

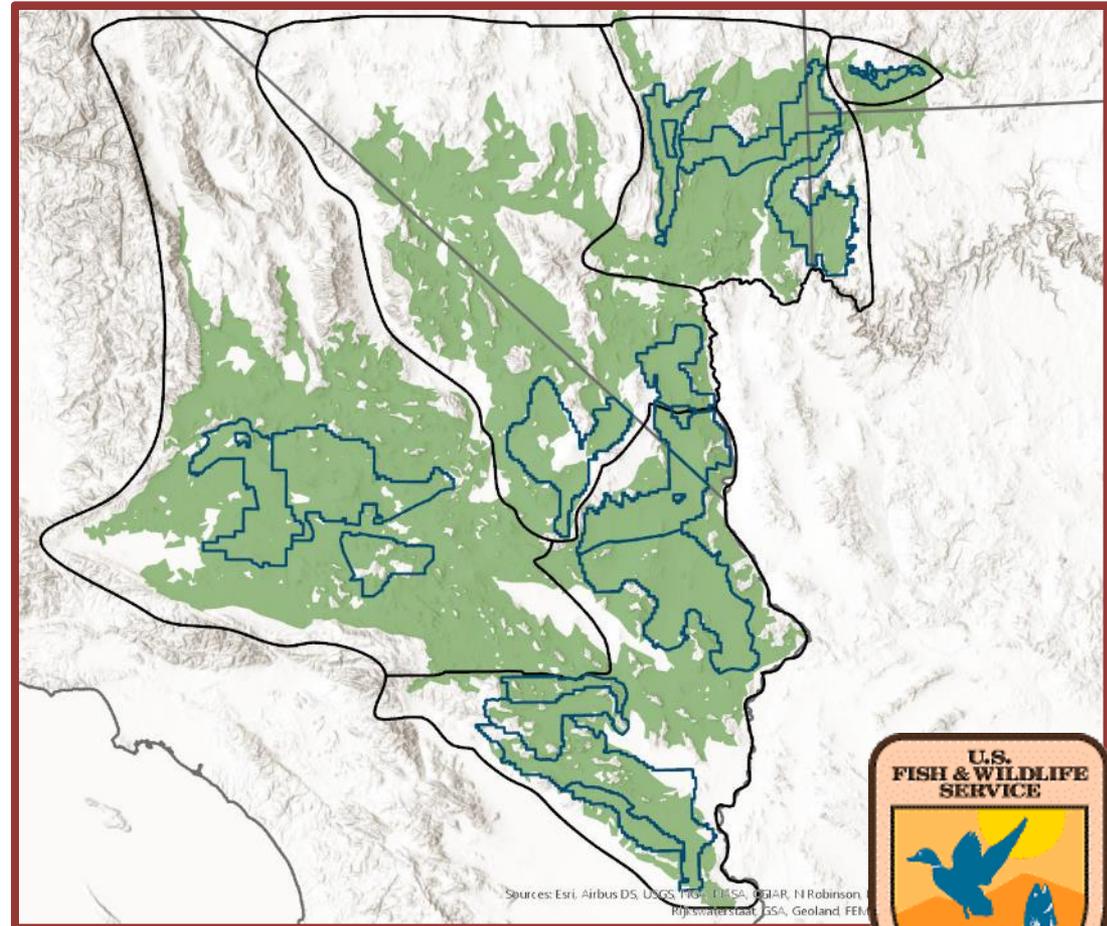
# Connectivity and the Framework for Recovery of the Mojave Desert Tortoise



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# What features would a viable, recovered species have?

- Representation
  - ~ Recovery Units
- Redundancy
  - ~ Tortoise Conservation Areas
- Resilience
  - ~ Ability to repopulate after a setback
  - ~ What is this for tortoises?



# Resilience – Ability to repopulate after a setback

Population growth through reproduction



Population growth through dispersal and immigration



# 1994 Recovery Plan Explored the Role of Space and Population Size in Recovery of *Gopherus agassizii*

## Desert Tortoise

(Mojave Population)

## Recovery Plan

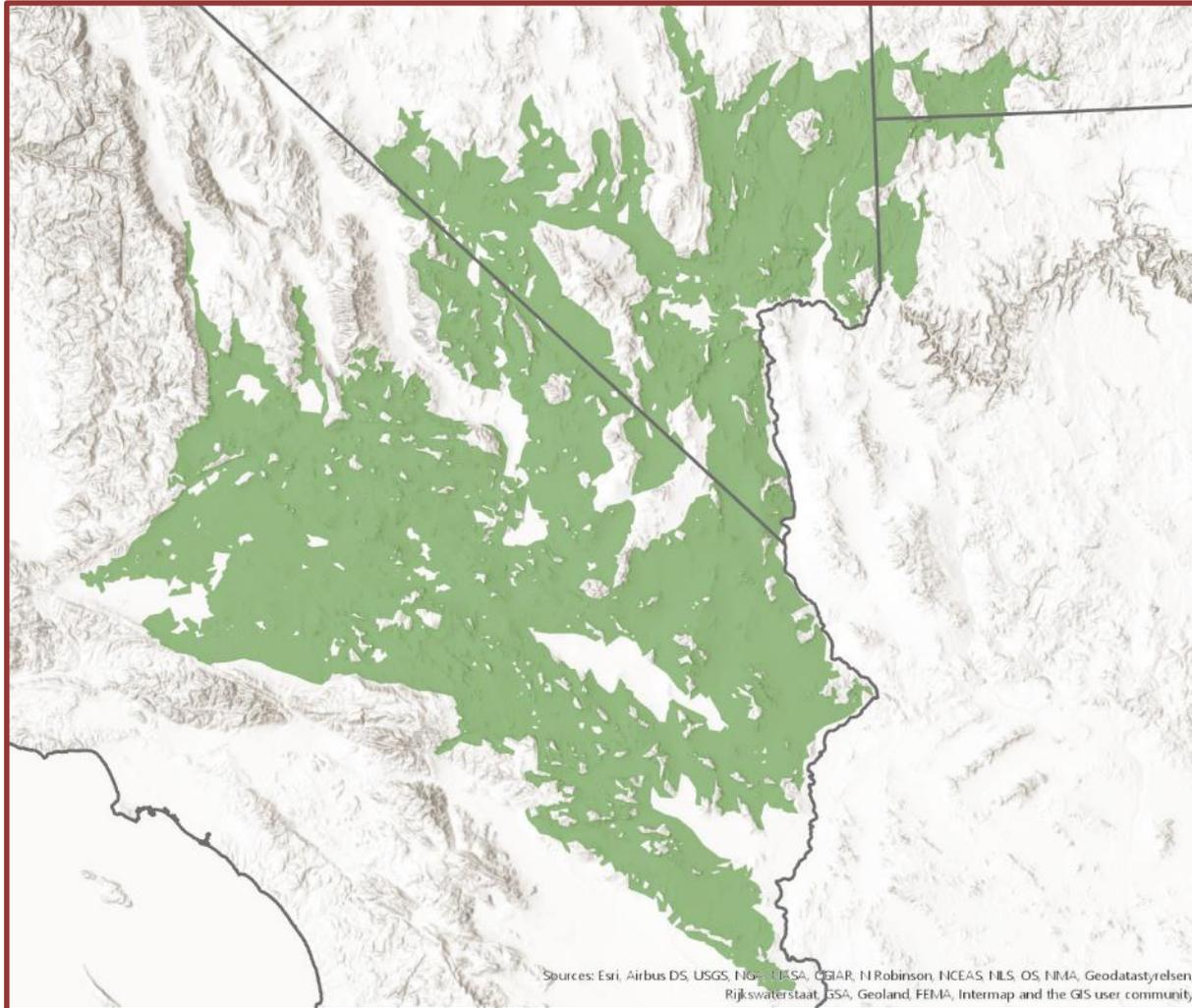
June 1994



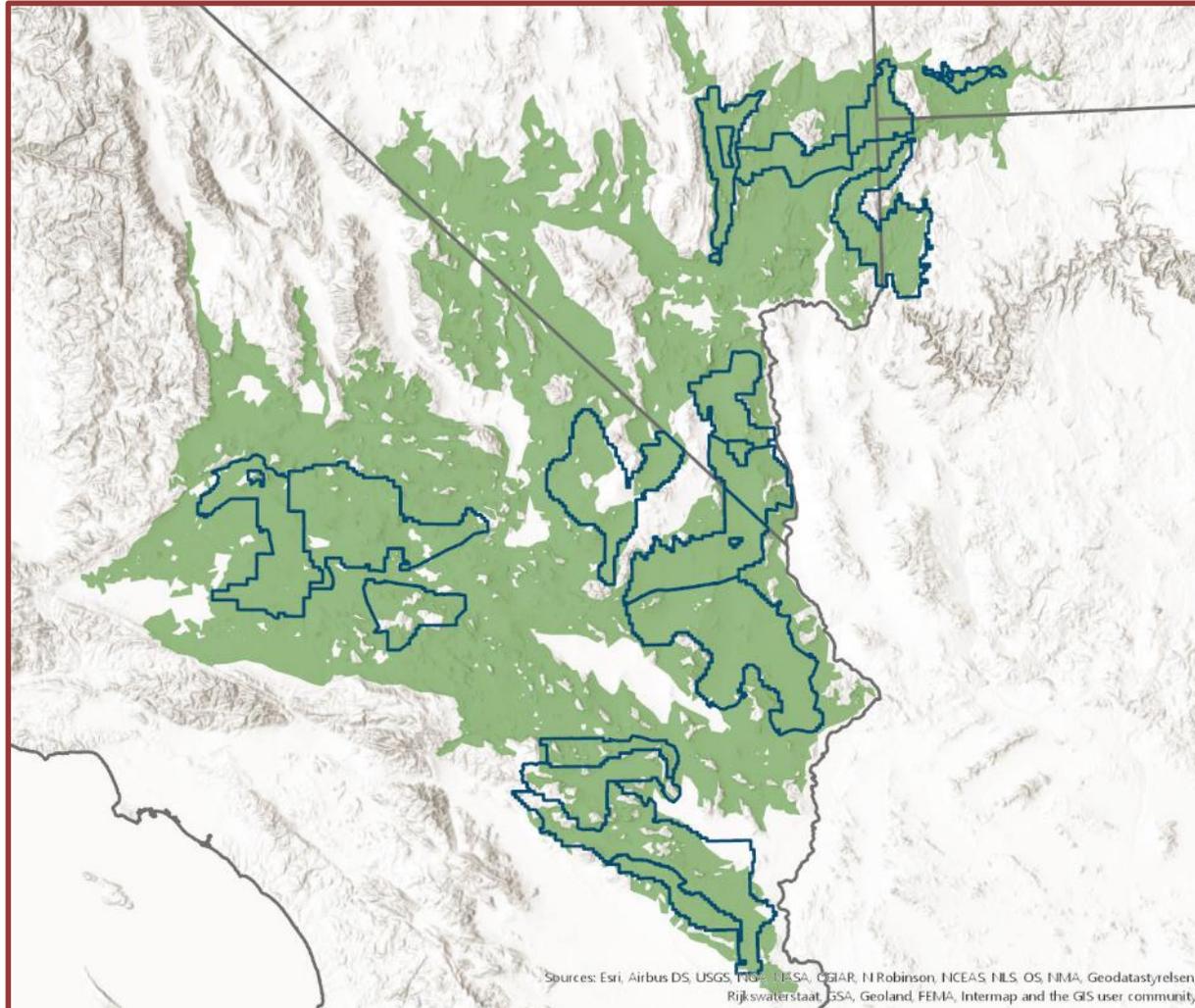
Prepared for Regions 1, 2, and 6 of the U.S. Fish and Wildlife Service  
Region 1 - Lead Region, Portland, Oregon.



# Mojave desert tortoise habitat historically was broadly continuous and connected

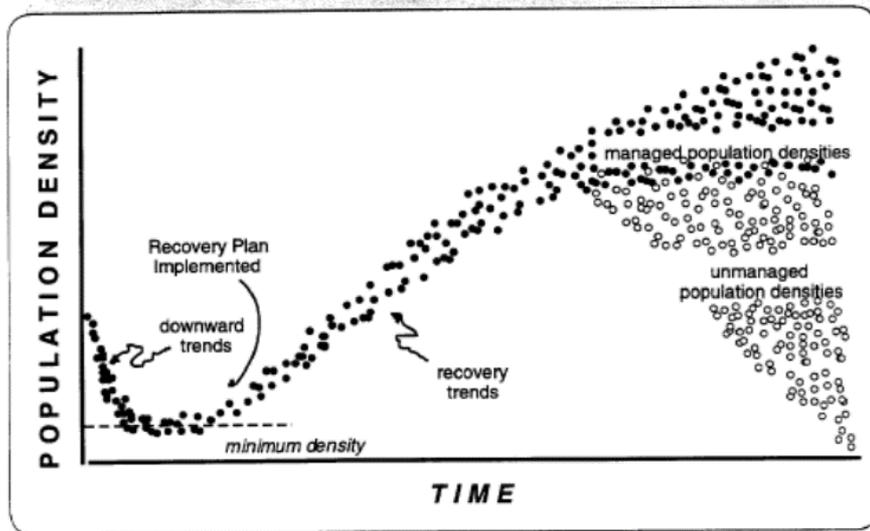


# Mojave desert tortoise habitat is currently managed primarily within Tortoise Conservation Areas (TCAs)



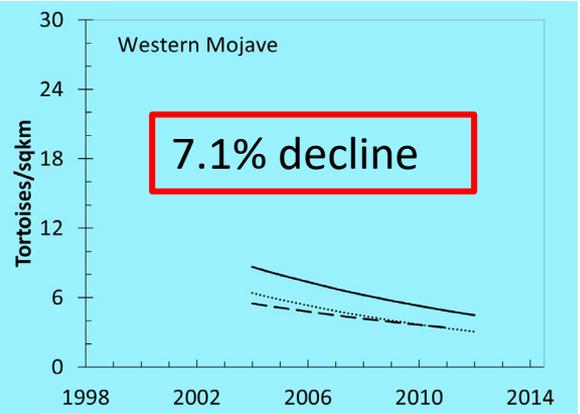
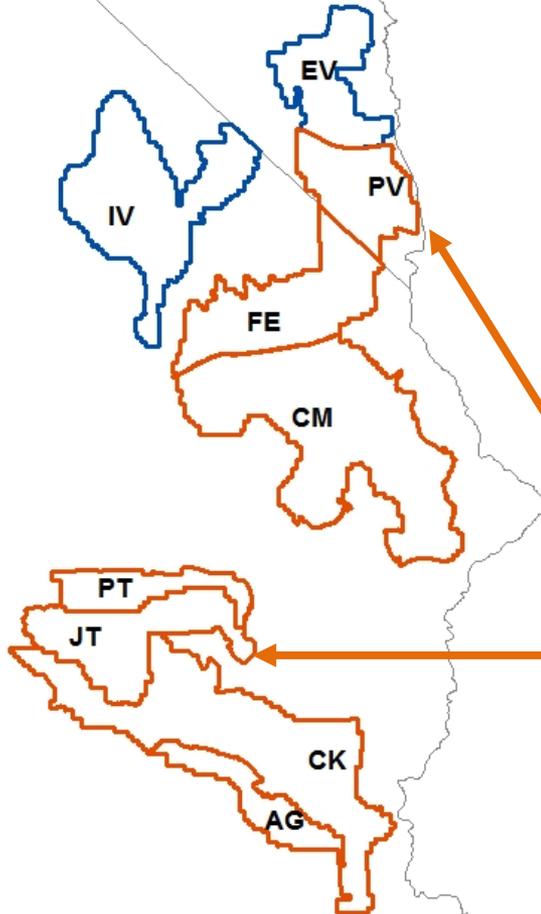
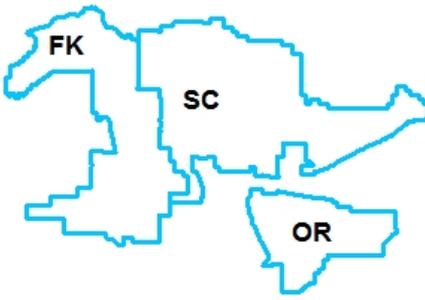
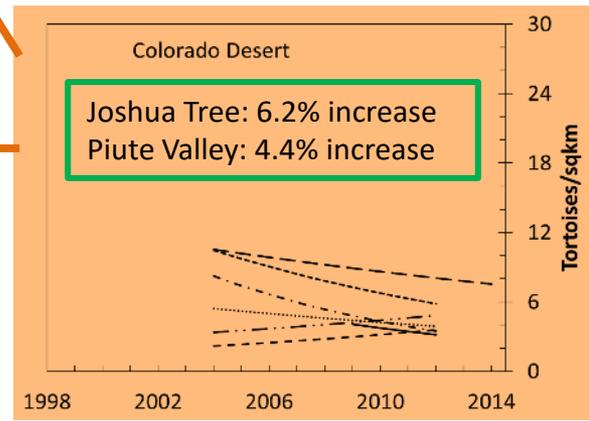
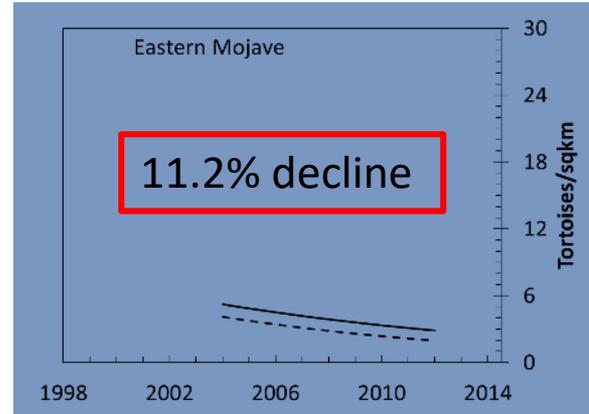
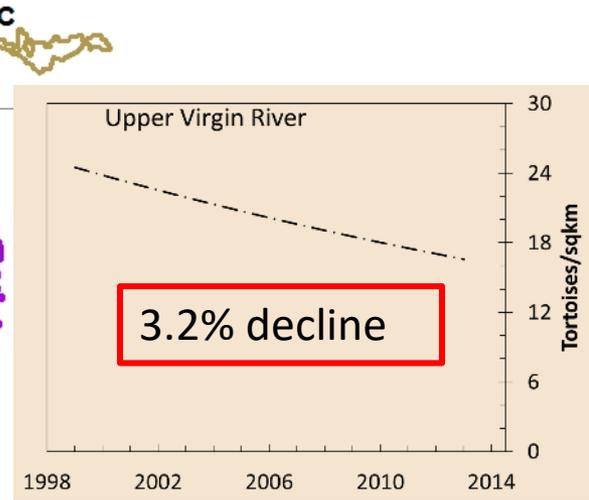
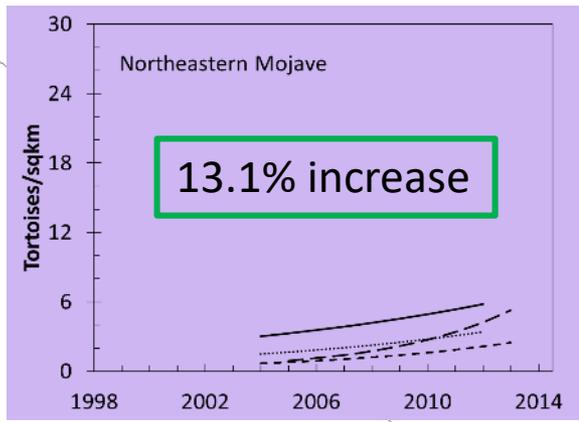
# How would recovery proceed in TCAs over time?

## 1994 Recovery Plan



**Figure C33.** Idealized population densities as a function of time shown before, during, and after recovery. Downward trends are reversed at or near minimum viable density. Subsequently, the population "recovers" by growing significantly for 25 years. At that time, the population could continue to grow in response to good conditions created by proper management until (or if) the population reaches a "carrying capacity". After the population has become dense, the population might continue to grow, fluctuate around a high density, or, if management is relaxed, it may again decrease slowly.

- Anticipated populations would decline further after listing
- Maintain at least 5000 adult tortoises in each TCA for long-term genetic health
- Design TCAs to be at least  $500 \text{ mi}^2 = 1295 \text{ km}^2$  to allow populations to grow from 5000 adults



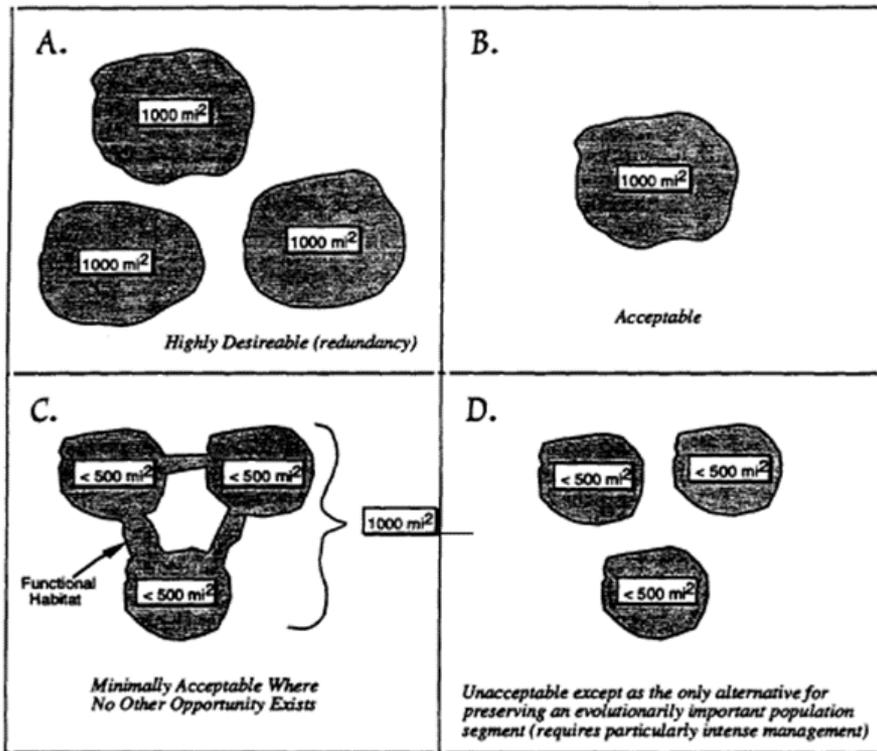
# Adult tortoise abundance in each TCA

Recovery Unit	TCA	Area (km <sup>2</sup> )	2004 Abundance	2014 Abundance
Western Mojave	Fremont-Kramer	2347	12251	6196
	Ord-Rodman	852	7036	3064
	Superior-Cronese	3094	19216	7398
Colorado Desert	Choc Mtn AGR	713	7327	5146
	Chuckwalla (BLM)	2818	14869	9304
	Chemehuevi	3763	29660	10469
	Fenner	1782	18067	8517
	Joshua Tree	1152	2418	4319
	Pinto Mtns	508	3126	1241
	Piute Valley	927	3002	4874
Northeastern Mojave	Beaver Dam	750	537	4652
	Coyote Springs	960	1434	3801
	Gold Butte-Pakoon	1607	1113	4278
	Mormon Mesa	844	2494	5432
Eastern Mojave	Eldorado Valley	999	3971	1543
	Ivanpah	2447	12693	5578
Upper Virgin River	Red Cliffs	115	2397	1760

# Role of connectivity in recovery

## 1994 Recovery Plan

### RECOVERY UNITS



- TCAs should support at least 5000 adults
- Corresponds to at least 500 mi<sup>2</sup> suitable (~1000 mi<sup>2</sup> total)
- TCAs that are smaller or support fewer adults need to maintain connections to other areas with tortoises



# What is Connectivity?

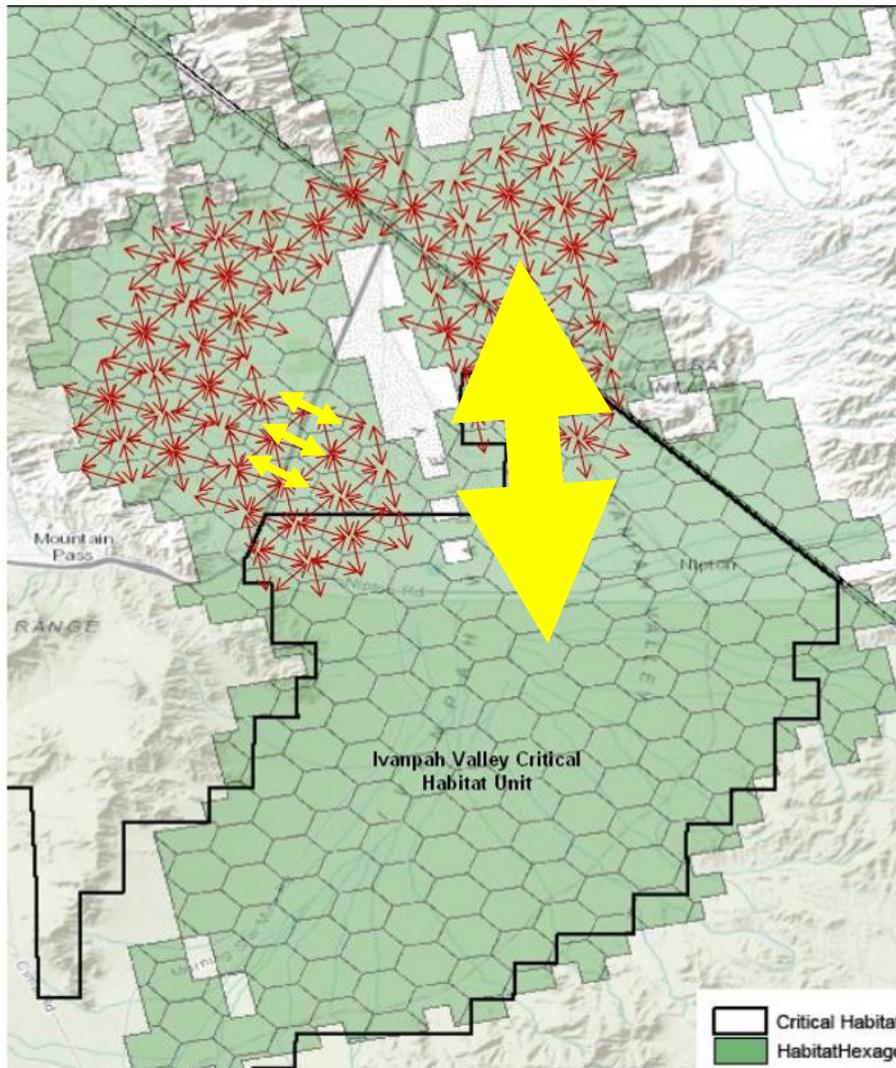
- The degree to which regional landscapes, encompassing a variety of natural, semi-natural, and developed land cover types, are conducive to wildlife movement and to sustain ecological processes (Ament et al. 2014)
- The degree to which landscapes actually facilitate or impede the movement of organisms and processes (Meiklejohn et al. 2010)

# Some factors that decrease connectivity

- Landscape barriers
  - Large-scale development
  - Fenced and unfenced linear features (for instance, roads)
- Landscape resistance
  - Terrain
  - Uninhabited ecotypes (playas, yes, but also grasslands)
  - Wildland-urban interface

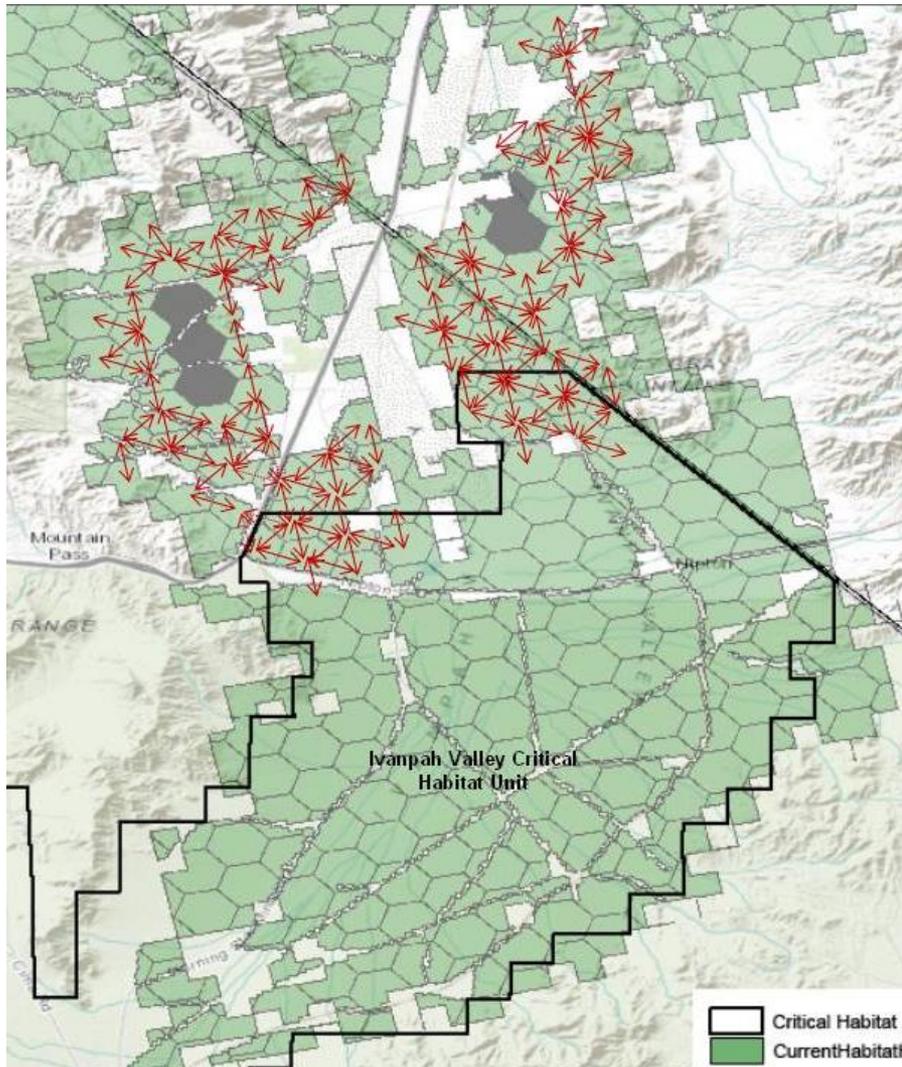


# Local populations need to experience recruitment and dispersal in order to persist



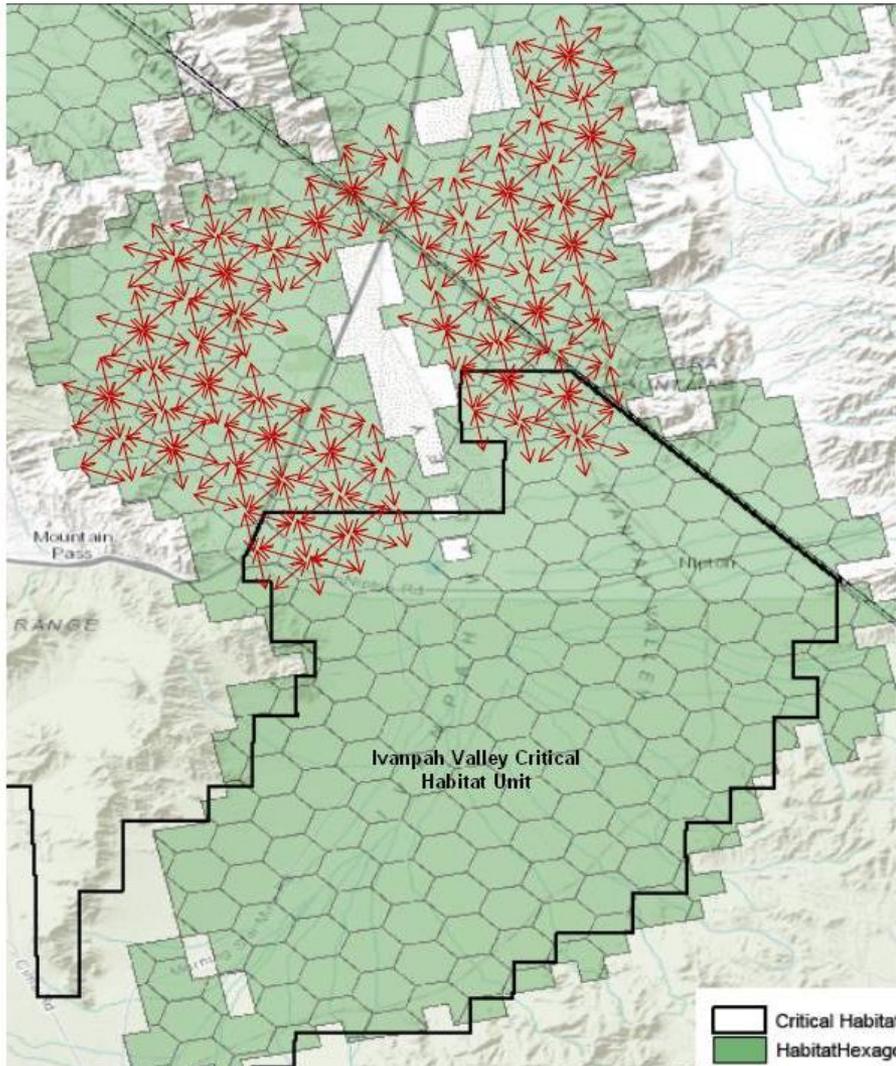
- Connectivity has to work for tortoises who don't move like rabbits
- Tortoises living near roads may cross short culverts in a short time
- However, for longer distances, think in terms of populations living and moving through the area – “corridor dwellers”

# Local populations need to experience recruitment and dispersal in order to persist



- Small populations are vulnerable to random population fluctuations
- Connectivity is necessary for TCA-scale genetic viability and for local population demographic viability

# Local populations need to experience recruitment and dispersal in order to persist



- Areas with fewer tortoises are less ecologically viable if not connected to nearby areas
- This is true within as well as between TCAs
- Within TCAs, many recovery actions are addressing threats to connectivity

# 2011 Recovery Plan Specified Recovery Actions (RAs) to Counteract Fragmentation in Recovery of *Gopherus agassizii*

- RA 1.1: Coordinate RIT activities with landscape and regional-level planning.
- RA 2.1: Conserve intact desert tortoise habitat
- RA 2.9: Secure lands/habitat for conservation
- RA 2.11: Connect functional habitat
- RA 4.3: Track changes in the quantity and quality of desert tortoise habitat
- RA 5.5: Determine the importance of corridors and physical barriers to desert tortoise distribution and gene flow



# 2011 Recovery Plan Specified Recovery Actions (RAs) to Increase Permeability in Recovery of *Gopherus agassizii*

- RA 2.5: Restrict, designate, close, and fence roads
- RA 2.6: Restore desert tortoise habitat
- RA 2.12: Limit mining and minimize its effects
- RA 2.16: Minimize impacts to tortoises from livestock grazing
- RA 4.4: Quantify the presence and intensity of threats to the desert tortoise across the landscape
- RA 5.2: Conduct research on the restoration of desert tortoise habitat



# Connectivity and the framework for recovery - conclusions

1. Based on genetic considerations, TCAs should sustain large numbers of tortoises through sufficient protected habitat or connection to outside areas
2. Tortoise populations rely on landscapes that facilitate recruitment and dispersal to maintain their viability.
3. Functional connectivity is the degree to which landscapes facilitate or impede the movement of organisms and sustain ecological processes.



# Connectivity and the framework for recovery - conclusions

4. Recovery actions are currently prioritized based on reducing local harm to tortoise populations. Many of these actions will also improve connectivity.
5. The ability to move for dispersal, foraging, and reproduction is site-specific and is not currently incorporated into recovery action prioritization

