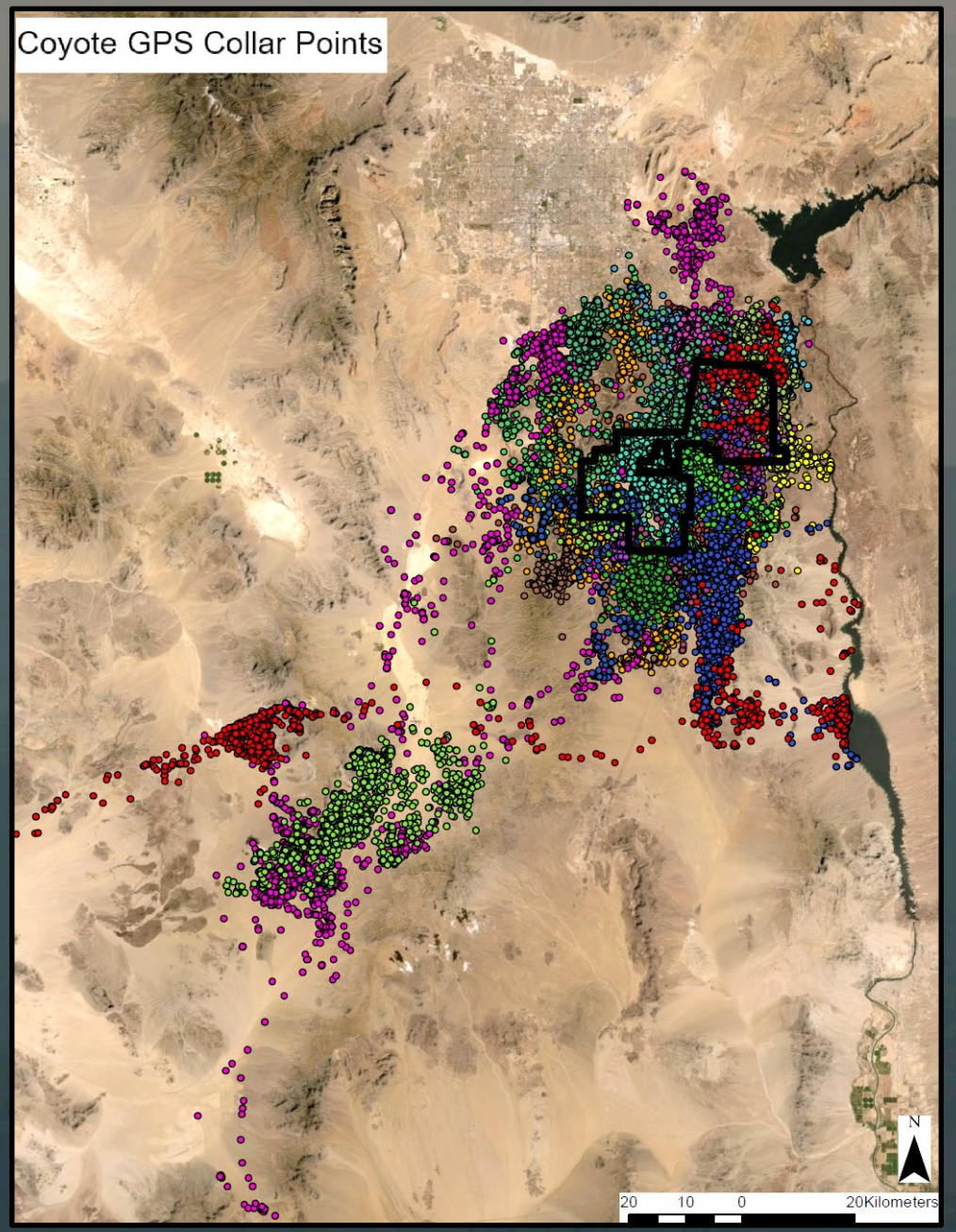


Photo: Christian Franco, USGS



Coyote Survival

- Included 21 individuals in analyses
- 5 (24%) died before collar drop-off

Cause of death

- Hunting (2)
- Vehicle collision (2)
- Starvation (1)

Annual survival probability

2019-2020	2021
0.95	0.81

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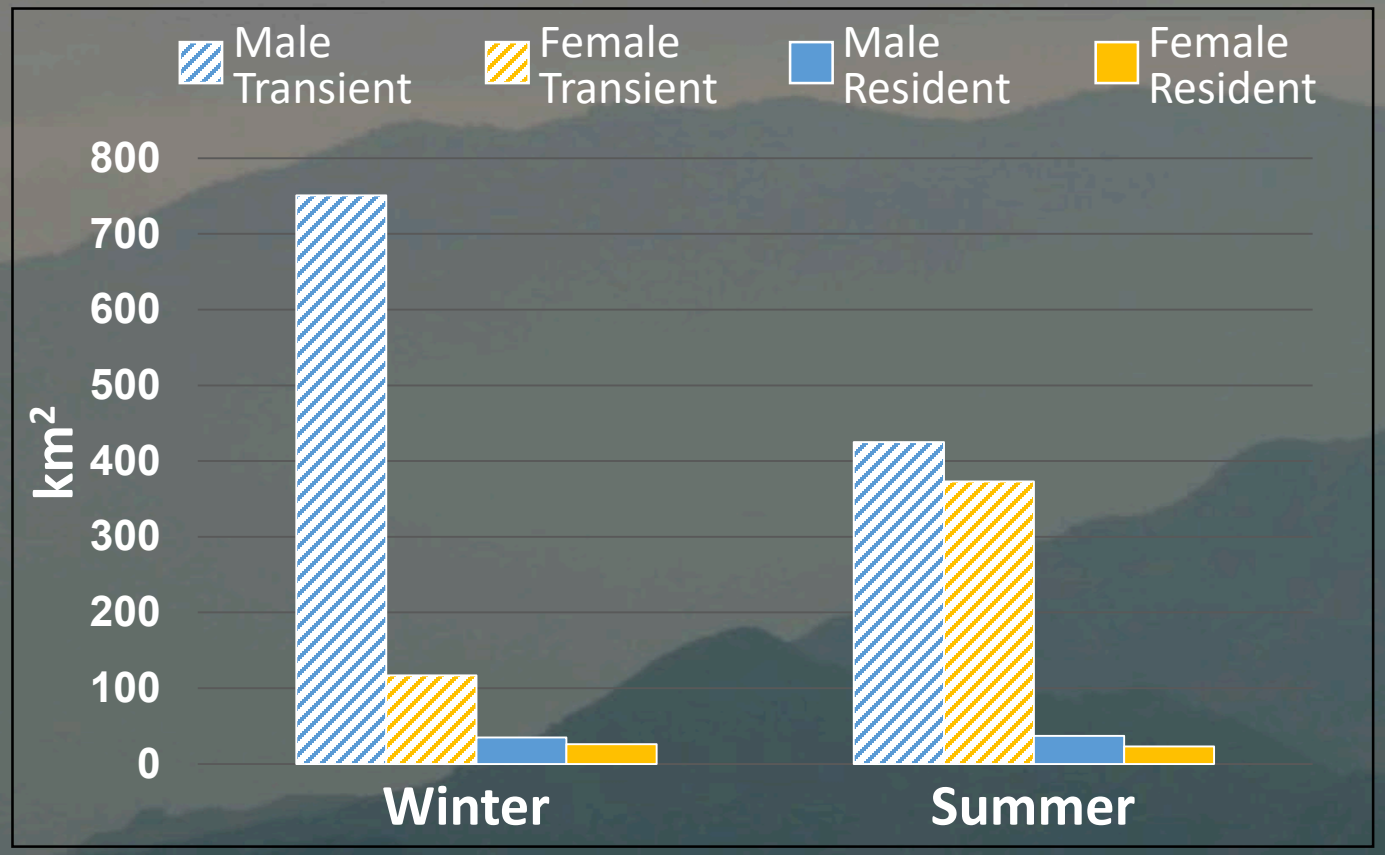
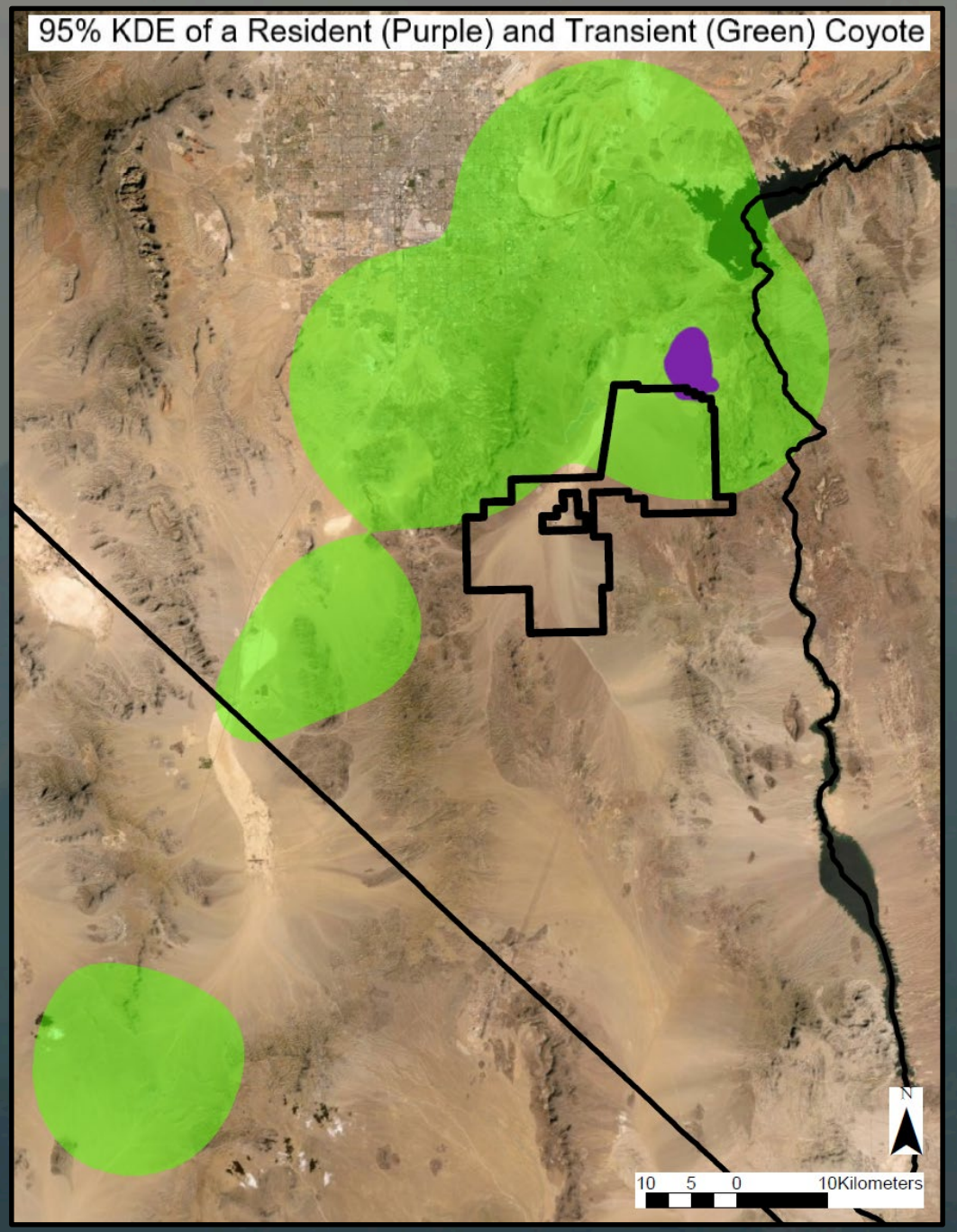
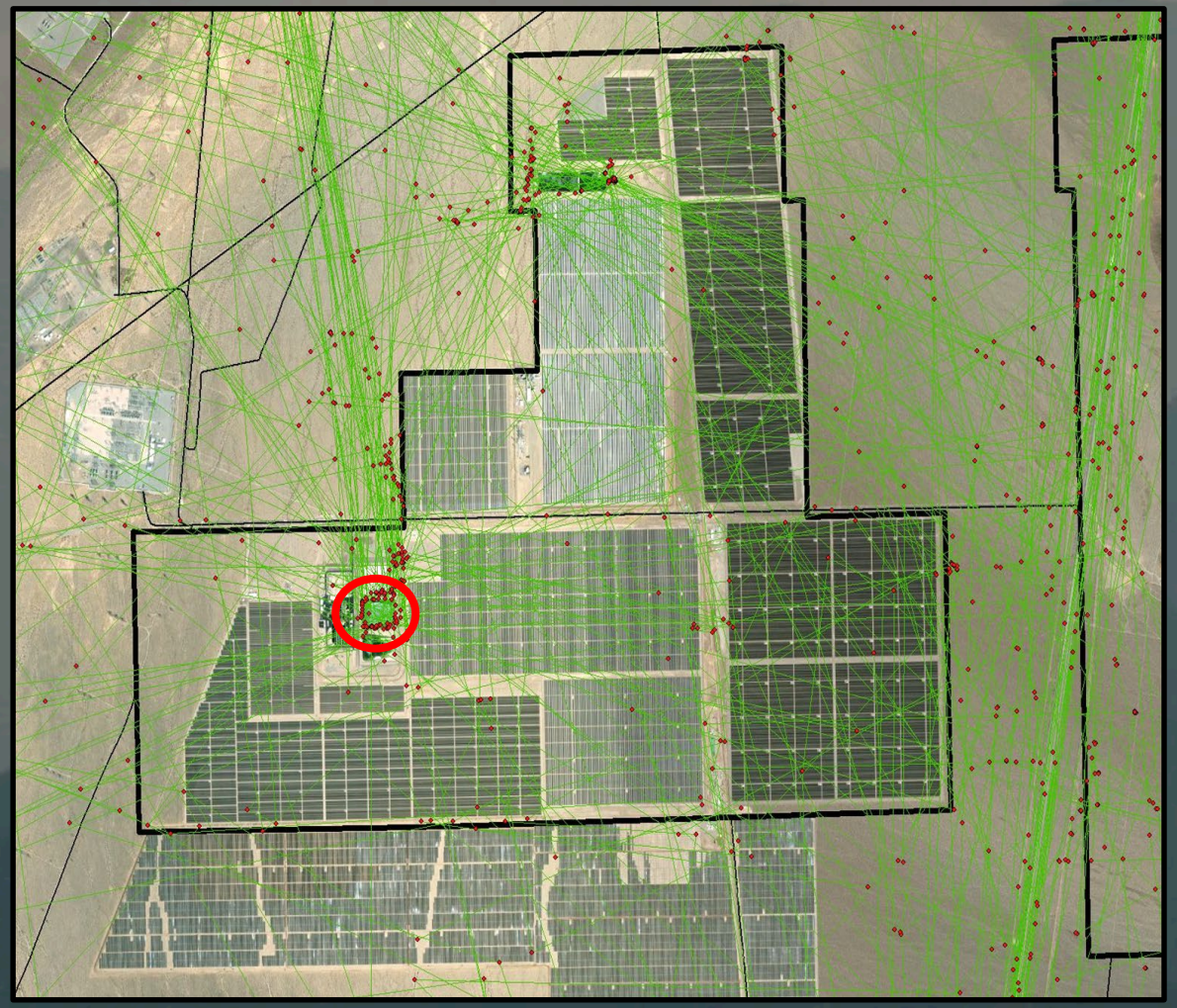
Coyote Home Range Size

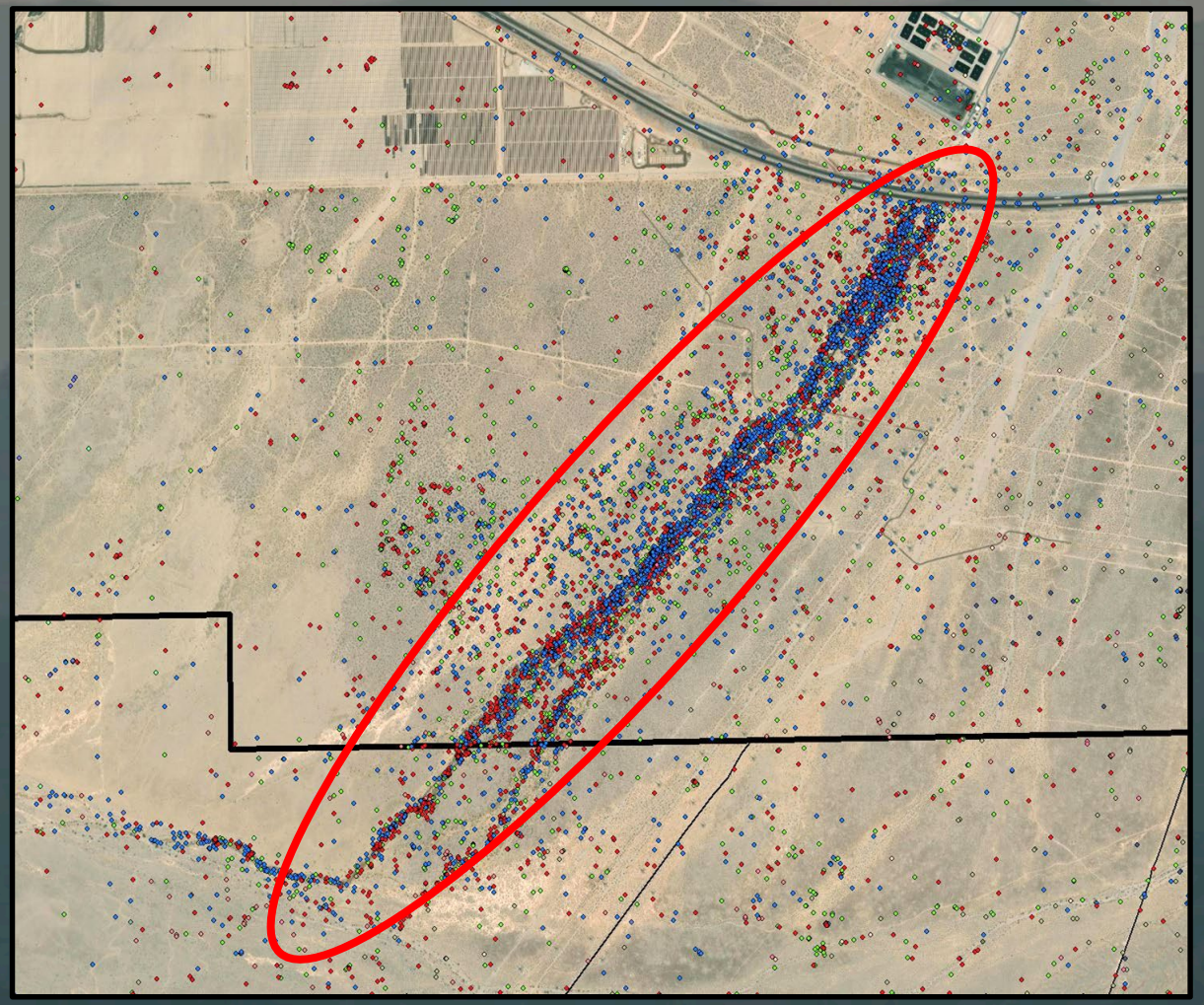


Sex	Status	Winter Mean (km^2)	Winter 95% CI	Summer Mean (km^2)	Summer 95% CI
Male	Transient	751	357-1276	425	281-641
Male	Resident	35	29-43	37	23-51
Female	Transient	117	71-179	373	145-788
Female	Resident	26	19-34	23	14-28



Coyotes Use of Anthropogenic Resources





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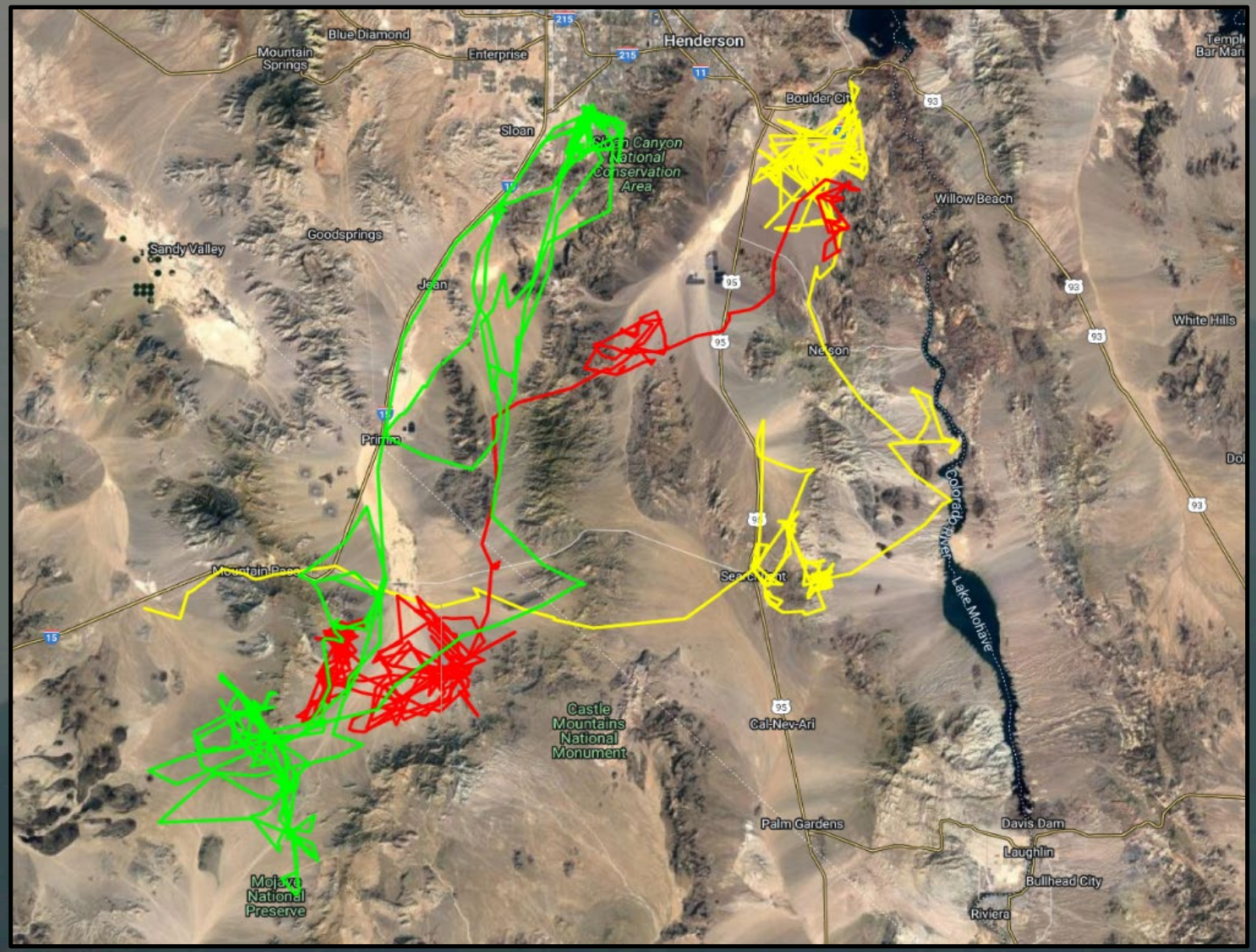

Anthropogenic resources provide coyotes with tremendous reach across the desert

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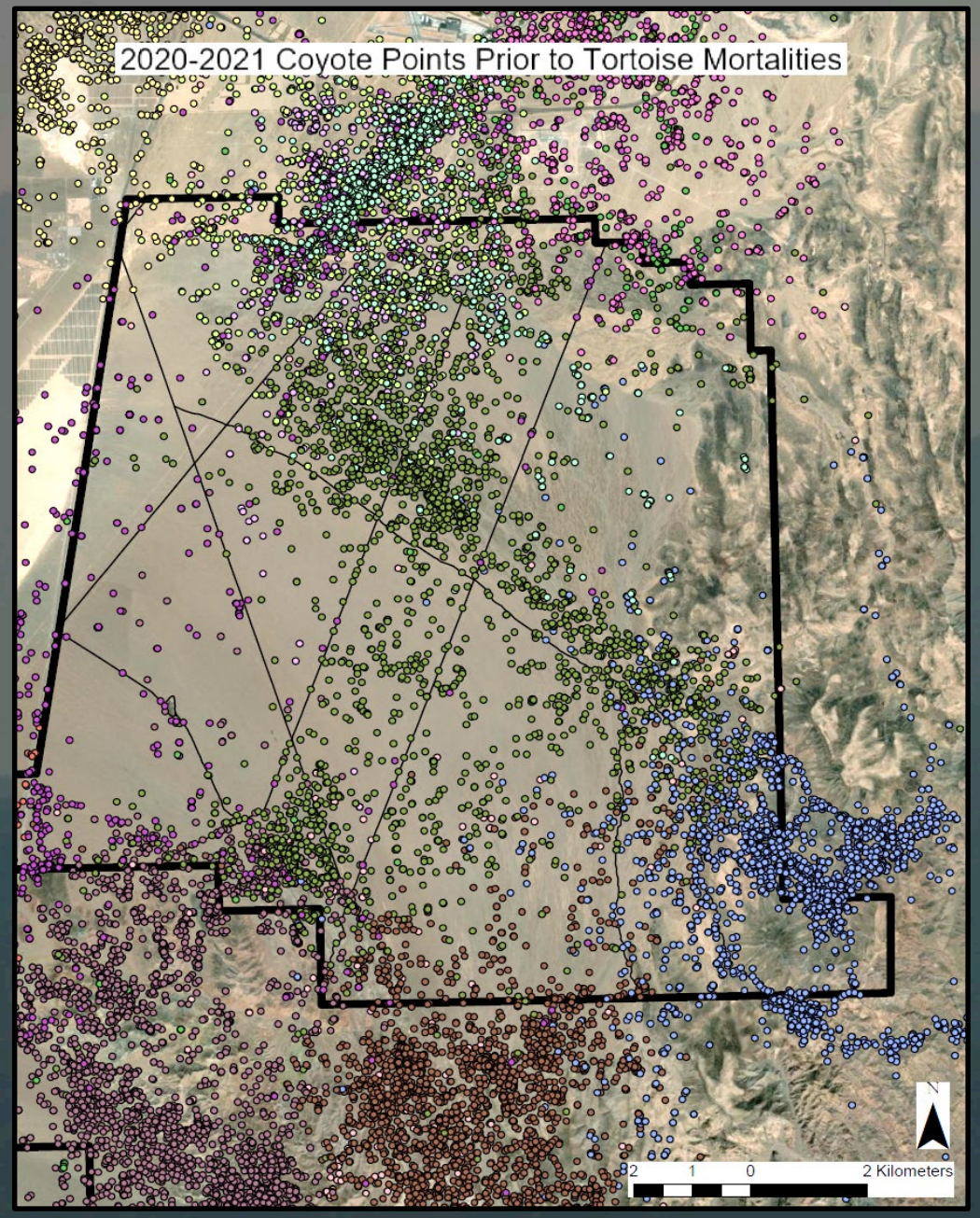
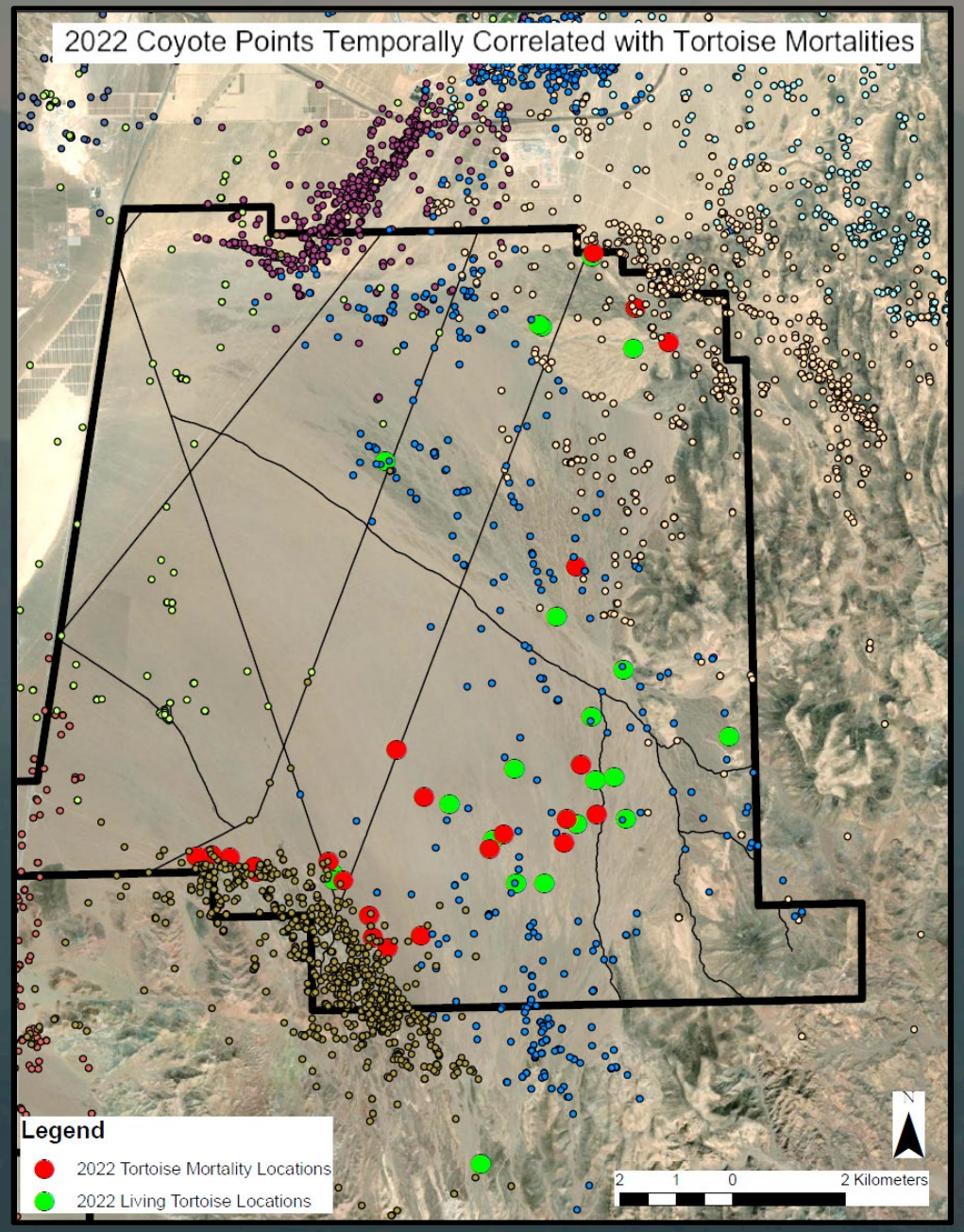
Coyotes and Tortoises





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Coyotes and Tortoises

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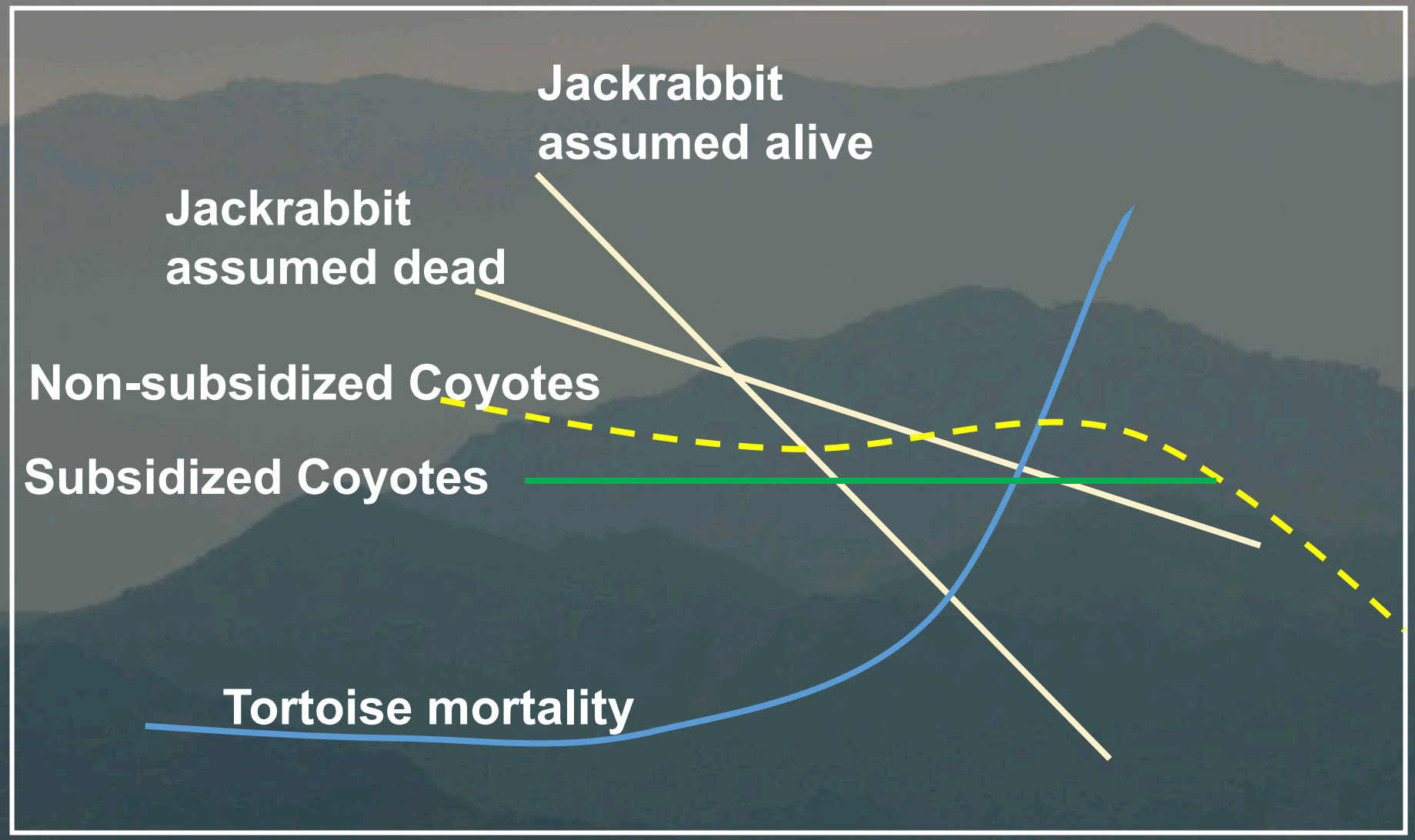
Jackrabbit
assumed alive
Jackrabbit
assumed dead
Non-subsidized Coyotes
Subsidized Coyotes
Tortoise mortality
Survival
2018
2019
2020
2021

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Management Considerations

1. **Reduce subsidies**
   - Landfill and trash subsidies
   - Boulder City outflow
   - Golf courses and other open waters
   - Cottontails and pets
2. **Weaponize focal tortoises -** dissuade coyotes from chewing on tortoises
3. **Coyote reproductive interference**
   - Surgical sterilization reduced coyote predation on domestic lambs and wild pronghorn fawns (Bromley and Gese 2001; Seidler et al. 2014)
   - Removal of adults and their litters or litters alone reduced predation of domestic sheep (Till and Knowlton 1983)

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Important Caveats to Management Considerations

- Coyote populations are driven by resources. Removal will be temporary if resources are not addressed.
- Age structure of the BCCE population indicates lethal management of adults could exacerbate the issue.
- Reproductive interference is an option but has high social and monetary cost and involves long-term, ongoing maintenance.

Future Work

- Reduce data for habitat selection, population size, and density for jackrabbits and coyotes
- Modify camera array for more robust open population model
- End nocturnal road surveys
- Continue capturing and collaring jackrabbits and coyotes to assist in spatial modeling
- Ongoing work to understand tortoise predation and predatory deterrence

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Questions?

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