

# Effective ratios for guiding selection of recovery action types

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# What is mitigation?

The Council for Environmental Quality (40 CFR 1508.20) defines mitigation as:

1. Avoiding the impact all together by not taking a certain action or parts of an action.
2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
3. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
5. Compensating for the impact by replacing or providing substitute resources or environments.

**Mitigation typically consists of off-site compensation for impacts to the desert tortoise and its habitat**

# Mitigation: Off-site Compensation

Mitigation typically consists of off-site compensation for impacts to the desert tortoise and its habitat

- This off-site compensation is traditionally land acquisition
  - *Fairly straight forward comparison between the extent of the impact and the necessary habitat that should be acquired to compensate (e.g. 100-acre impact requires 500-acres of acquisition if the mitigation ratio is 5:1)*
- However there are circumstances where recovery actions other than land acquisition may also be appropriate for off-site compensation

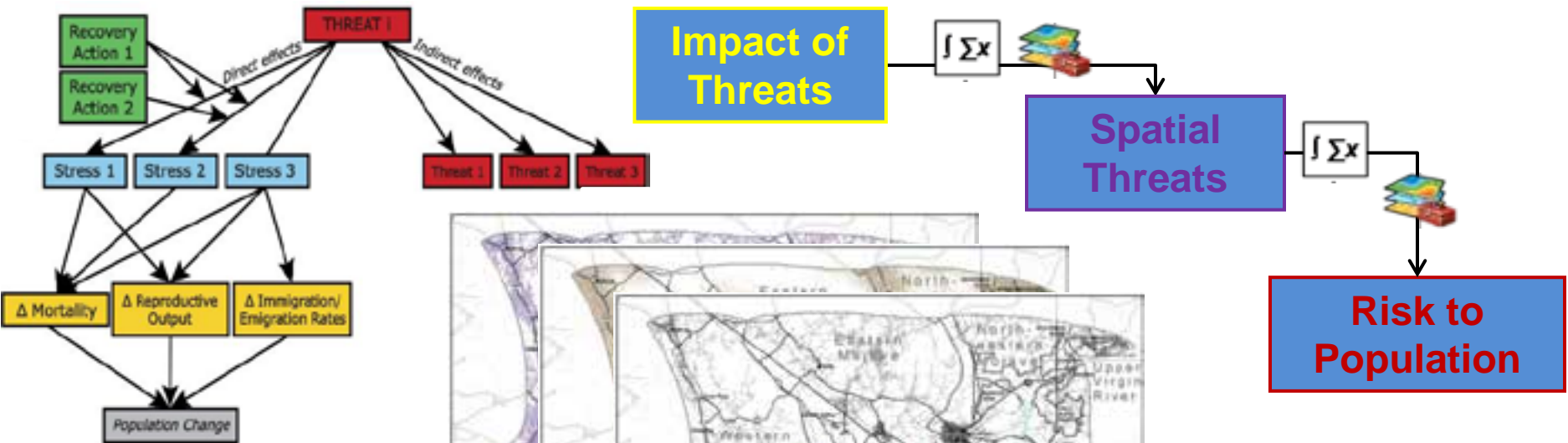


# Relative value of recovery actions

*What is the benefit to the tortoise of a particular recovery action compared to the benefit of land acquisition?*



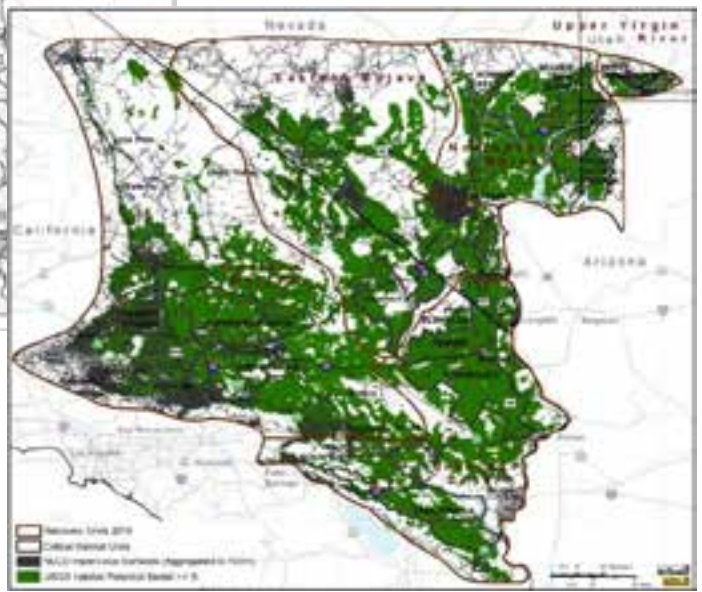
# Spatial Decision Support System



Model of how threats and recovery actions affect tortoises

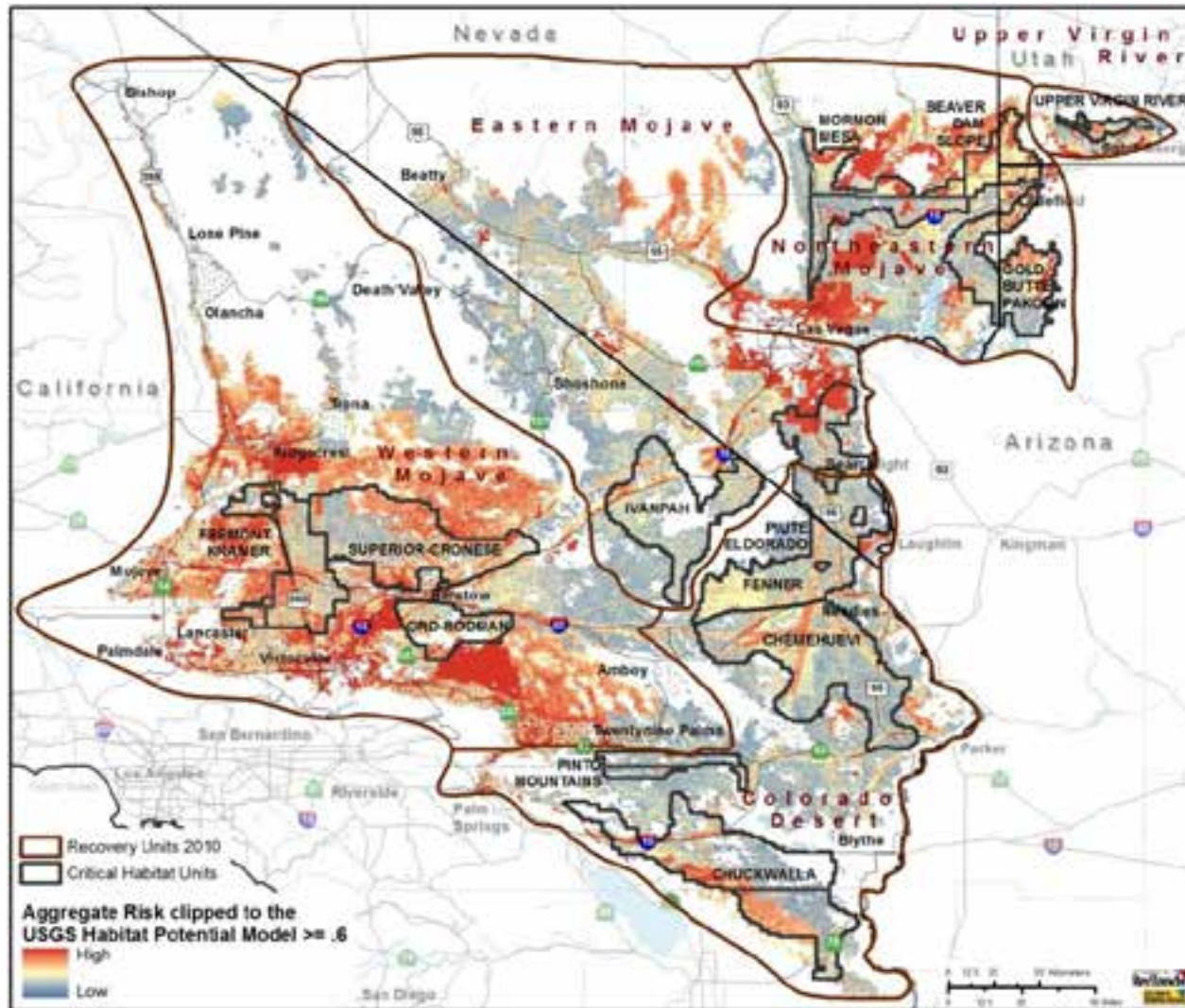


Spatial variation in threats



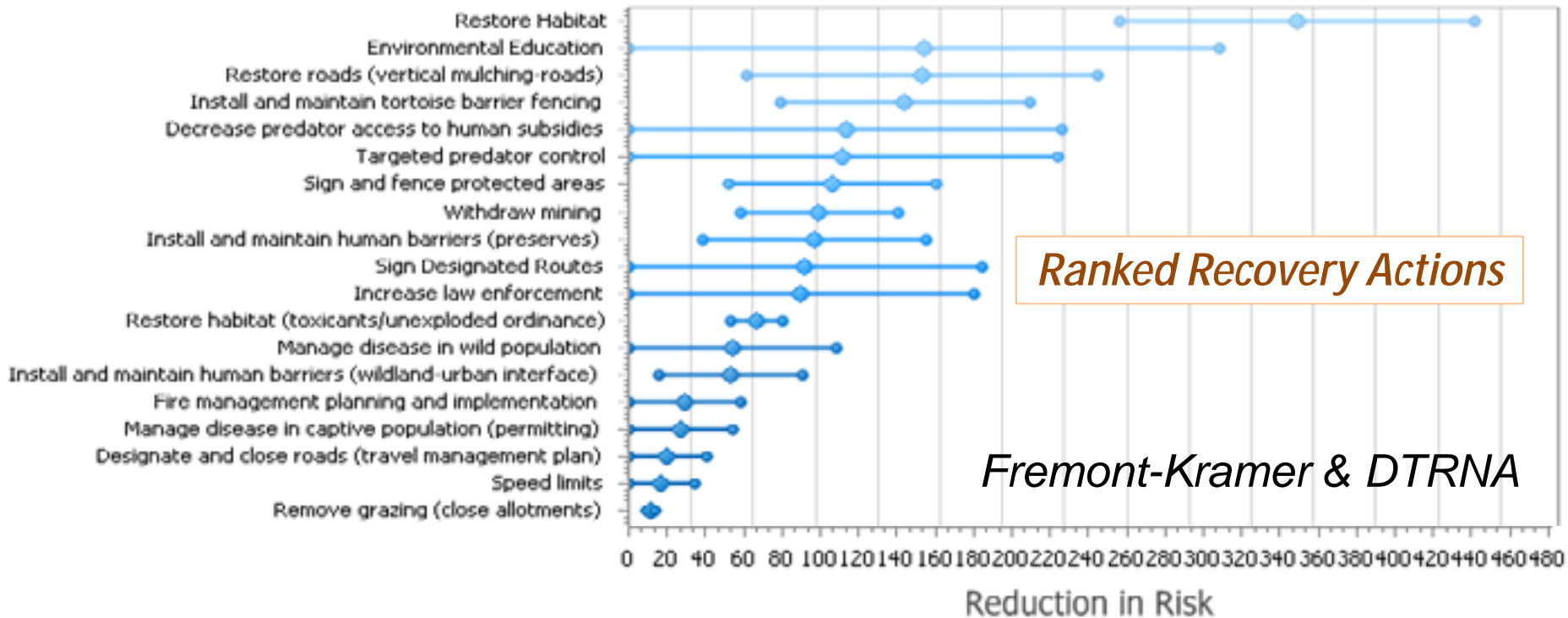
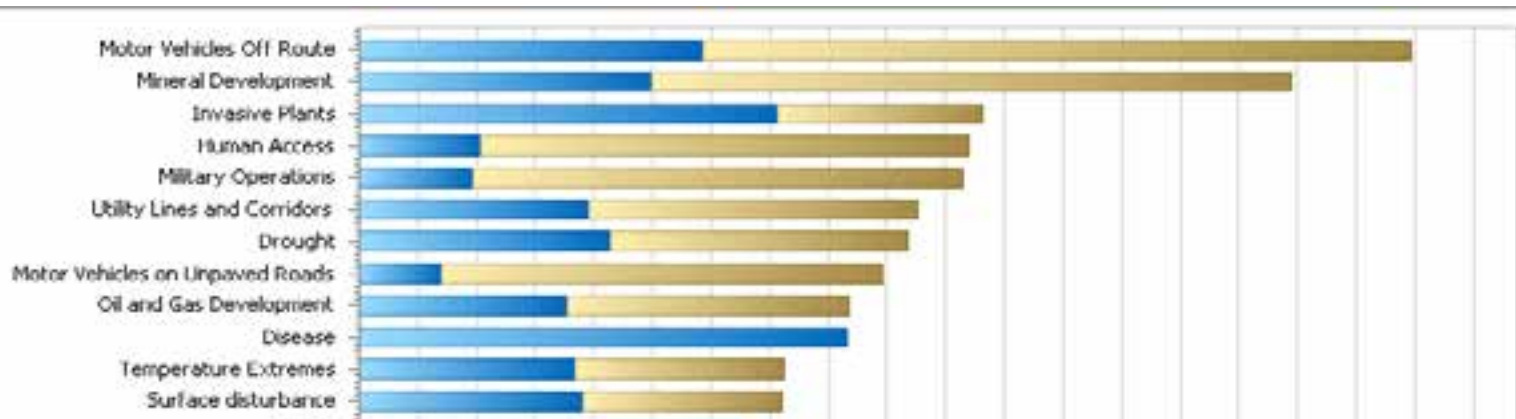
Where we expect tortoises to occur

# Spatial Decision Support System



Risk to the Tortoise

# Spatial Decision Support System



# Benefits of recovery actions relative to acquisition

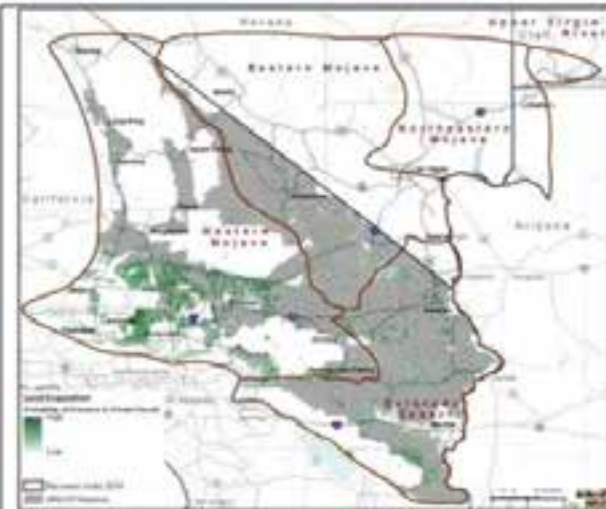
Using the SDSS, we asked:

How much of each recovery action equates to the same decrease in risk to the desert tortoise in each California recovery unit?

1. 100-acres of **land acquisition** of tortoise habitat to facilitate recovery
2. ? miles of installation and maintenance of **fencing and signs around tortoise conservation areas**
3. ? miles of installation and maintenance of **desert tortoise highway fencing**
4. ? acres of **restoration of desert tortoise habitat** in areas previously damaged by grazing, fire, or off-highway vehicles
5. ? acres of **relinquishment of grazing allotments** within desert tortoise habitat
6. ? **additional law enforcement** dedicated to reducing threats to the tortoise within Desert Wildlife Management Areas



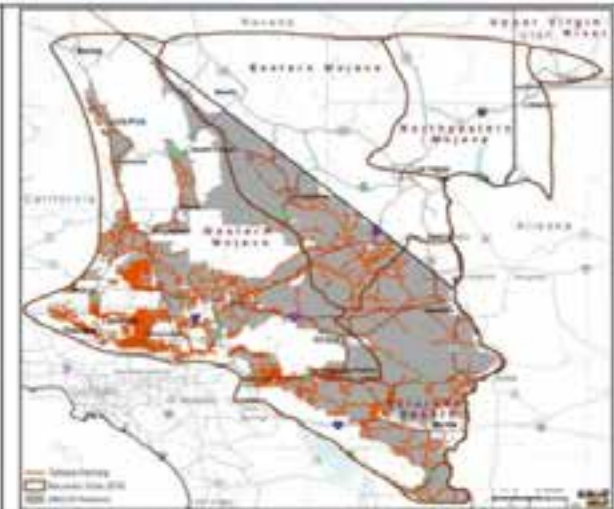
# Benefits of recovery actions relative to acquisition



a. Land acquisition of tortoise habitat to facilitate recovery



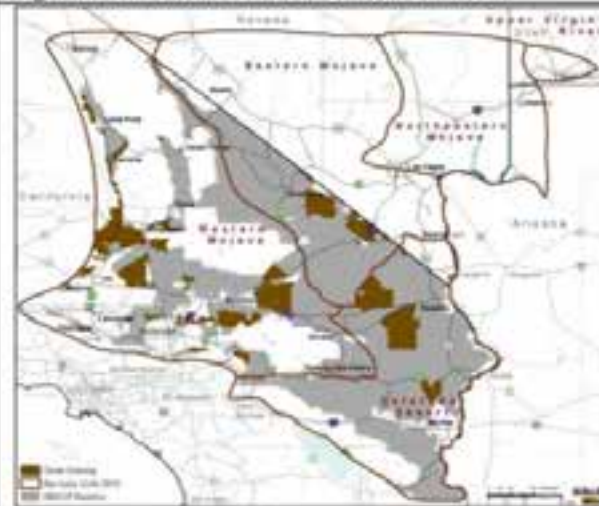
b. Installation and maintenance of fencing and signs around tortoise conservation areas



c. Installation and maintenance of desert tortoise highway fencing



d. Restoration of desert tortoise habitat in areas previously damaged by grazing, fire, or off-highway vehicles

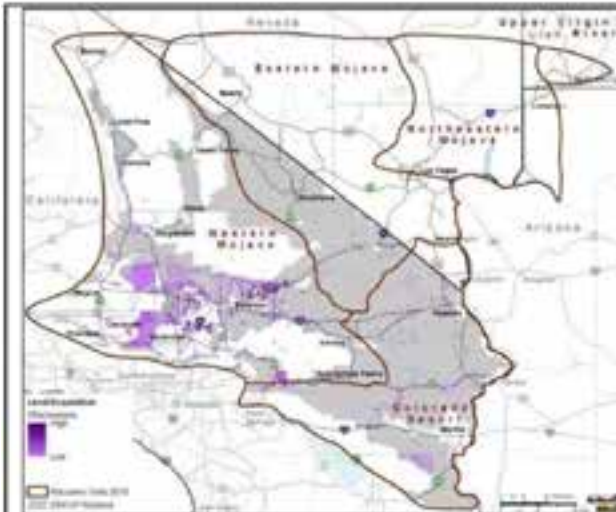


e. Relinquishment of grazing allotments within desert tortoise habitat



f. Increase in law enforcement dedicated to reducing threats to the tortoise within Desert Wildlife Management Areas

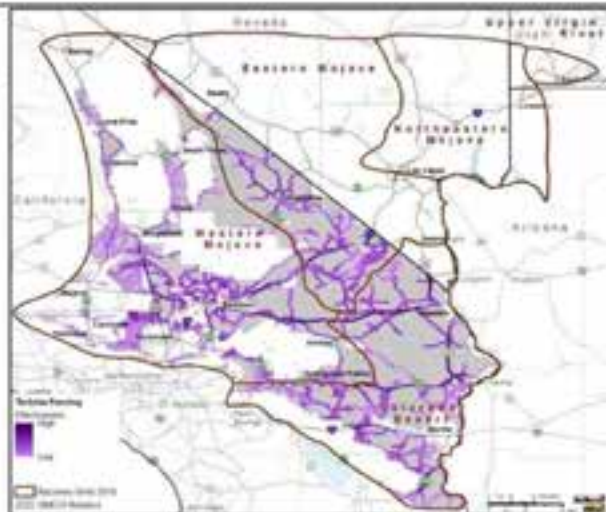
# Benefits of recovery actions relative to acquisition



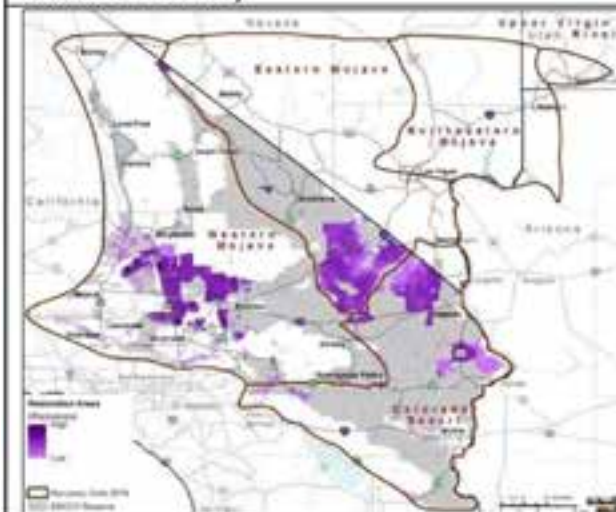
9a. Land acquisition of tortoise habitat to facilitate recovery



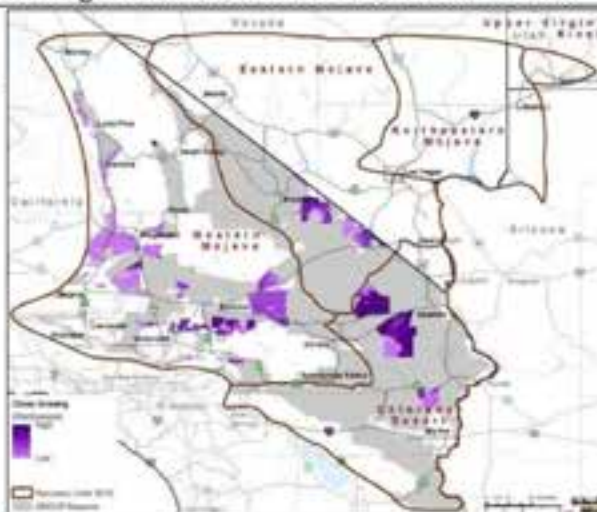
9b. Installation and maintenance of fencing and signs around tortoise conservation areas



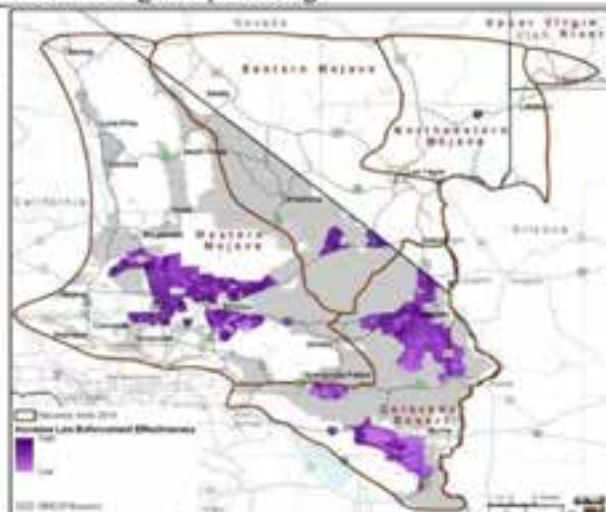
9c. Installation and maintenance of desert tortoise highway fencing



9d. Restoration of desert tortoise habitat in areas previously damaged by grazing, fire, or off-highway vehicles

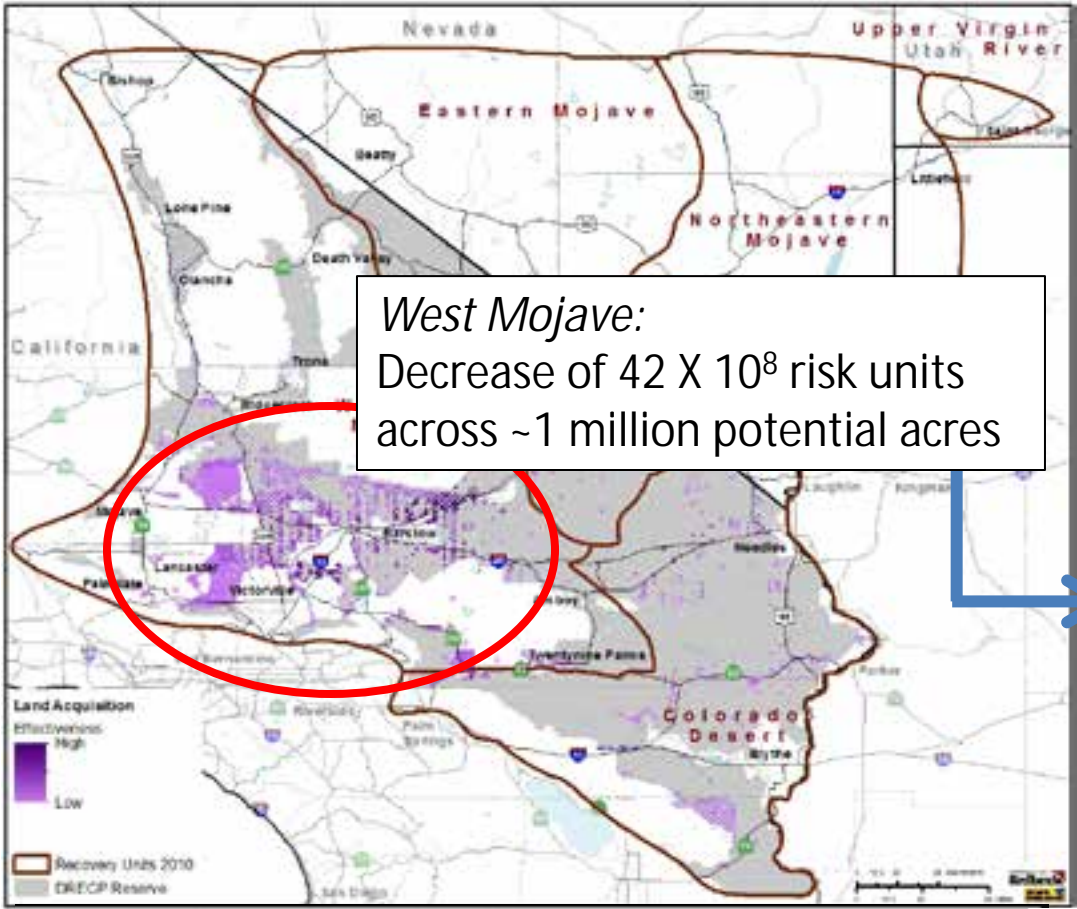


9c. Relinquishment of grazing allotments within desert tortoise habitat



9d. Increase in law enforcement dedicated to reducing threats to the tortoise within Desert Wildlife Management Areas

# Benefits of recovery actions relative to acquisition

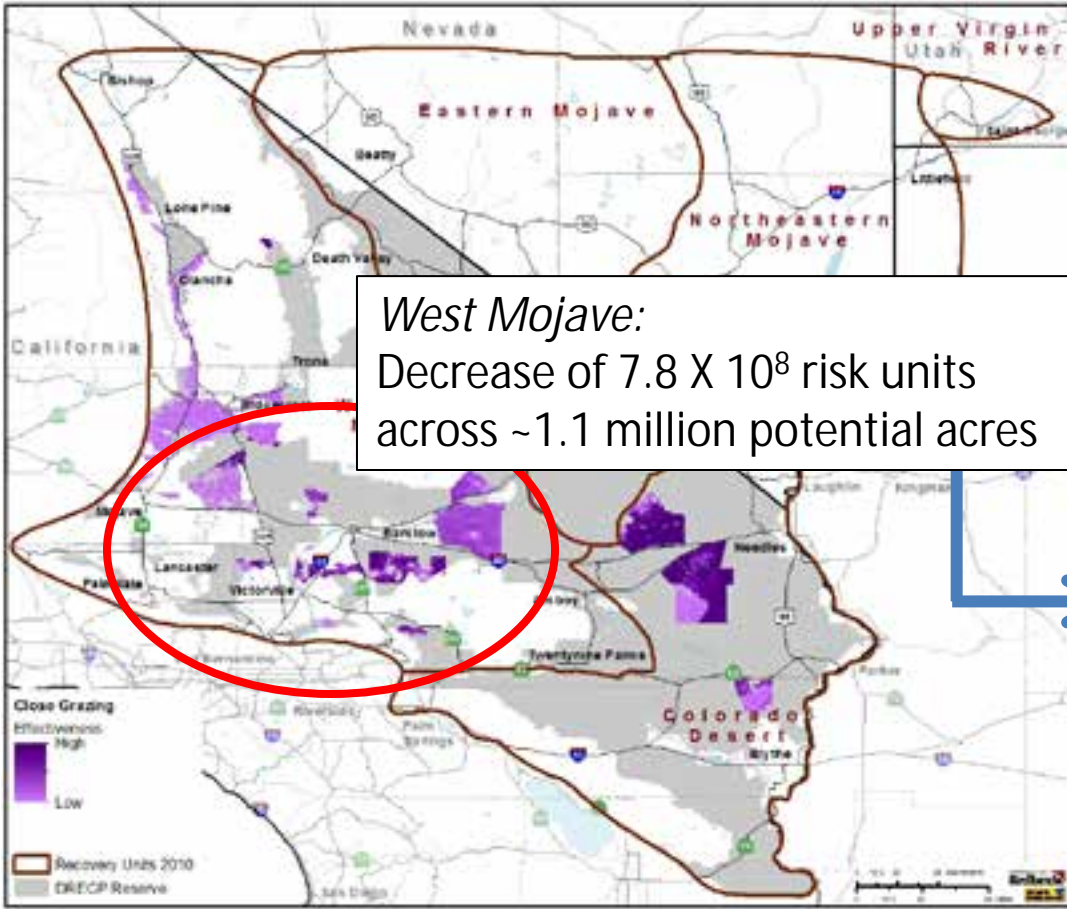


*West Mojave:*  
Decrease of  $42 \times 10^8$  risk units  
across ~1 million potential acres

Average decrease in risk of 420,000 units for every 100-acres of land acquisition

9a. Land acquisition of tortoise habitat to facilitate recovery

# Benefits of recovery actions relative to acquisition



*West Mojave:*  
Decrease of  $7.8 \times 10^8$  risk units  
across ~1.1 million potential acres

Average decrease in risk of 710  
units per acre of relinquishment

It takes 560-acres of relinquishment  
to get the same decrease in risk as  
100-acres of land acquisition in the  
West Mojave Recovery Unit

9c. Relinquishment of grazing allotments  
within desert tortoise habitat

# Variance due to design

- Many sources of uncertainty in these estimates
  - Model
  - Data
  - Computational
  - Expert weights.....
- Also uncertainty that comes from design

# Variance in Ratios

To understand the variance around this average, we divided the 100-m<sup>2</sup> cells where each action could be implemented into 10% percentile bins based on effectiveness.

*We assumed recovery actions are most likely implemented in the top 50% of the potential locations*

Effectiveness Percentile	Grazing Relinquishment	Land Acquisition
50-59%	777-acres	100-acres
60-69%	510-acres	100-acres
70-79%	623-acres	100-acres
80-89%	654-acres	100-acres
90-100%	977-acres	100-acres

Recorded the minimum and maximum values as the expected variance for each ratio, within each recovery unit

**Average for the all possible action locations in the West Mojave Recovery Unit:**

100-acres of land acquisition = 560-acres of grazing relinquishment

Range of variance = 510 to 977-acres of grazing relinquishment

# Benefits of recovery actions relative to acquisition

## West Mojave Recovery Unit:

Recovery Action	Unit	Ratio to Land Acquisition	Variance in Ratios to Land Acquisition
Installation and maintenance of <i>fencing and signs around tortoise conservation areas</i> marking boundaries of particularly sensitive or heavily impacted areas	Miles	1	(1–3)
Installation and maintenance of <i>desert tortoise highway fencing with culverts</i> where appropriate	Miles	10	(9– 17)
<i>Restoration of desert tortoise habitat</i> in areas previously damaged by grazing, fire, or off-highway vehicles	Acres	395	(246– 997)
<i>Relinquishment of grazing allotments</i> within desert tortoise habitat	Acres	560	(510– 977)
<i>Land acquisition</i>	Acres	100	--

# Benefits of recovery actions relative to acquisition

West Mojave Recovery Unit:

Eastern Mojave Recovery Unit:

	Recovery Action	Unit	Ratio to Land Acquisition	Variance in Ratios to Land Acquisition
Insta arou boul imp	Installation and maintenance of <i>fencing and signs</i> around tortoise conservation areas marking boundaries of particularly sensitive or heavily impacted areas	Miles	3	(1–5)
Insta high	Installation and maintenance of <i>desert tortoise highway fencing</i> with culverts where appropriate	Miles	7	(3– 13)
Rest prev vehi	<i>Restoration of desert tortoise habitat</i> in areas previously damaged by grazing, fire, or off-highway vehicles	Acres	798	(243– 2381)
Reli tort	<i>Relinquishment of grazing allotments</i> within desert tortoise habitat	Acres	662	(216– 1361)
Land	<i>Land acquisition</i>	Acres	100	--



# Benefits of recovery actions relative to acquisition

West Mojave Recovery Unit:

Eastern Mojave Recovery Unit:

Colorado Desert Recovery Unit:

	Recovery Action	Unit	Ratio to Land Acquisition	Variance in Ratios to Land Acquisition
Installation and maintenance of fencing and signs around tortoise conservation areas marking boundaries of particularly sensitive or heavily impacted areas	Miles	3	(1-4)	
Installation and maintenance of desert tortoise highway fencing with culverts where appropriate	Miles	2	(1- 3)	
Restoration of desert tortoise habitat in areas previously damaged by grazing, fire, or off-highway vehicles	Acres	335	(116- 1029)	
Relinquishment of grazing allotments within desert tortoise habitat	Acres	121	(67- 473)	
Land acquisition	Acres	100	--	

# Benefits of recovery actions relative to acquisition

West Mojave Recovery Unit:

Eastern Mojave Recovery Unit:

Colorado Desert Recovery Unit:

Recovery Action	Unit	Ratio to Land Acquisition	Variance in Ratios to Land Acquisition
Installation and maintenance of <i>fencing and signs</i> around tortoise conservation areas marking boundaries of particularly sensitive or heavily impacted areas	Miles	3	(1-4)

Installation and maintenance of *fencing and signs* around tortoise conservation areas marking boundaries of particularly sensitive or heavily impacted areas

Installation and maintenance of *highway fencing* with *Restoration of desert* previously damaged vehicles

Relinquishment of tortoise habitat

Land acquisition

## Increasing Law Enforcement compared to Land Acquisition

Recovery Unit	DWMA Area (acres)	# of 100-acre land acquisitions = 1 additional LEO
West Mojave	1,271,876	124-175
Eastern Mojave	126,137	83-88
Colorado Desert	1,641,113	142-194

# Conclusions

- Using the desert tortoise SDSS, we can calculate how much of different recovery actions equates to the same decrease in risk to the desert tortoise
- The relative values of actions differ based on the recovery unit given spatial-variation in risk
- The value of off-site compensation packages with various actions, in addition to land acquisition, can now be assessed
- The exact reduction in risk can be calculated for site-specific recovery actions
- Ratios among actions will change over time as new threats appear, recovery actions are implemented and baseline risk changes across the landscape



# Thank you



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