Mohave project

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Biostats 502 Fall 2018

Desert Renewable Energy Conservation Plan (DRECP)

- This dataset provides a visual framework for the California Energy Commission on vegetative land masses in the Mohave desert and elsewhere in Southern California.

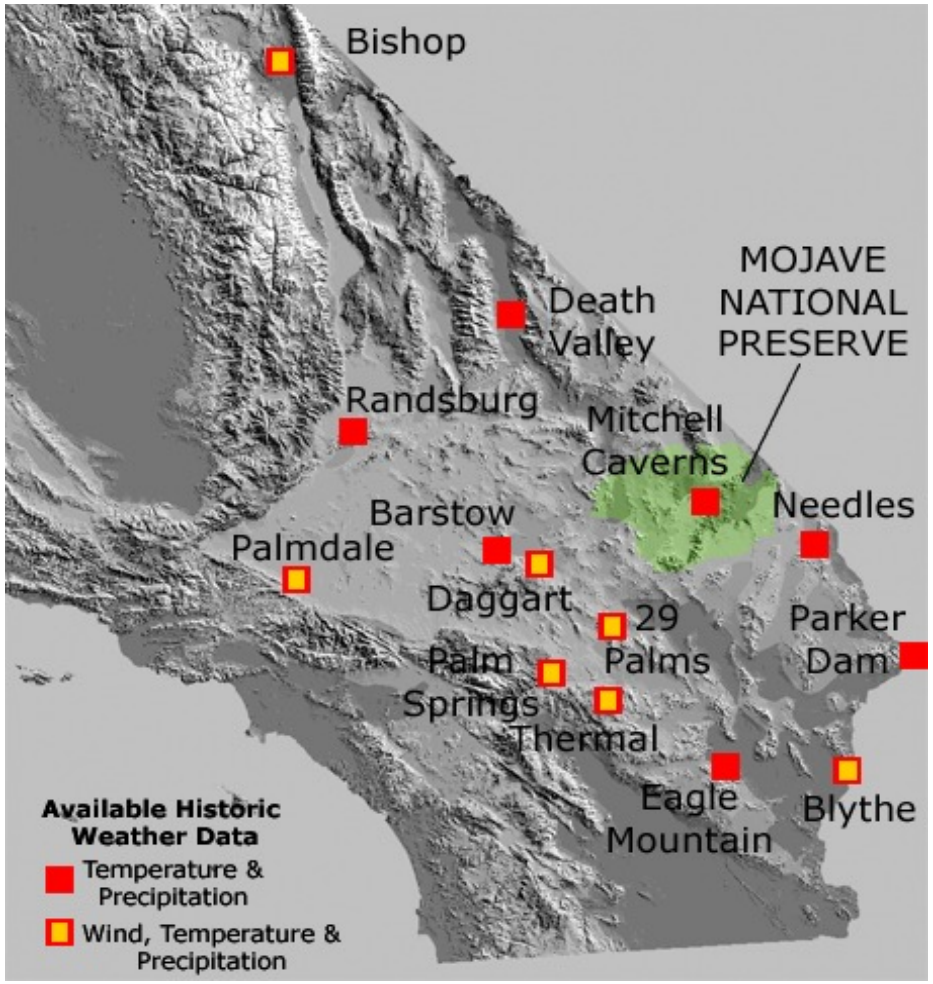
- Research in this area will help support advances in renewable energy through the use of aerial photointerpretation and spatial conservation software—a system of mapping “polygons” that correspond to acres of categorized land use.

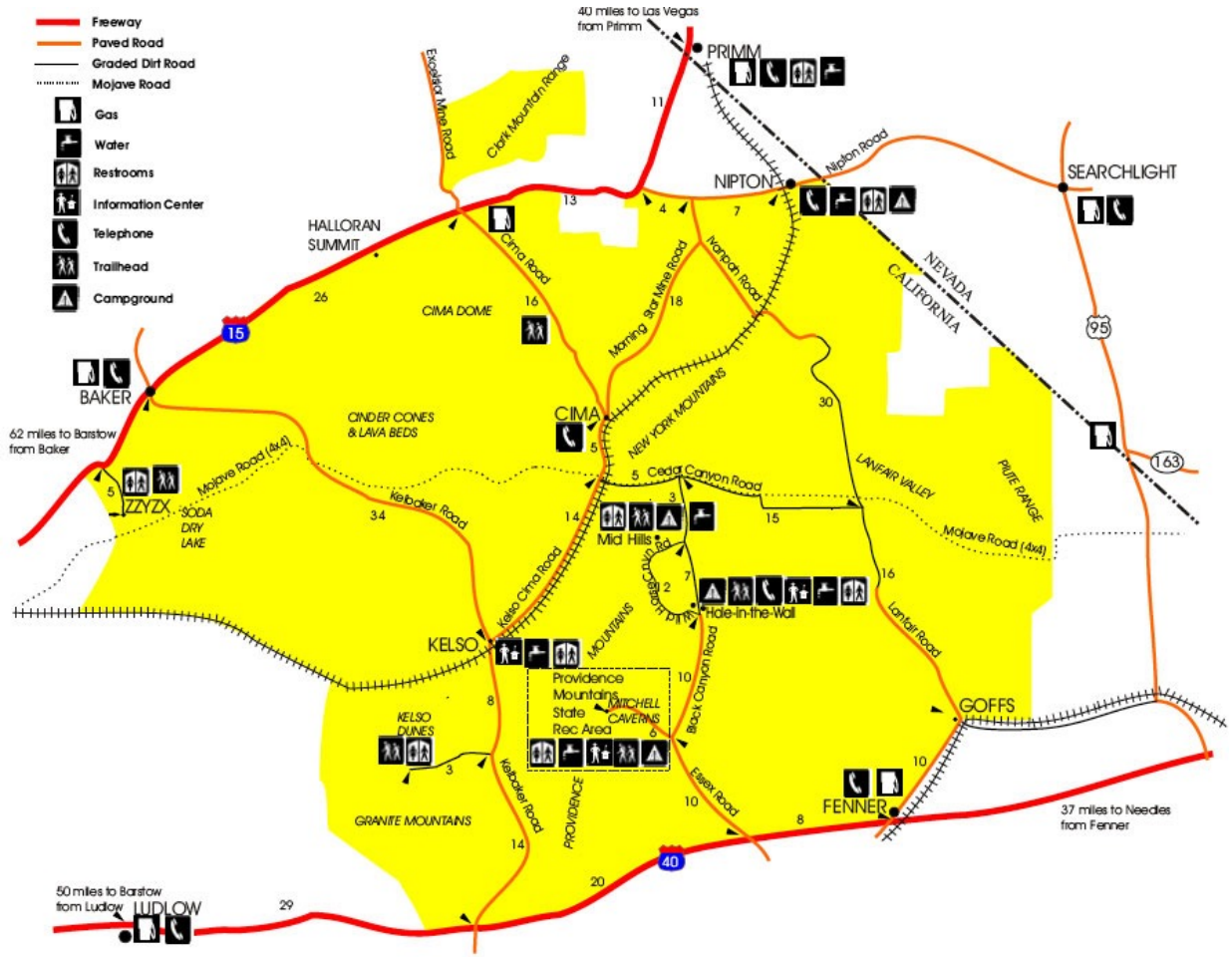
- Studies of six million acres in and around Inyo, Kern, Los Angeles, San Bernardino, Riverside, and Imperial Counties were completed in 2013.

Why I chose this dataset

- My graduate research is on population genetics surrounding different species of *Oenothera* (Evening Primrose).
- Most of these species are in arid landscapes such as the Mohave Desert, where I will be doing field work in Spring 2019.
- I am interested in renewable energy, but also concerned about the carbon footprint of solar panels.
- Lastly, I was curious to see how the federal and state governments are appropriating land use and if this had any effect on plant biodiversity.

Map of Mohave National Preserve





Map of the General Study Area and DRECP boundary lines

Figure 1. The DRECP Planning Area (Courtesy of CDFG). (Note: This map reflects boundary changes in San Diego County from the map included in the Public Review Draft Science Advisory Report.)

Biological Hypothesis 1

- ***Does Development affect tree cover?***
- Null Hypothesis: Development does not affect tree cover
- Alternative Hypothesis: Development does affect tree cover
- Test used: CHI SQUARED TEST
- Graph: GROUPED BAR
- WHY? To see how tree cover is affected by Development

What do I mean by *Development?*

- None
- Low = **<2%** of the polygon is junk piles, cement pads or other structures that are widely dispersed
- Moderate = **2 – 5%** of the polygon is junk piles, buildings or other structures that are densely or singly dispersed
- High = **>5%** of the polygon is multiple examples of junk that are evenly dispersed

Tree cover is categorized according to RANGE

- 0 = **None**
- 1 = **> 0 – 1%** emergent tree-size *Juniperus californica*
- 2 = **> 1 – 5%** most *Yucca brevifolia* or open *Juniperus californica*
- 3 = **> 5 – 15%** highest density *Yucca brevifolia*, *Juniperus californica*
- 4 = **> 15 – 25%** *Q. lobata*, *Q. douglasii* or *Q. chysolepis* (oaks)
- 5 = > **25 – 50%** high-cover *Pseudotsuga macrocarpa* (big cone spruce), dense strands of *Populus fremontii* (Alamo cottonwood)
- 6 = **> 50 – 75%** rare category

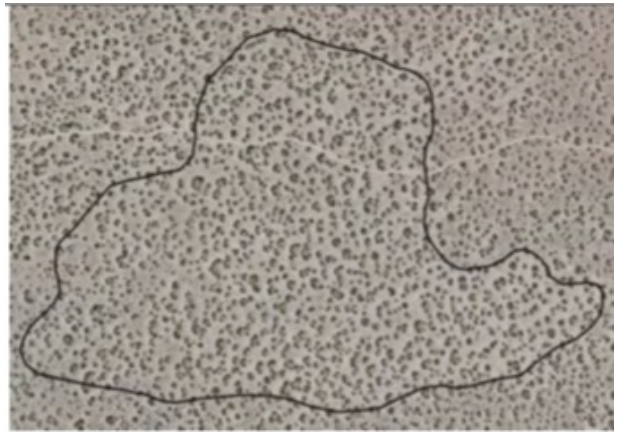
Biological Hypothesis 2

- ***Does the degree of Roadedness Disturbance vary with exotic cover?***
- Null Hypothesis: Roadedness Disturbance does not vary with exotic cover
- Alternative Hypothesis: Roadedness Disturbance does vary with exotic cover.
- Test used: CHI SQUARED TEST
- Graph: GROUPED BAR
- WHY? To see to what extent roadways affect exotic cover

4 categories of *Roadedness Disturbance*

- Low = 2/3 of vegetation is roadless
- Medium = 1/3 – 2/3 of vegetation has roads
- High = less than 1/3 of vegetation is roadless
- N/A = all miscellaneous class (human land use, 9000)

LOW



MEDIUM

HIGH

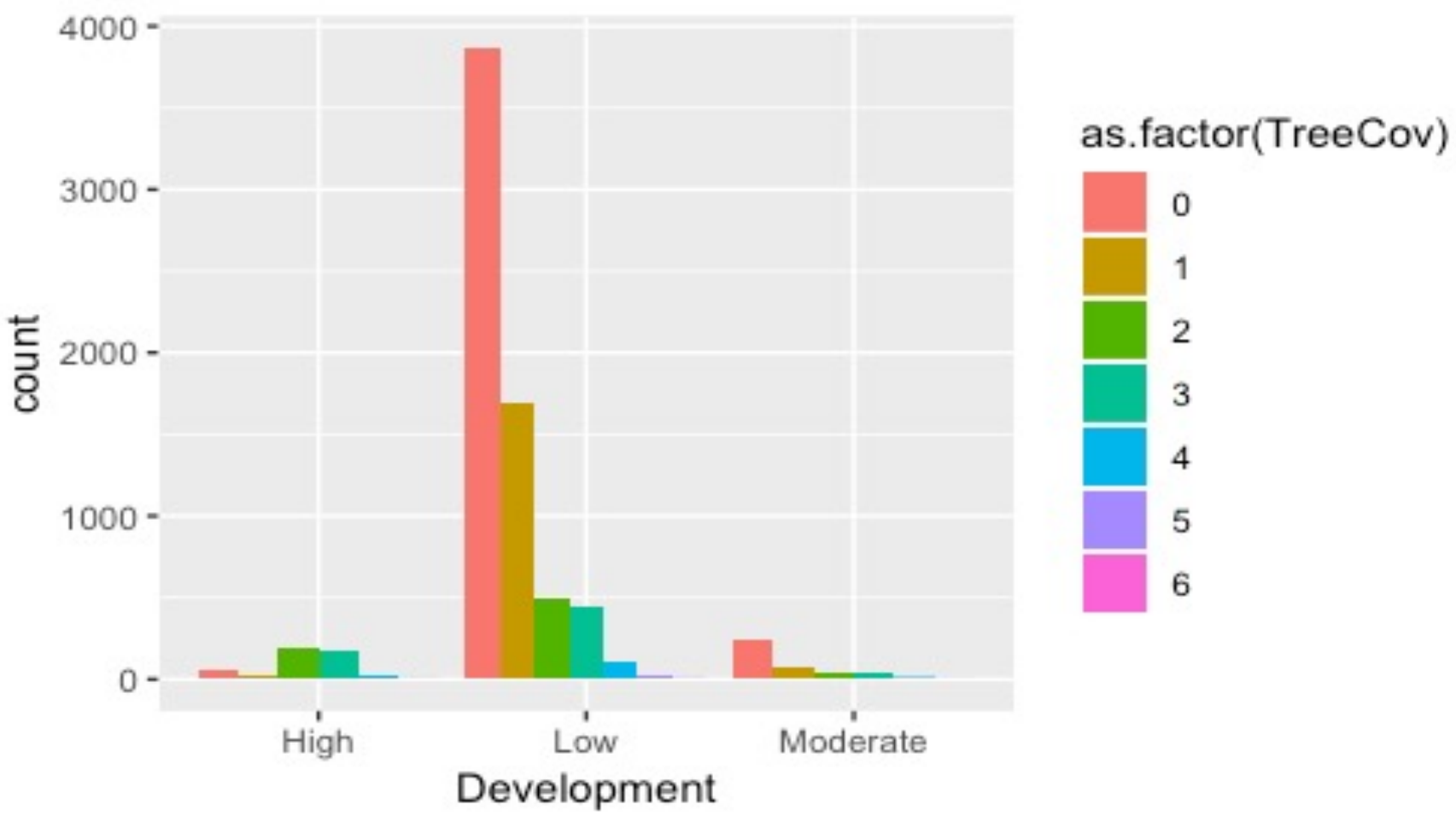
Exotic cover is categorized according to RANGE

- 0 = **None**
- 1 = **Low**
- 2 = **Moderate**
- 3 = **High**

Biological Hypothesis 1

- ***Does Development affect tree cover?***
- Null Hypothesis: Development does not affect tree cover
- Alternative Hypothesis: Development does affect tree cover
- Test used: CHI SQUARED TEST
- Graph: GROUPED BAR
- WHY? To see how tree cover is affected by Development

Figure 1. Biological Hypothesis 1
Development v. tree cover



Tree cover is categorized according to RANGE

- **0 = None**
- **1 = > 0 – 1% emergent tree-size *Juniperus californica***
- 2 = **> 1 – 5%** most *Yucca brevifolia* or open *Juniperus californica*
- 3 = **> 5 – 15%** highest density *Yucca brevifolia*, *Juniperus californica*
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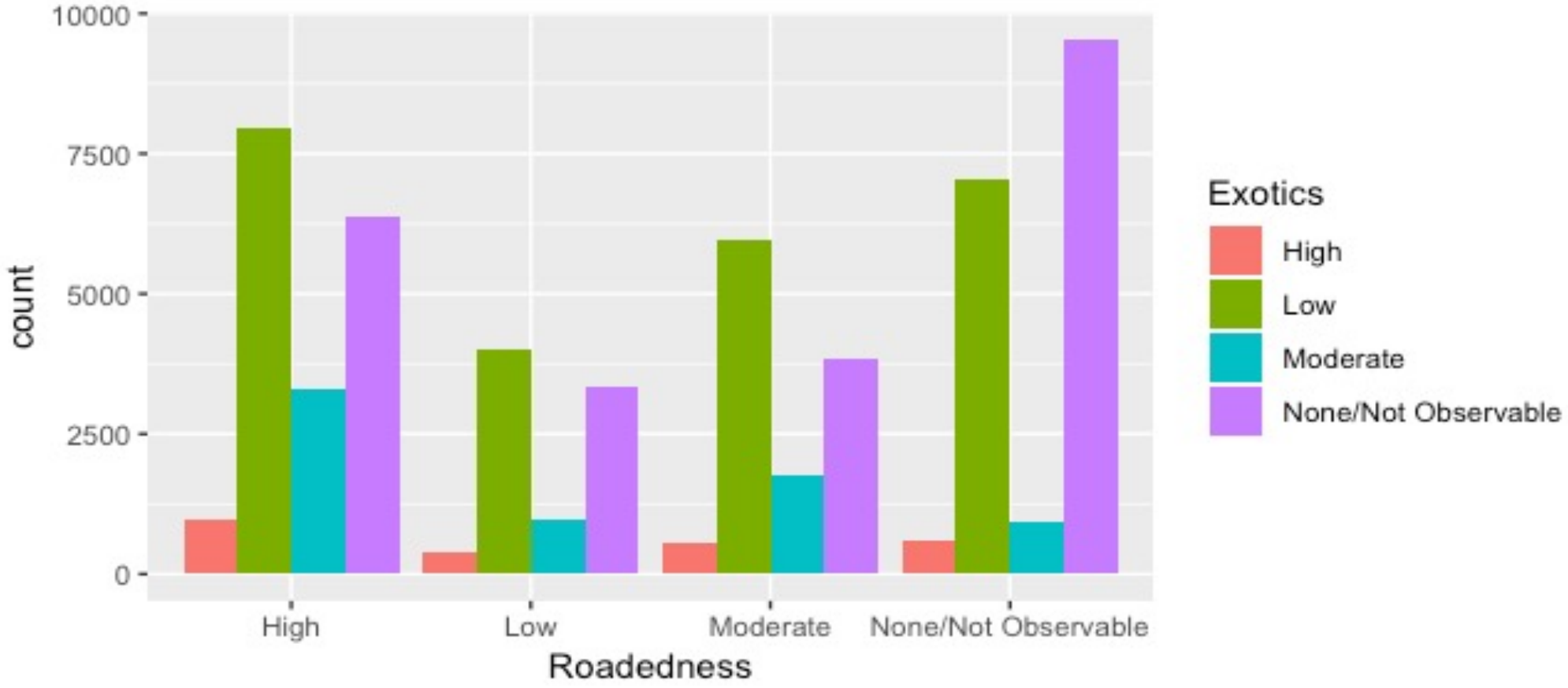
- 6 = **> 50 – 75%** rare category

Biological Hypothesis 2

- ***Does the degree of Roadedness Disturbance vary with exotic cover?***
- Null Hypothesis: Roadedness disturbance does not vary with exotic cover
- Alternative Hypothesis: Roadedness disturbance does vary with exotic cover.
- Test used: CHI SQUARED TEST
- Graph: GROUPED BAR
- WHY? To see if roadways impact exotic cover

Figure 2. Biological Hypothesis 2
Roadedness Disturbance v. exotic cover



Results *Development v. tree cover*

- In Figure 1, ***Development v. tree cover*** we used a grouped bar plot to graph the categorical variables of development against the categorical continuous variable of tree cover. Our test statistic is:

$$X^2_{1,12} = 1278.1,\ p < 2.2 \times 10^{-16}$$

Results *Roadedness Disturbance v. exotic cover*

- In Figure 2, ***Roadedness Disturbance v. exotic cover*** we used a grouped bar plot to graph the categorical variable of road disturbance against the categorical variable of exotic coverage. Our test statistic is:

$$X^2_{1,9} = 2624.3, \quad p < 2.2 \times 10^{-16}$$

What does this mean?

- ***Development v. tree cover***

Our p value = 2.2×10^{-16}

$X^2 = 1278.1$, df = 12, $p < 2.2 \times 10^{-16}$

- ***Roadedness disturbance v. exotic cover***

Our p value = 2.2×10^{-16}

$X^2 = 2624.3$, df = 9, $p < 2.2 \times 10^{-16}$

Statistical Conclusions

- (1) ***Does Development affect tree cover?***
- The $p<2.2 \times 10^{-6}$, which is less than our significance value 0.05, so we reject the null hypothesis and support the alternative that Development affects tree cover.

- (2) ***Does the degree of Roadedness Disturbance vary with exotic cover?***
- The $p<2.2 \times 10^{-6}$, which is less than our significance value 0.05, so we reject the null hypothesis and support the alternative that Roadedness Disturbance varies with exotic cover.

Real-life Conclusions 1

- ***(1) Development v. tree cover***

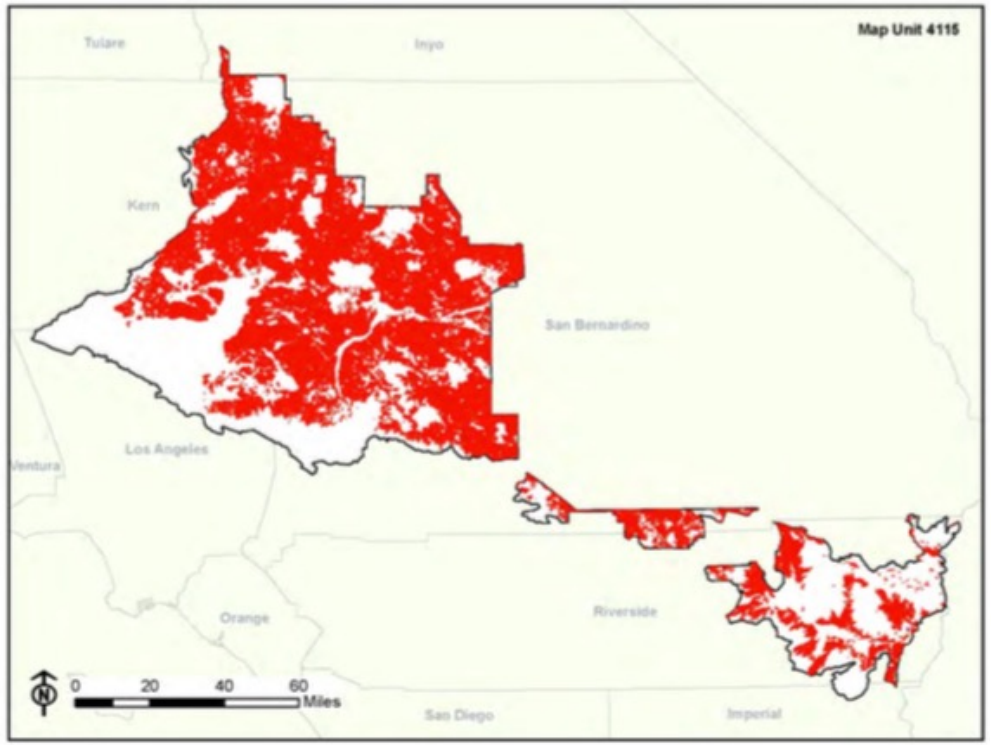
I was surprised to learn that while Development and tree cover are related, there was little to no impact on tree cover due to human development.

- ***(2) Roadedness Disturbance v. exotic cover***

According to the research, exotic trees (Eucalyptus) exist in areas where there was former human habitation, so presence of roadways would be typical.

Roughly 45% of the study area is mostly Creosite Bush (white bursage scrub)

4115 – *Larrea tridentata – Ambrosia dumosa* Alliance



The green, medium-height *Larrea tridentata*, seen here with yellow flowers, dominates the entire landscape of this image over a variable cover of smaller, light blue-gray *Ambrosia dumosa* shrubs. Understory annual grasses (mostly non-native) occur here as an inconsistent cover in this stand.

Real-life Conclusions 2

- One large shortcoming of the study is that there is **zero reference** in regards to **conservation of endangered plant and animal species** and also **renewable wind energy development.**
- California has **lofty goals** for renewable energy standards:
- **33%** by **2020**
- **50%** by **2030**
- **100%** by **2045**

(source: California Energy commission)

- ***However, what future measures will help to simultaneously conserve and manage biodiversity?***

The Desert Tortoise is threatened

Common Name	Scientific Name	CESA[1]	ESA[1]	California Special Concern	BLM Sensitive
Bighorn sheep	*Ovis canadensis*	Threatened	Endangered		
Burrowing owl	*Athene cunicularia*			X	X
Cactus wren	*Campylorhynchus brunneicapillus*			X	
California black rail	*Laterallus jamaicensis coturniculus*	Threatened			
California condor	*Gymnogyps californianus*	Endangered	Endangered		
California leaf-nosed bat	*Macrotus californicus*			X	X
California pocket mouse	*Chaetodipus californicus*			X	
Cave myotis	*Myotis velifer*			X	X
Coachella Valley fringe-toed lizard	*Uma inornata*	Endangered	Threatened		
Coachwhip	*Masticophis flagellum*			X	
Colorado desert fringe-toed lizard	*Uma notata*			X	X
Common ensatina	*Ensatina eschscholtzii*			X	X
Common yellowthroat	*Geothlypis trichas*			X	
Crissal thrasher	*Toxostoma crissale*			X	
Desert night lizard	*Xantusia vigilis*			X	
Desert tortoise	*Gopherus agassizii*	Threatened	Threatened		
Desert woodrat	*Neotoma lepida*			X	
Ferruginous hawk	*Buteo regalis*				X
Flat-tail horned lizard	*Phrynosoma mcallii*			X	X
Fringed myotis	*Myotis thysanodes*				X
Gila monster	*Heloderma suspectum*			X	X
Gila woodpecker	*Melanerpes uropygialis*	Endangered			
Gilded flicker	*Colaptes chrysoides*	Endangered			

Wind Energy has largely been ignored

PUBLIC LANDS

Interior proposal throws doubt on Calif. renewable zone

Scott Streater, E&E News reporter

Greenwire: Thursday, February 1, 2018

The Interior Department is considering making wholesale changes to the Desert Renewable Energy Conservation Plan. Tom Brewster Photography/Bureau of Land Management/Flickr

Final thoughts and questions for the future

- ***What are the tradeoffs of Utility-Scale Solar Energy Development (USSED) on native plant and animal species?***

Potential solution: According to the U.S. National Environmental Policy Act (NEPA) it is important to avoid, minimize, restore and offset areas of ecological value.

- ***How has human land use impacted the weather that shapes the environment?***

Potential solution: It would be useful to further study regions that would be more stable in the face of climate change as suitable places to construct USSED.

Take home

- **Biological conservationists can use the information in this study to help protect and enhance habitats of plant and animal species in order to achieve a net neutral or positive outcome for biodiversity.**

Thank you!

Photo credit: James M. André *Oenothera deltoides ssp. deltoides*