The Influence of Solar Facilities on Coyote Spatial Ecology in Southern Nevada

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Western Ecological Research Center
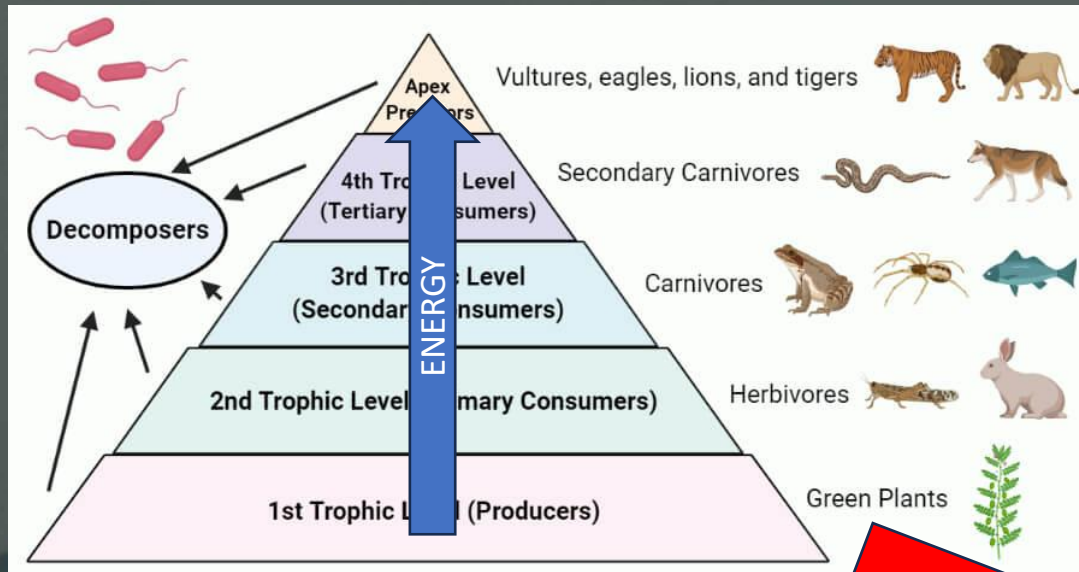**Boulder City Field Station**

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

Outline

- **Predator-Prey Dynamics and Hierarchies**

- **Coyote Ecology**

- **Issues in the Mojave Desert**

- **Overview of Research**

- **Preliminary Results Related to Solar**

- **Management Considerations**

Trophic Levels and Predator-Prey Dynamics

Typical Trophic Levels

https://www.inspiritvr.com/

SYNTHESIS — Journal of Animal Ecology

Using experimentation to understand the 10-year snowshoe hare cycle in the boreal forest of North America

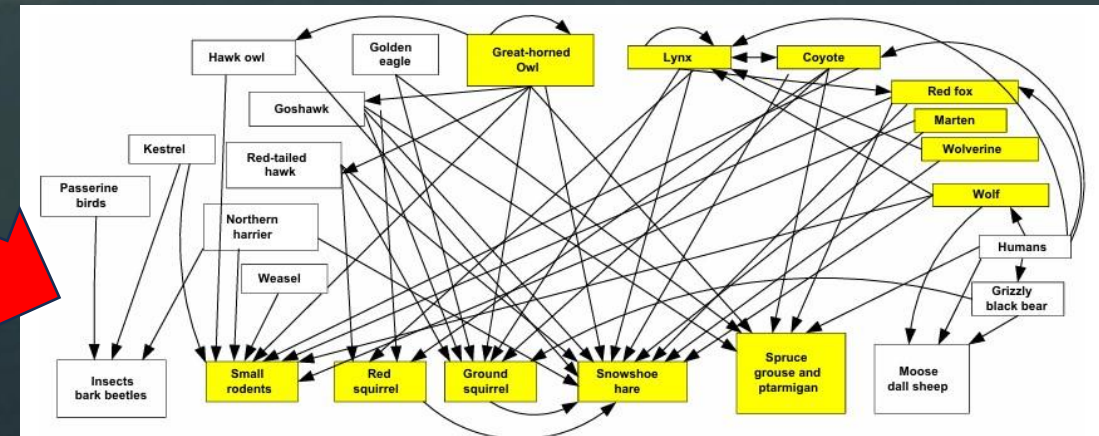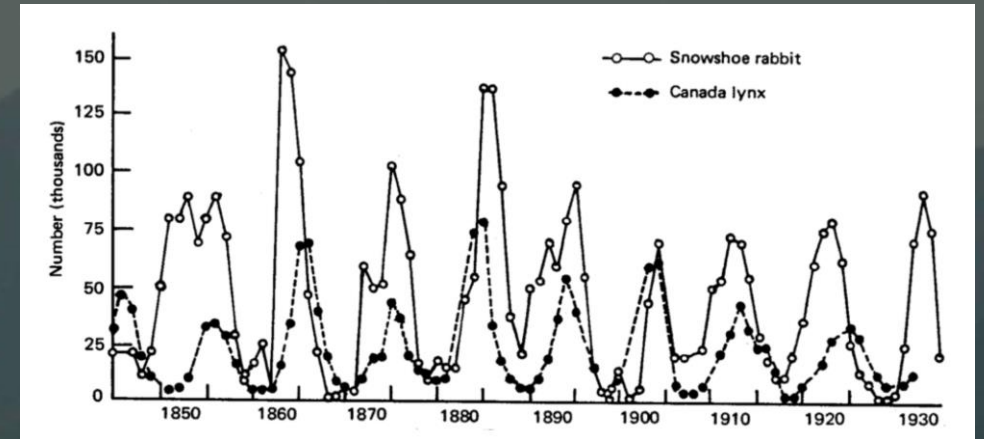Charles J. Krebs[1] | Rudy Boonstra[2] | Stan Boutin[3]

FIGURE 6 Herbivore and carnivore food web for major species in the Kluane Yukon terrestrial ecosystem. Species shaded in yellow are the main species for which we have quantitative data. Occasional diet items are not shown in this diagram [Colour figure can be viewed at wileyonlinelibrary.com]
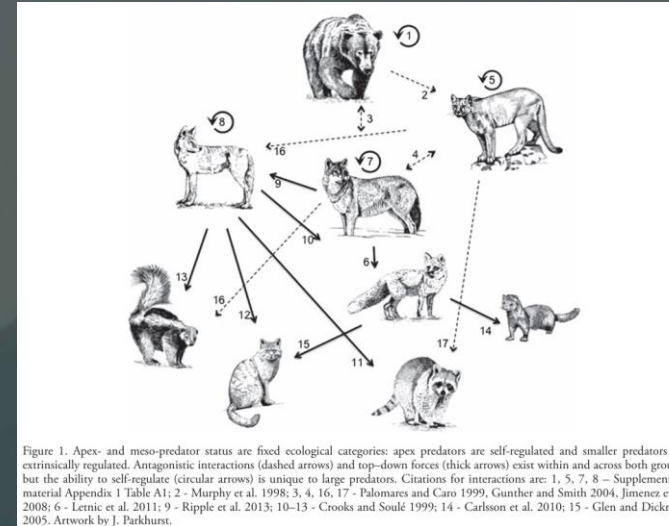
Predator Hierarchy

Dominant vs. Subordinate

- **Multi-carnivore guilds**
- **Body size (15 kg threshold)**
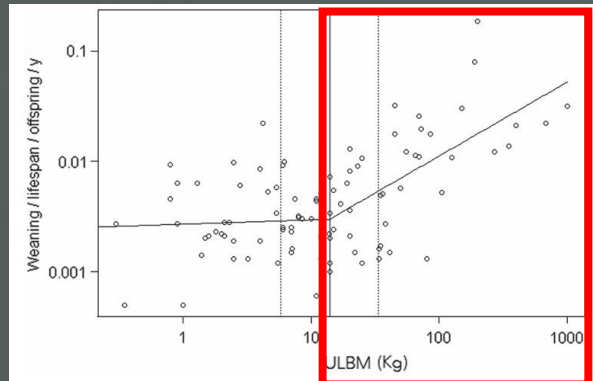
- **Social structure**
  - **Solitary vs. group**
- **Resource avail./use**
  - **Specialist vs. generalist**

Figure 1. Apex- and meso-predator status are fixed ecological categories: apex predators are self-regulated and smaller predators are extrinsically regulated. Antagonistic interactions (dashed arrows) and top–down forces (thick arrows) exist within and across both groups, but the ability to self-regulate (circular arrows) is unique to large predators. Citations for interactions are: 1, 5, 7, 8 – Supplementary material Appendix 1 Table A1; 2 - Murphy et al. 1998; 3, 4, 16, 17 - Palomares and Caro 1999, Gunther and Smith 2004, Jimenez et al. 2008; 6 - Letnic et al. 2011; 9 - Ripple et al. 2013; 10–13 - Crooks and Soulé 1999; 14 - Carlsson et al. 2010; 15 - Glen and Dickman 2005. Artwork by J. Parkhurst.

Wallach et al. 2015: 10.111/oik.01977

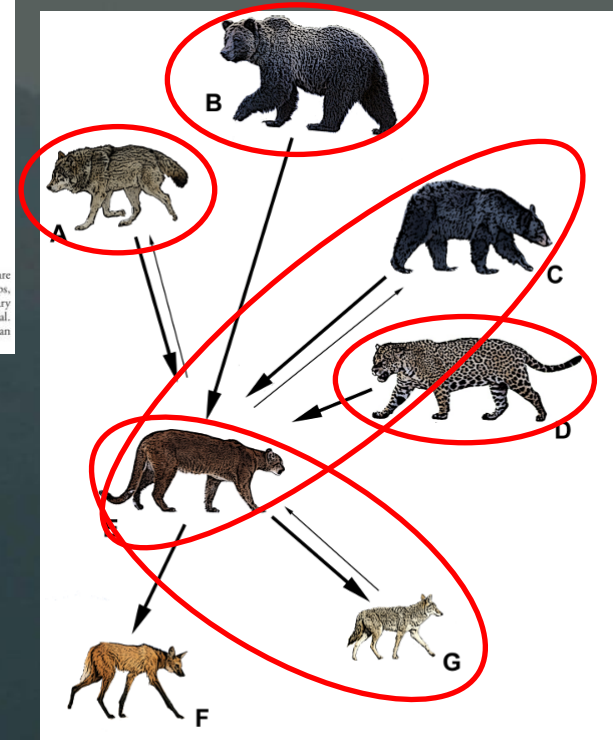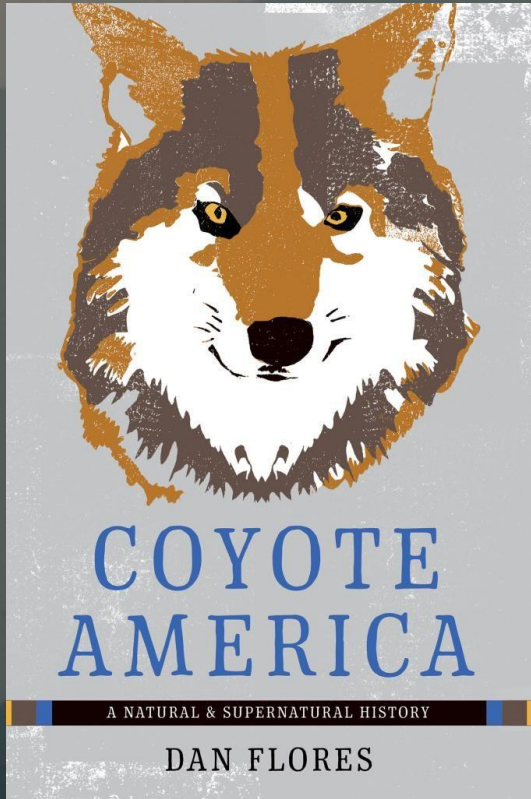

https://animalia-life.club

Figure 1 The apex predators of North and South America and their relative competitive relationship with pumas (E). Bold arrows denote dominance, and point from the dominant species to the subordinate. Thin arrows denote some evidence to the contrary. (A) gray wolf (*Canis lupus*), (B) grizzly bear (*Ursus arctos*), (C) American black bear (*Ursus americanus*), (D) jaguar (*Panthera unca*), (E) puma (*Puma concolor*), (F) maned wolf (*Chrysocyon brachyurus*), (G) coyote (*Canis latrans*). Drawings by Mark Elbroch.

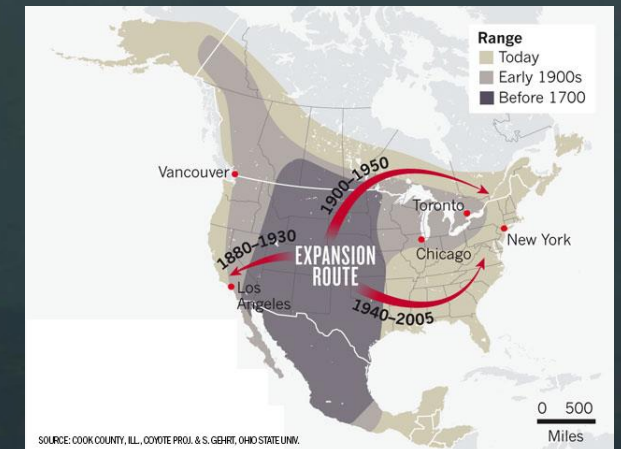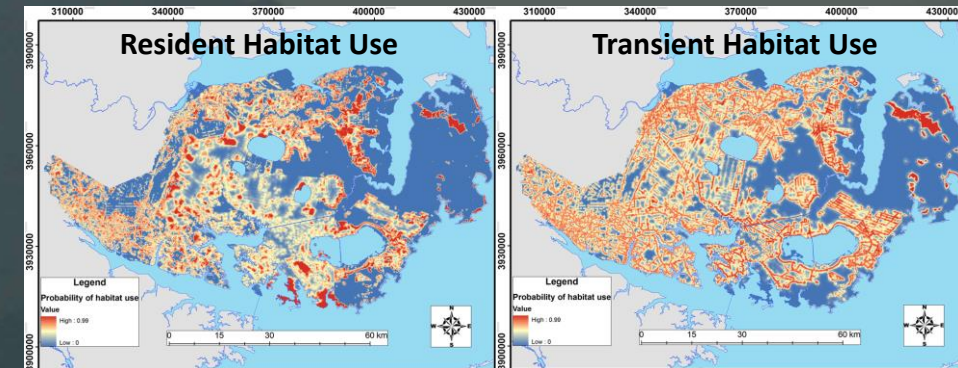Elbroch and Kusler 2018: 10.7717/peerj.4293

Where do coyotes fit?

Resident and transient coyotes exhibit differential patterns of movement behavior across heterogeneous landscapes in the southeastern United States
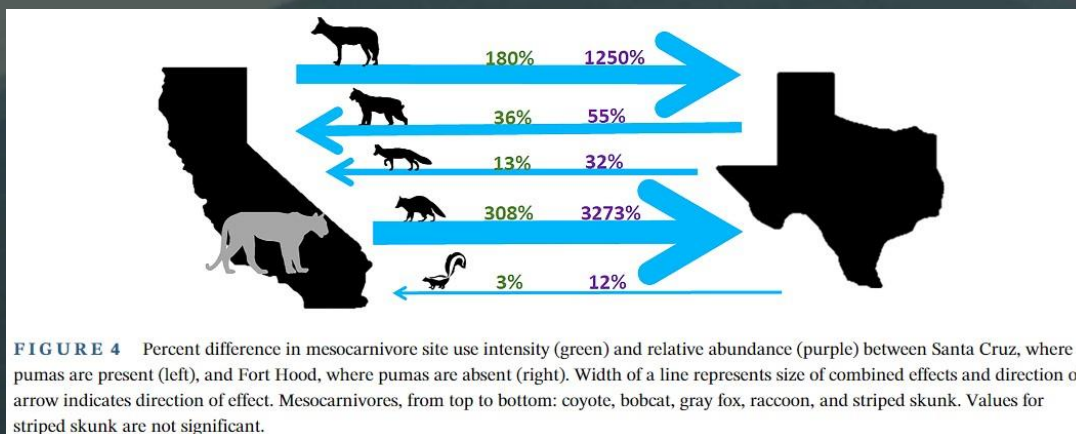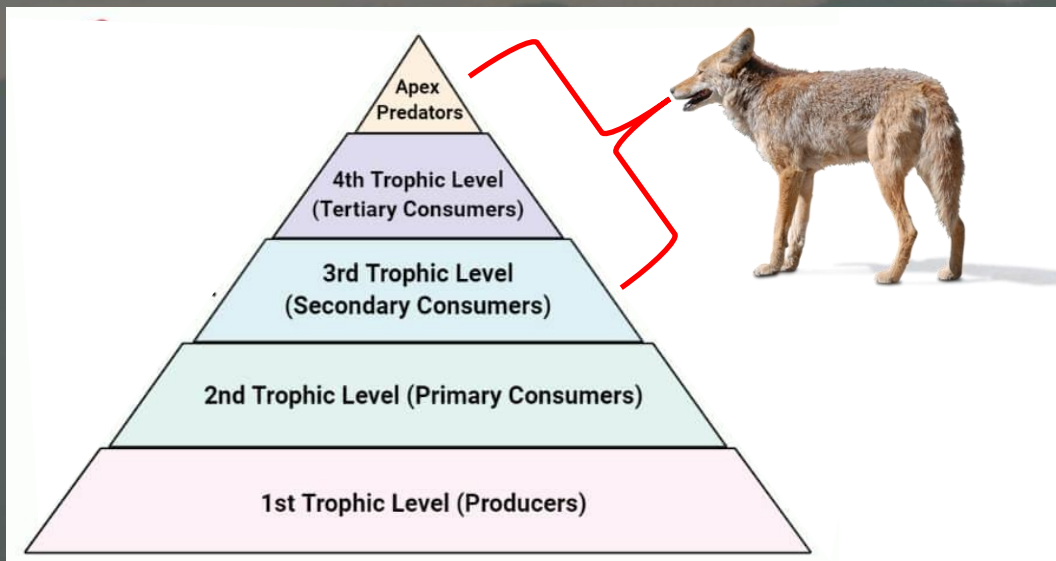
Sarah C. Webster[1] | James C. Beasley[1] | Joseph W. Hinton[2] | Michael J. Chamberlain[3]

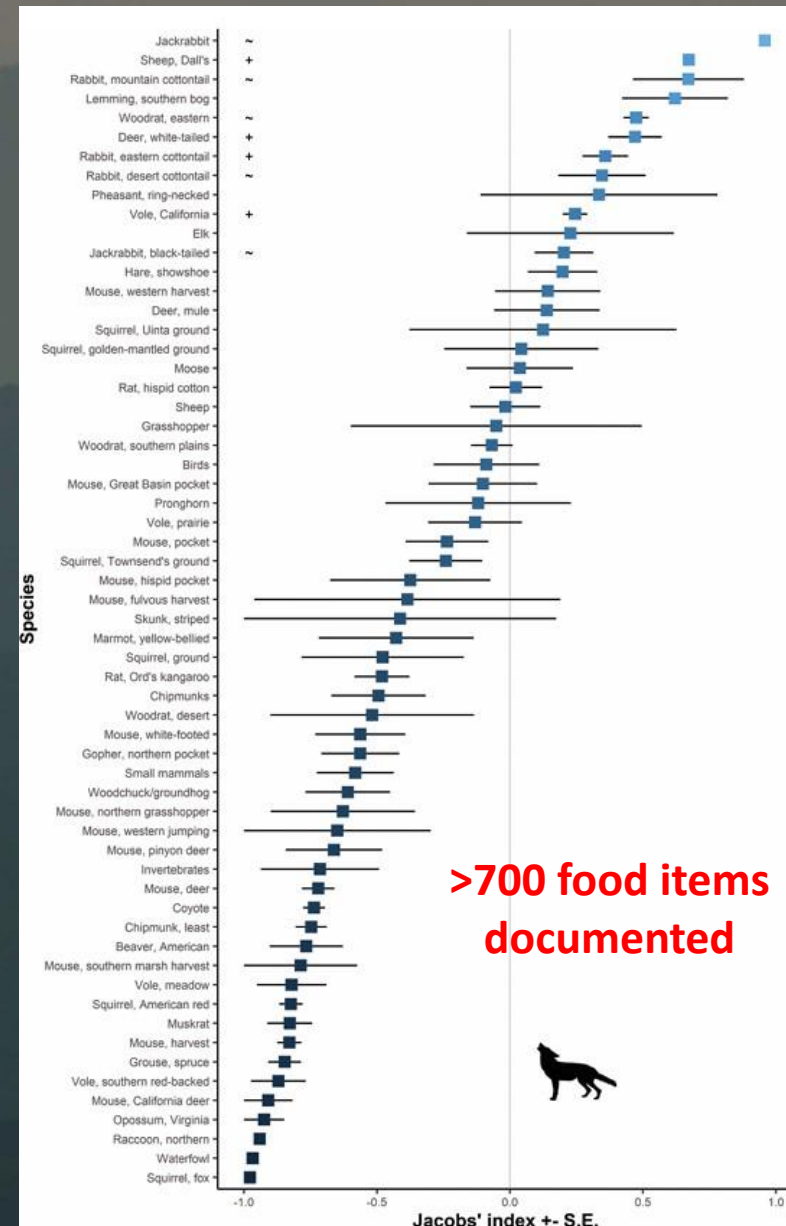Space Use and Habitat Selection by Resident and Transient Coyotes (*Canis latrans*)

Joseph W. Hinton[1]*, Frank T. van Manen[2], Michael J. Chamberlain[1]

- **Wide body size range**
- **Hybridization**
- **Generalist predator**
  - Often omnivorous
- **No special habitat req.**
- **Hierarchical social structure**
  - Residents vs. transients
- **Self-regulating pop. size/density**
  - Low maternal investment
  - Typically small litters, but…
  - Compensatory reproduction
  - Compensatory immigration
  - Pack dissolution + reformation

Resident Habitat Use   Transient Habitat Use

Where do coyotes fit?

FIGURE 4 Percent difference in mesocarnivore site use intensity (green) and relative abundance (purple) between Santa Cruz, where pumas are present (left), and Fort Hood, where pumas are absent (right). Width of a line represents size of combined effects and direction of arrow indicates direction of effect. Mesocarnivores, from top to bottom: coyote, bobcat, gray fox, raccoon, and striped skunk. Values for striped skunk are not significant.

Avrin et al. 2023: 10.1002/ecs2.4383

>700 food items documented

Hayward et al. 2023: 10.1093/jmammal/gyad094

Mojave Desert

- Multi-carnivore guild
- APEX → Pumas… but restricted suitability
- Could coyotes be apex predators in much of the ecoregion?
- Increased anthropogenic subsidies

Heightened concern about presumed coyote predation
of Mojave desert tortoises

- Implications:
  - Additive tortoise mortality
  - Tortoise translocation success
  - Tortoise pop. declines

Effects of subsidized predators, resource variability,
and human population density on desert tortoise
populations in the Mojave Desert, USA

Todd C. Esque[1,•], Ken E. Nussear[1], K. Kristina Drake[1], Andrew D. Walde[2],
Kristin H. Berry[3], Roy C. Averill-Murray[4], A. Peter Woodman[5], William I. Boarman[6],
Phil A. Medica[1], Jeremy Mack[3,8], Jill S. Heaton[7]

Coyote diet patterns in the Mojave Desert: implications for
threatened desert tortoises

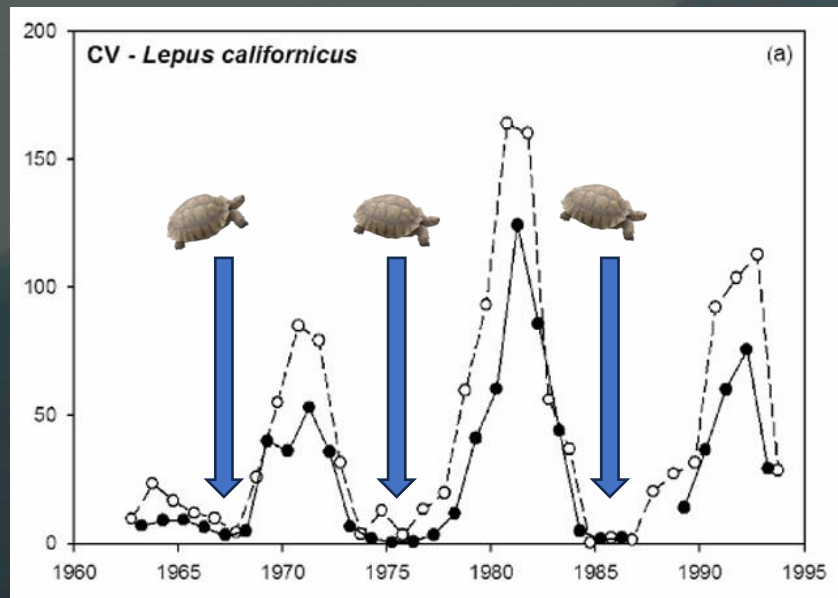Brian L. Cypher[A,B], Erica C. Kelly[A], Tory L. Westall[A] and
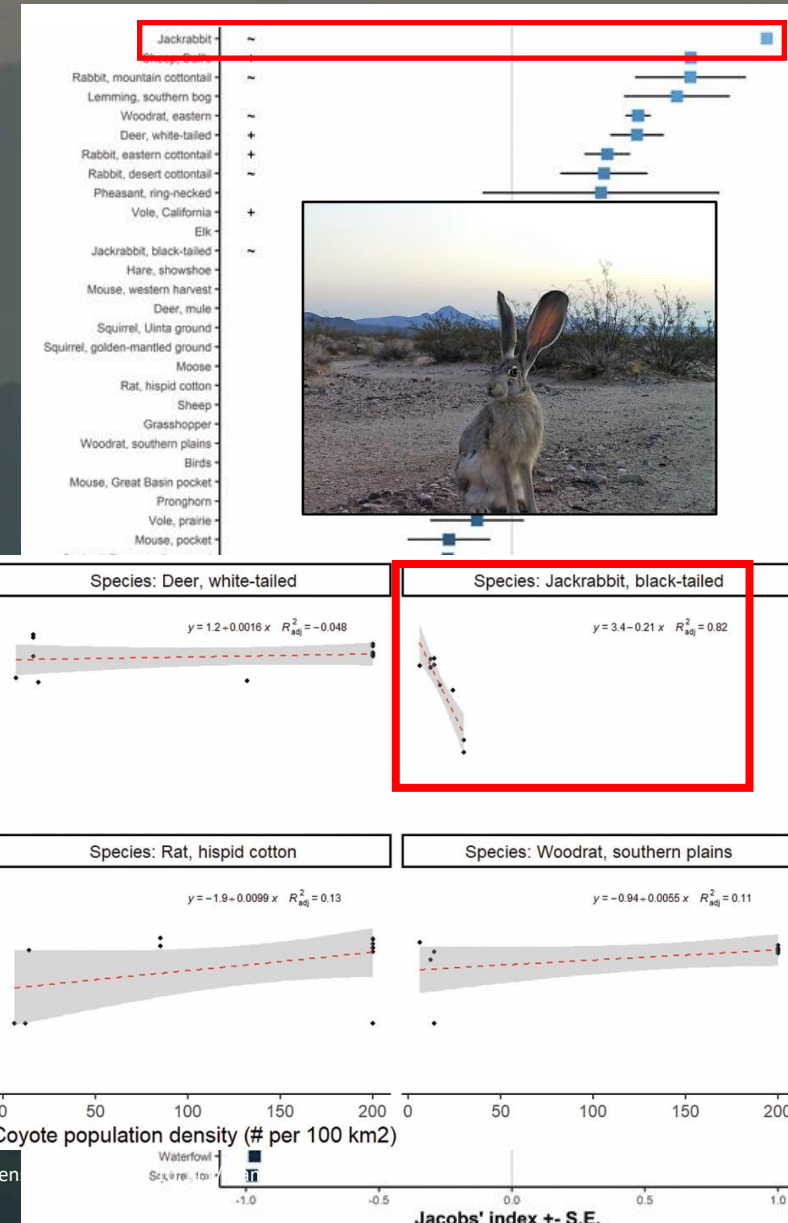Christine L. Van Horn Job[A]

Mojave Desert

<u>Working Hypothesis:</u>
Jackrabbit population declines

coyotes 'prey switch' to desert tortoises
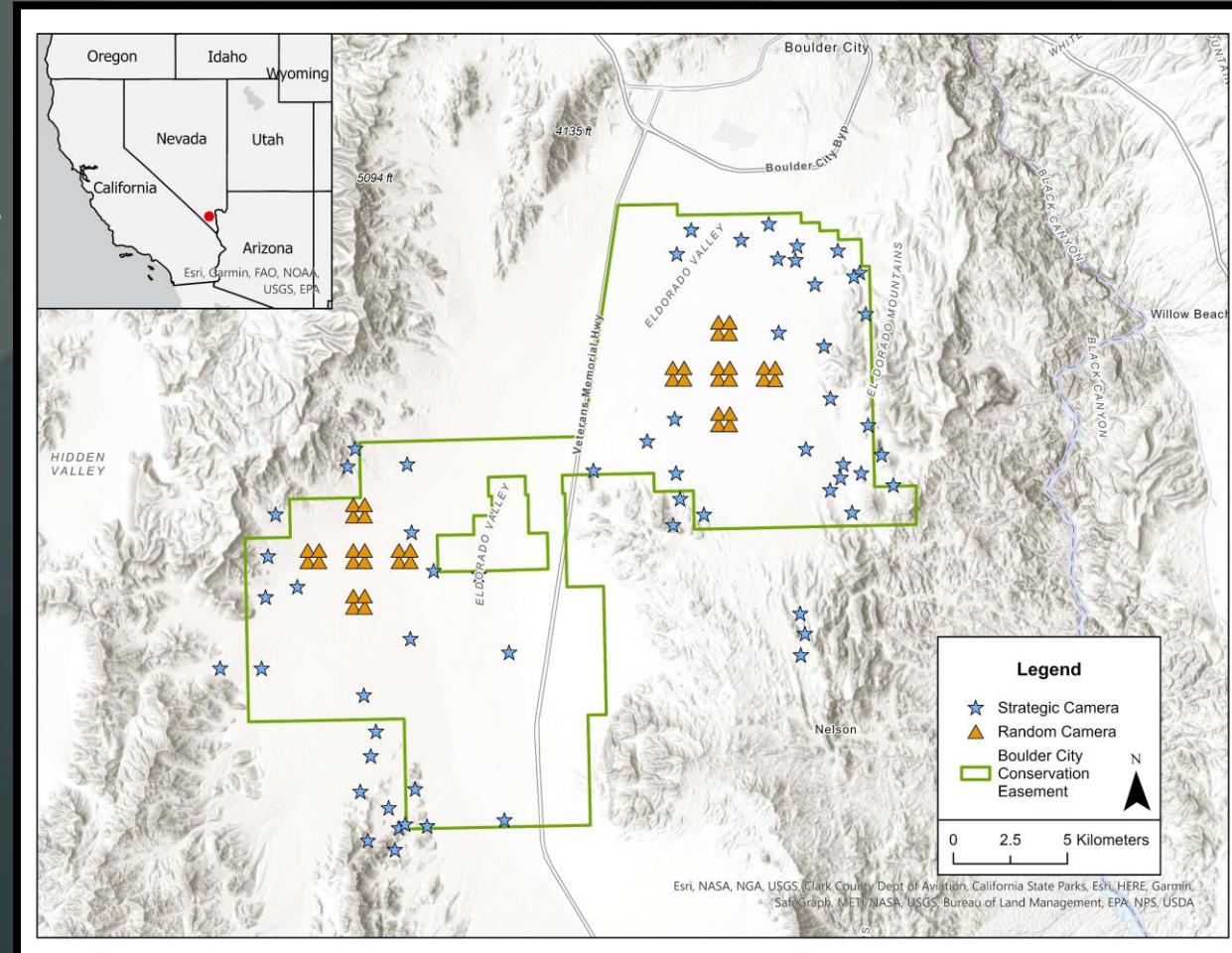
Bartel et al. 2008: 10.1644/07-MAMM-A-378.1

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

Research Objectives

Investigate:

- **Population Ecology**
  - **Density/Abundance**
  - **Survival**
  - **Cause-specific mortality**

- **Spatial Ecology**
  - **Habitat selection**
  - **Home range size**
  - **Movements**

Inform:

- **Coyote management**
- **Tortoise conservation**

Methods
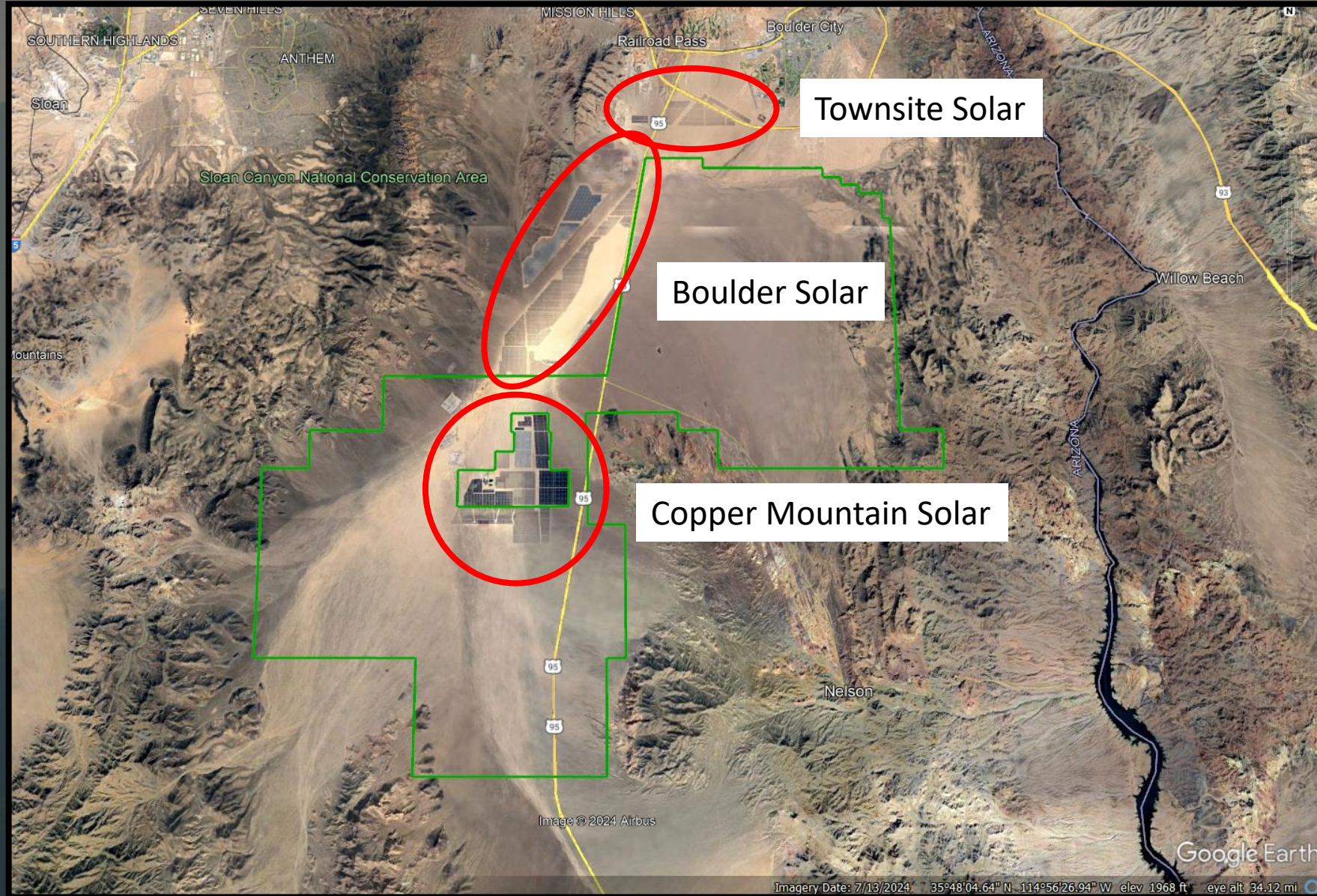
Camera traps

Capture + Collar Jackrabbits

Capture + Collar Coyotes

Analytical Methods

Photo: Christian Franco, USGS

- **Move+Social =** Continuous-time movement models
- **HR Size =** Autocorrelated KDEs
- **Hab. Selection =** RSFs via conditional binomial GLMMs

Solar Facilities in Study Area

Preliminary Results
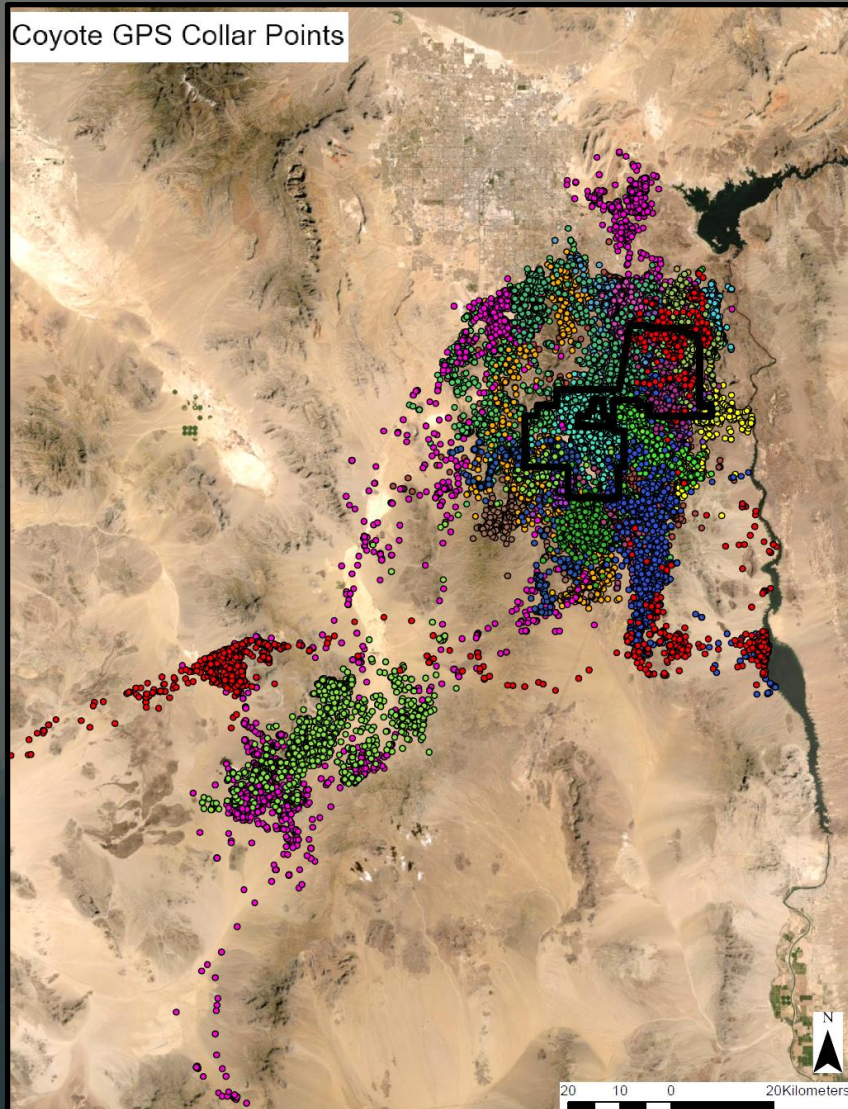## *Coyote Spatial Ecology and Solar*
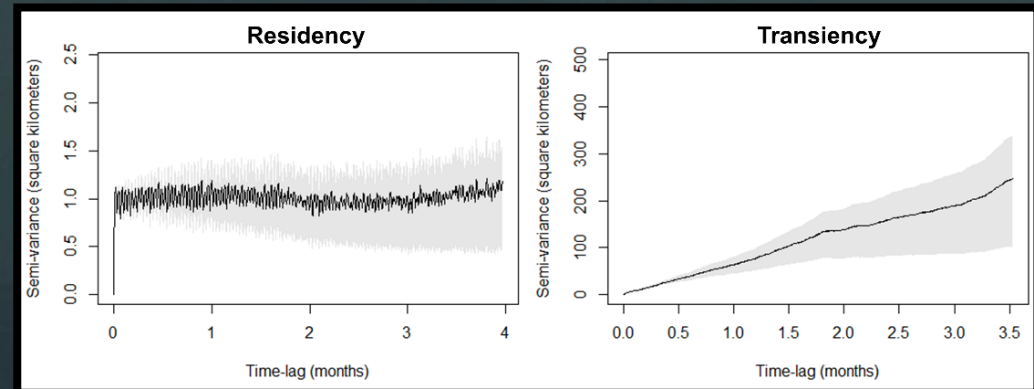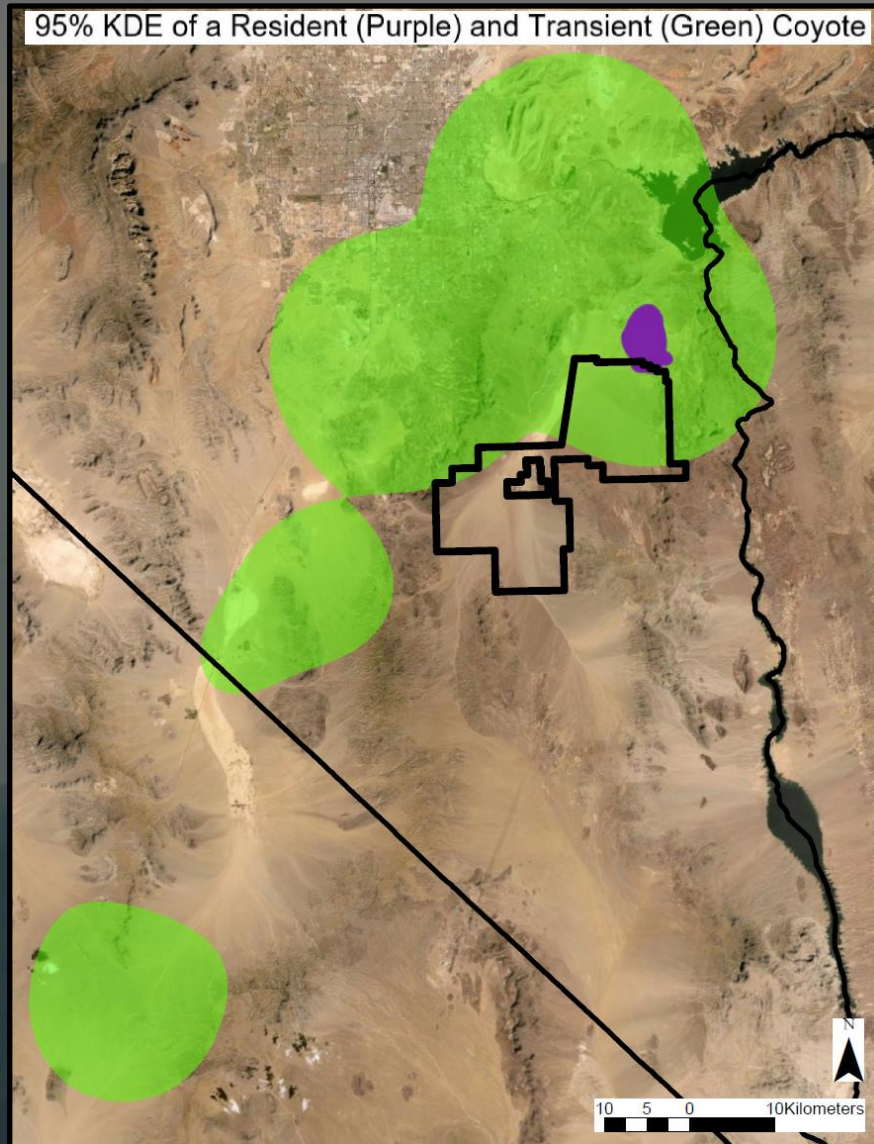## *2019-2021*

Photo: Ben Gottsacker

2023-10-24 18:02:56   M 3/3   23°C

H1   RECONYX

Movements + Social Status

Coyote GPS Collar Points

- **52 seasonal datasets for 21 GPS-collared coyotes**

- **Multiple long-range forays by transients**
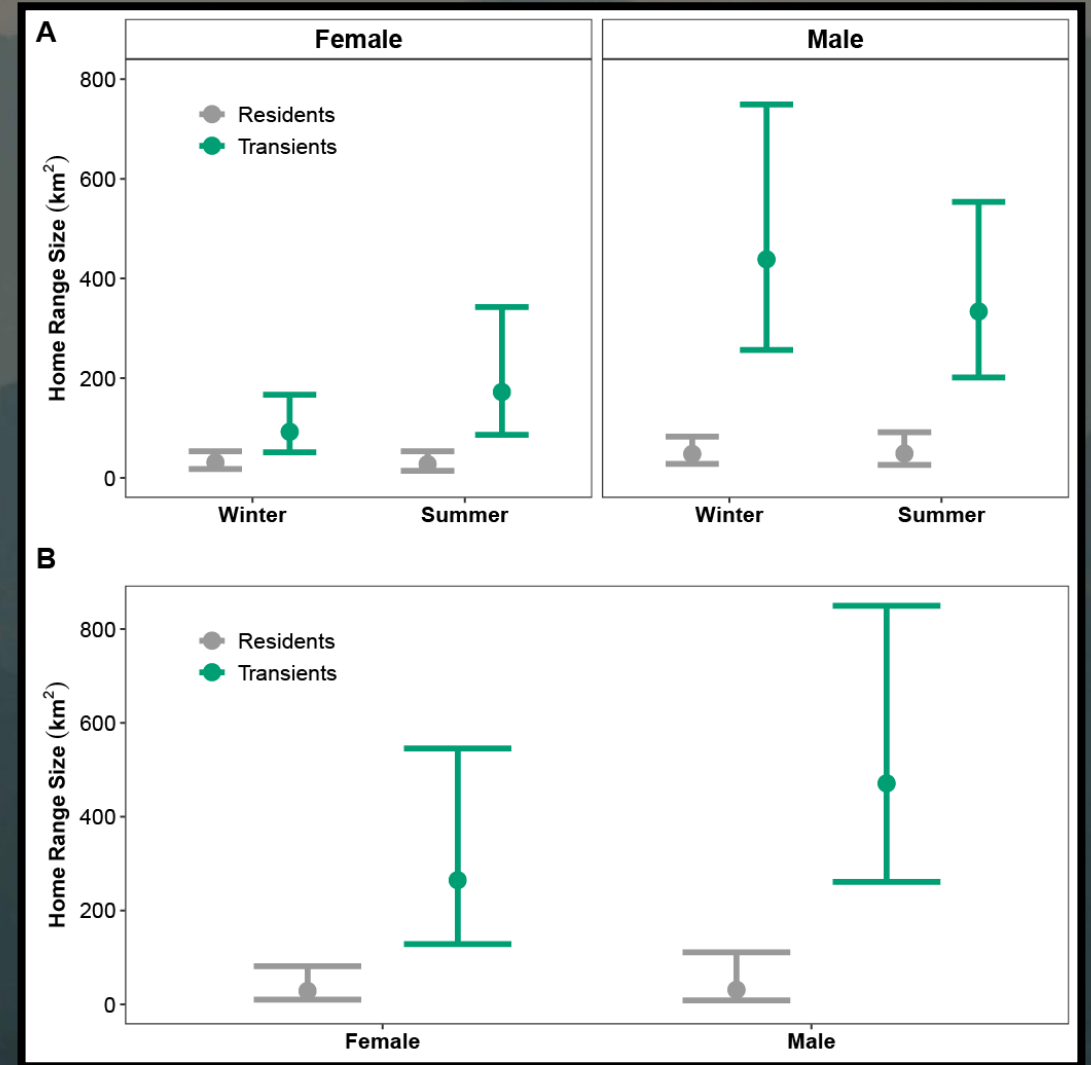
- **Only ~20% of coyotes exhibited residency**

Home Range Characteristics

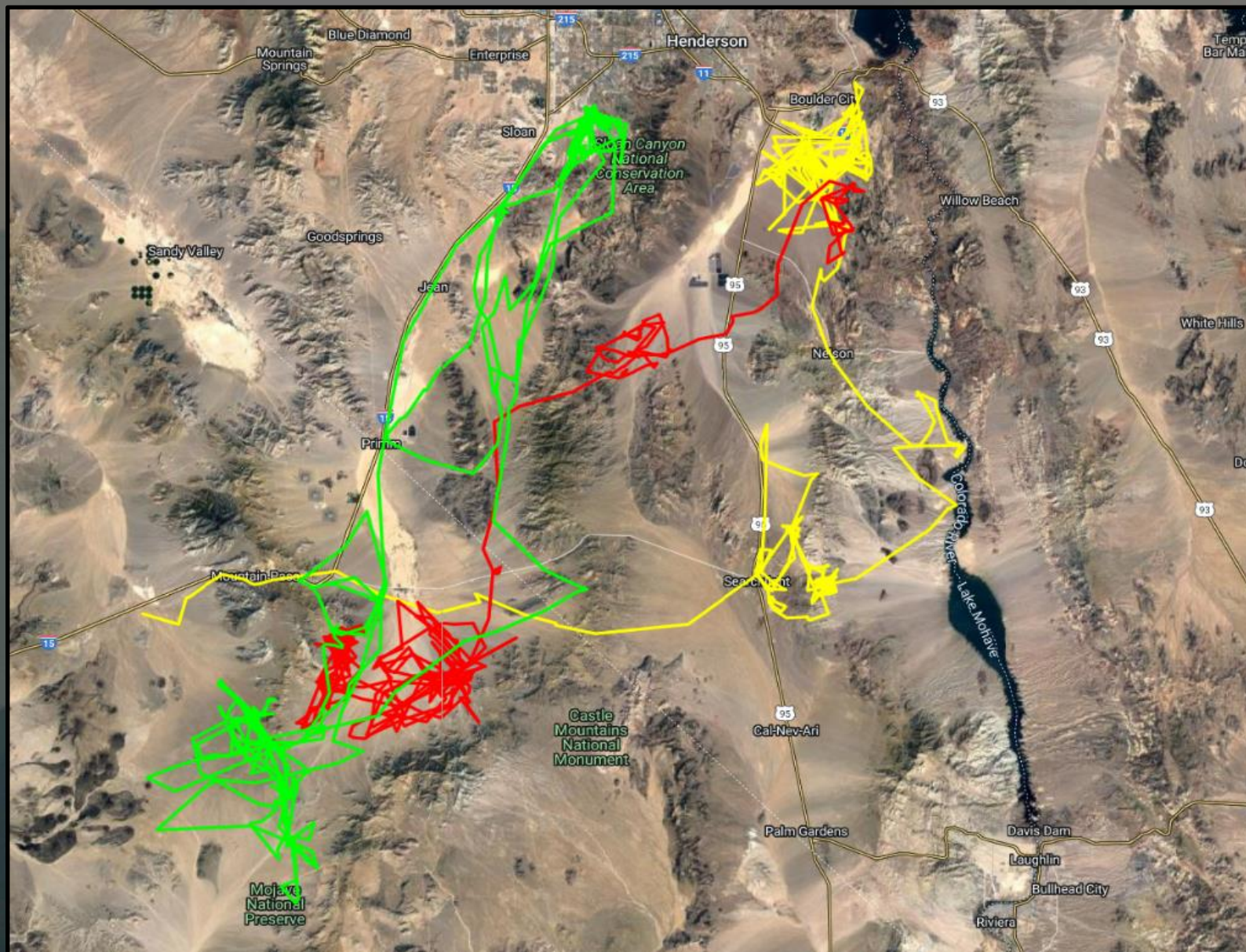95% KDE of a Resident (Purple) and Transient (Green) Coyote

Multiple home range relocations among seasons and years documented

Home Range Sizes

- **Residents → Similar HRs between seasons and sexes**

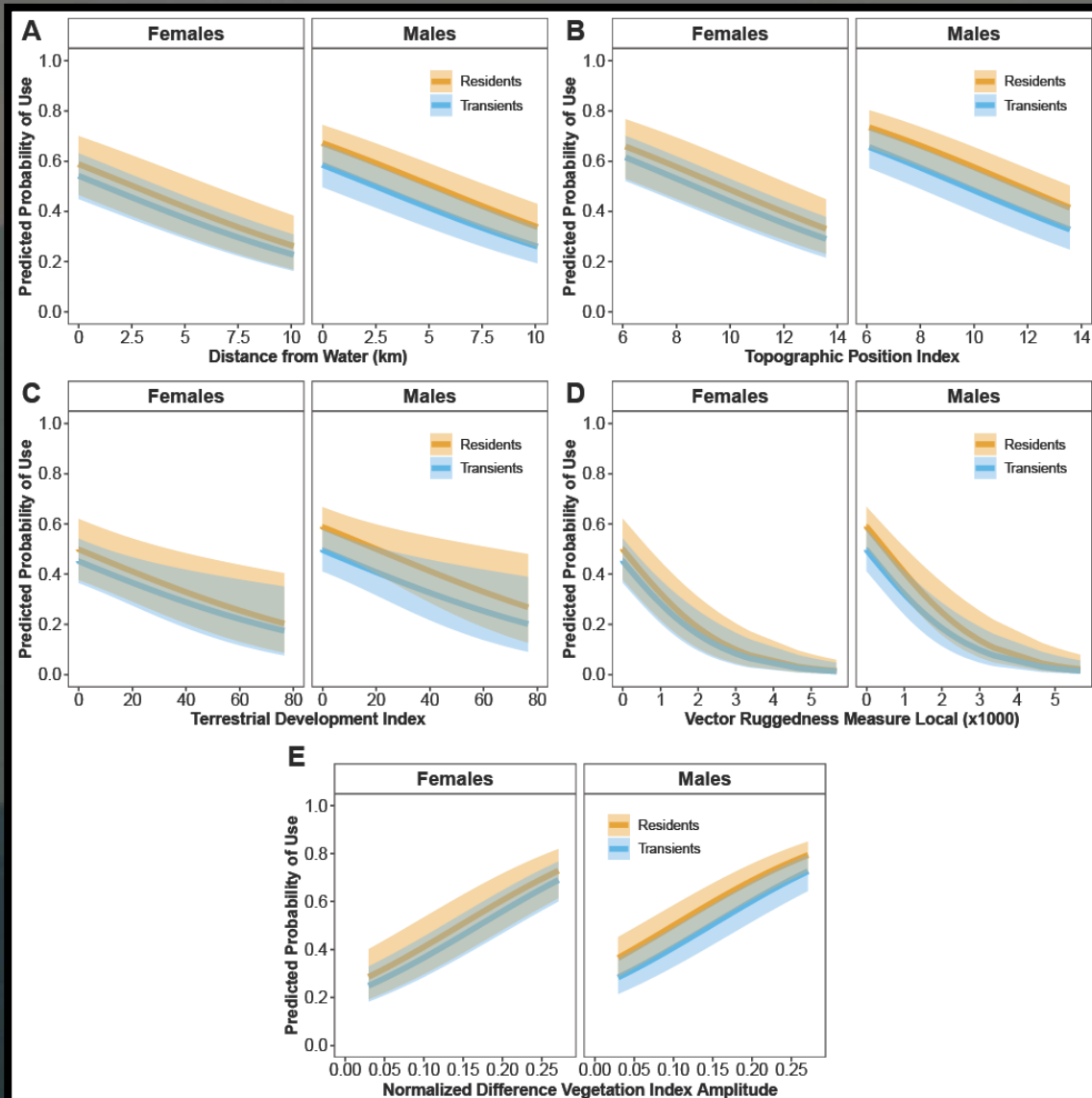- **Transients → up to 25× larger HRs than residents**

Coyotes have tremendous reach across the desert.
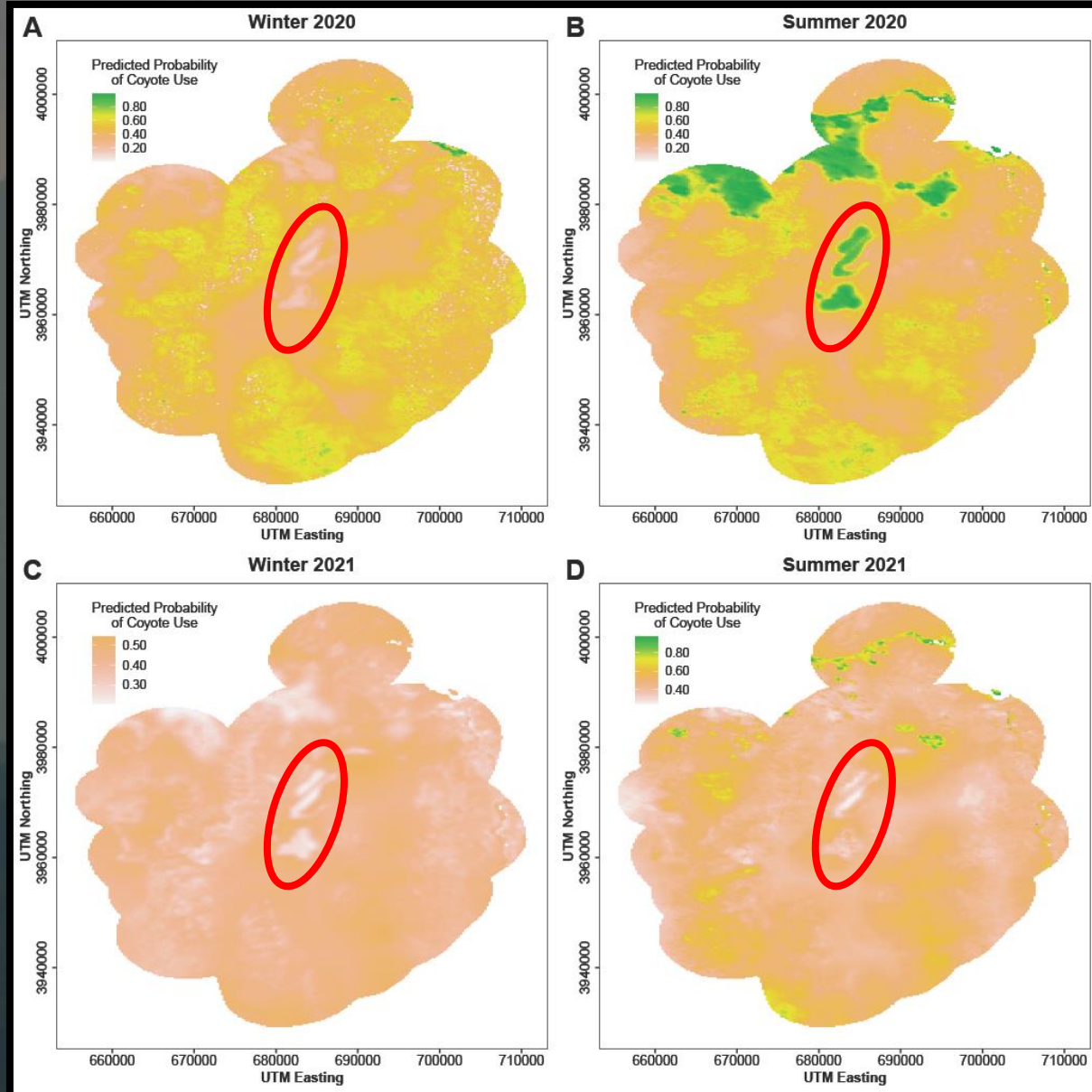
Influenced by anthropogenic subsidies?

Habitat Selection

- Selecting for:
  - **Winter = Breeding Season**
  - More rugged areas that have denser/more vegetation but are <u>away from human developments</u>

  - **Summer = Pup Rearing**
  - Less rugged areas that are closer to water and <u>closer to human developments</u>
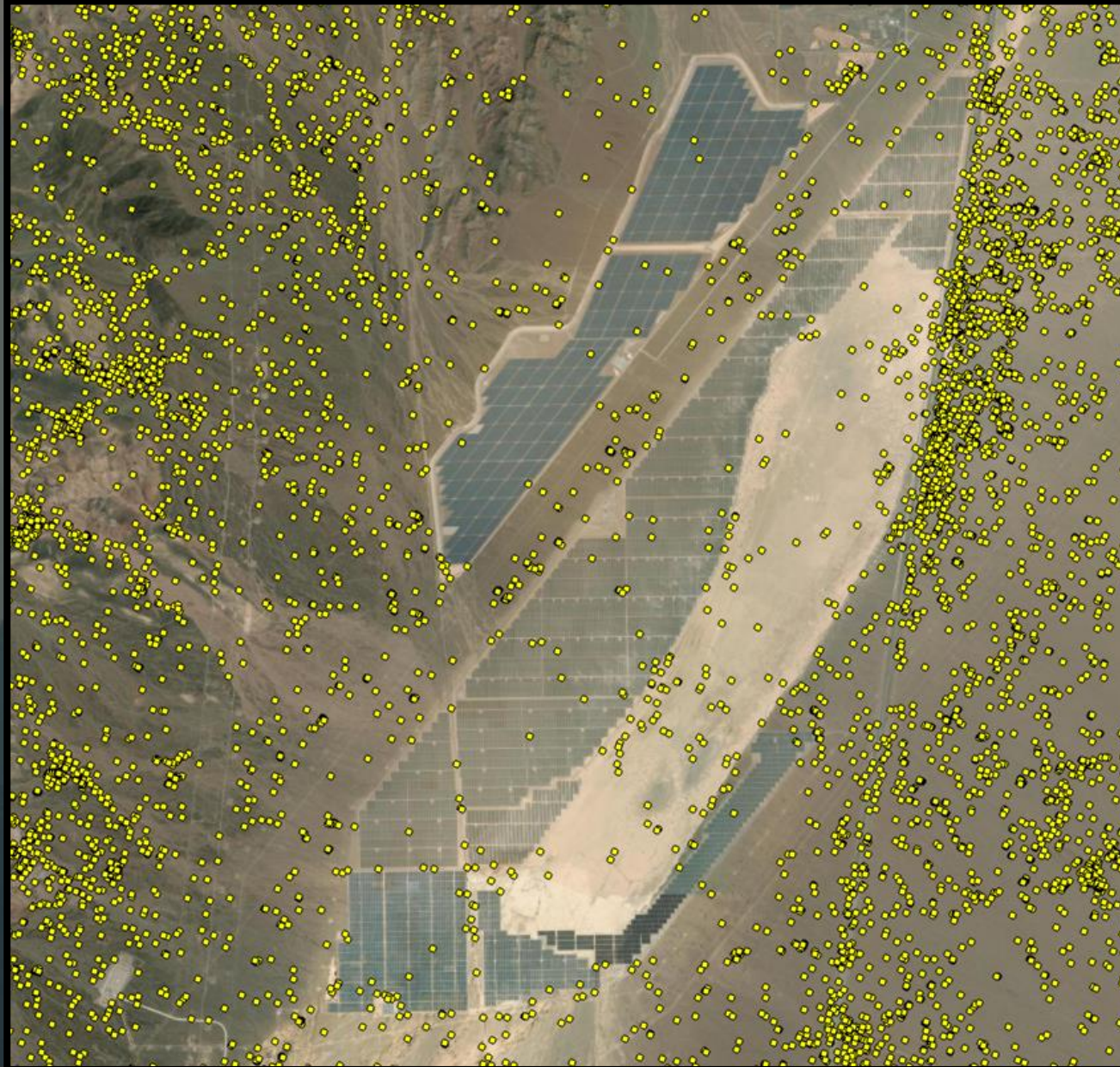
Winter

Summer

Substantial seasonal and annual variation in use of solar facilities

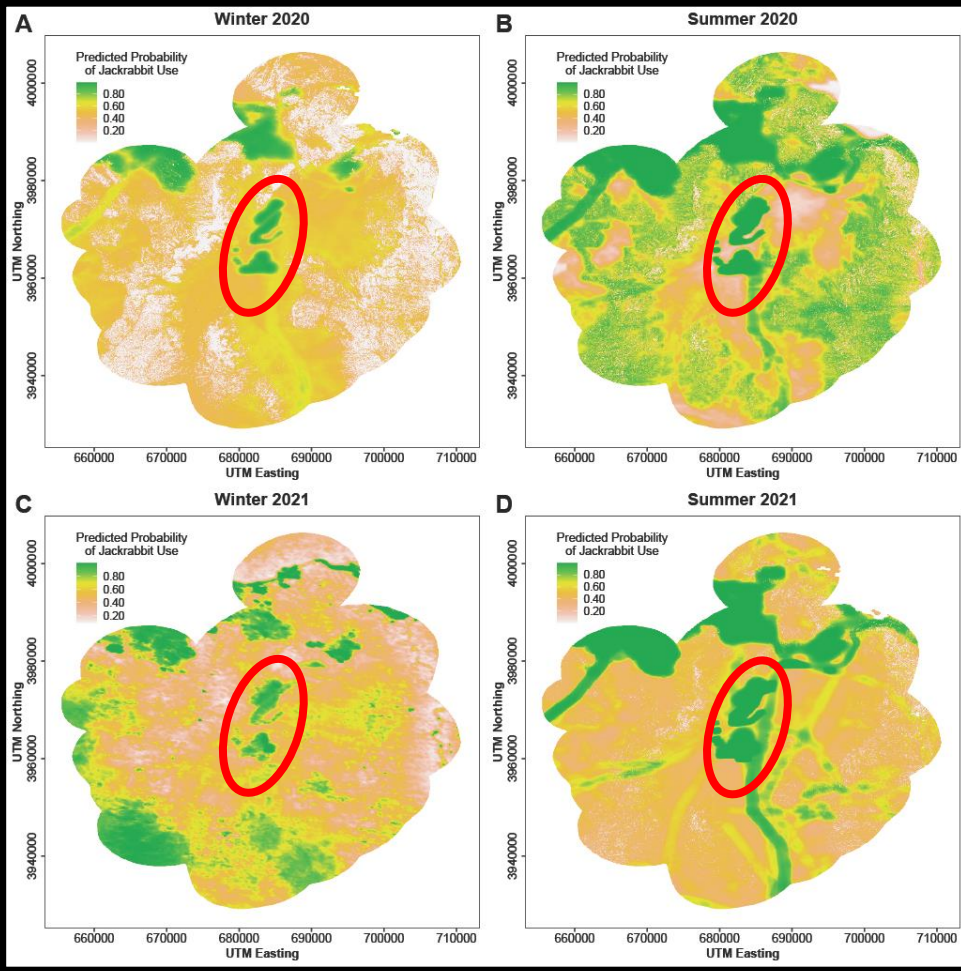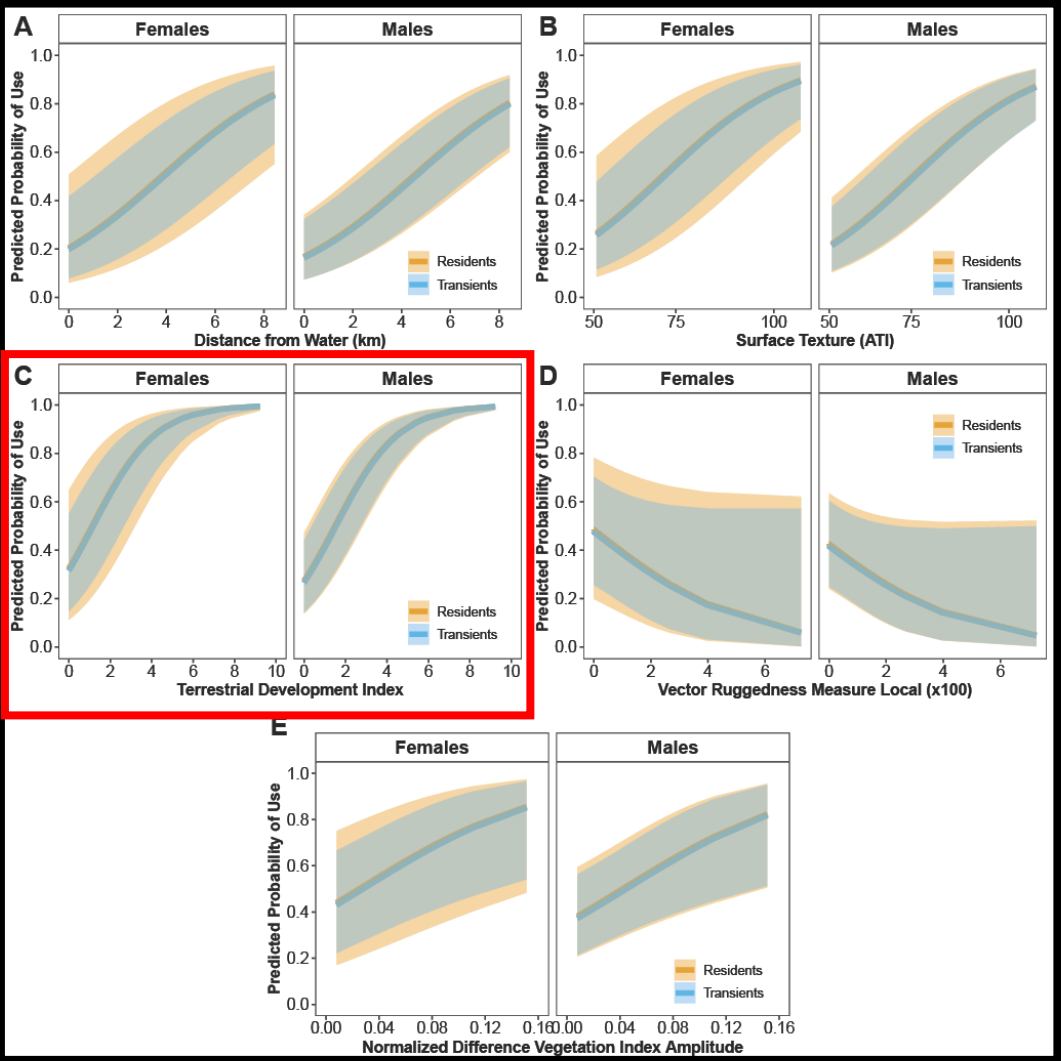**Winter = Avoid Summer = Use**

# Coyote Use of Solar

Coyote Use of Solar

Jackrabbit Habitat Selection

- Selecting for:
  - Summer + Winter = Areas with denser/more vegetation that are <u>closer to human developments</u>

Management Conundrum

- **Coyotes may be functioning at multiple trophic levels**
  - Dominant in valleys, but subordinate in surrounding mountains?
  - Population dominated by transients.
    - High turnover rate?
- **Anthropogenic subsidies**
  - Water at solar pools, golf courses, Boulder City outflow; food at landfill, residential trash
  - Not really using human areas during winter (mating season)
  - Spring/Summer = Pup-rearing = need more resources = riskier behavior
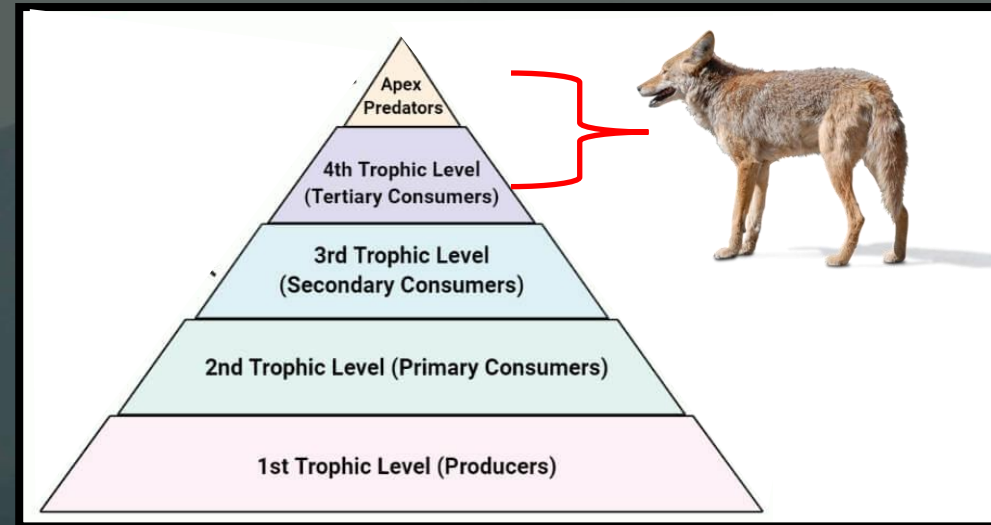
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Stephi Matsushima	Gretchen Gantz	Carleen Silva
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Gabbie Berry	Sabrina Lewicki	Ross Van Gaalen
	Amanda McDonald	

Questions?