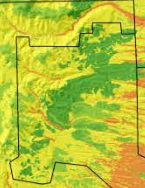
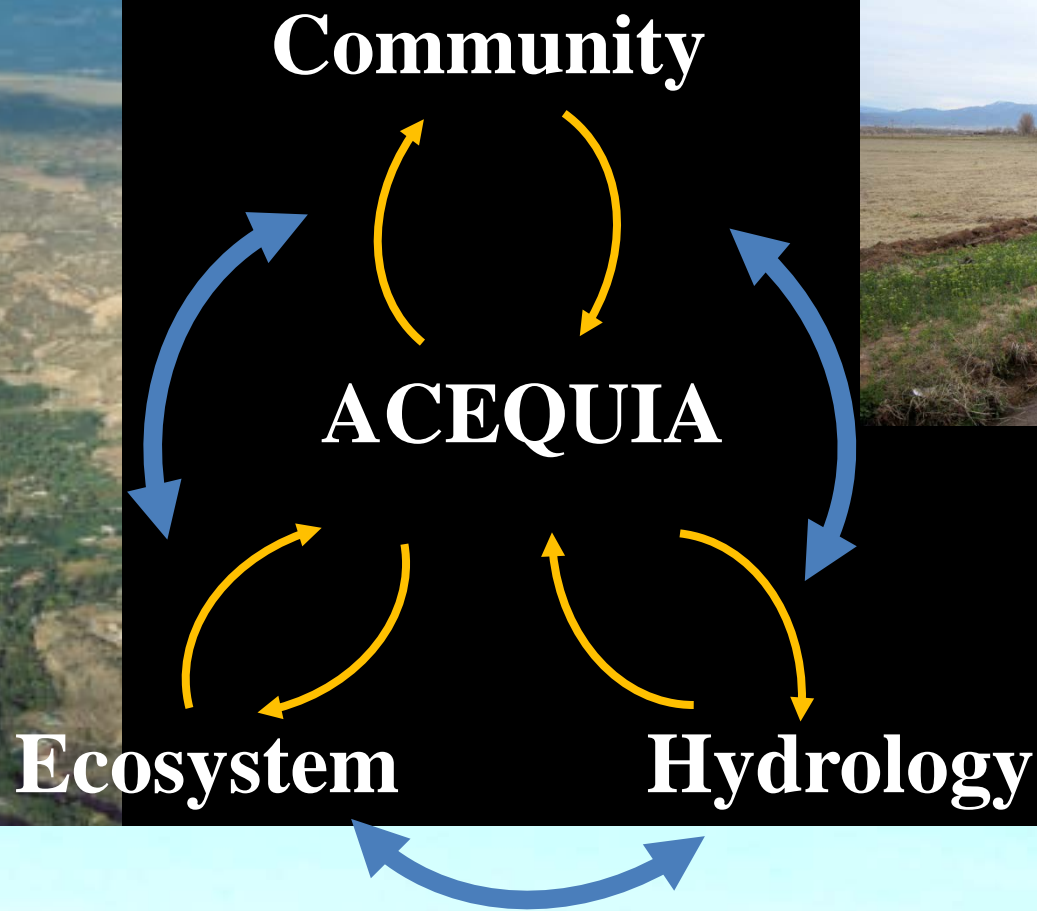


# Ecosystem Services, Faunal Biodiversity and Vegetation Dynamics in Response to Forecasted Land-Use and Climate Change within the Upper Rio Grande



Kenneth G Boykin  
Elizabeth A. Samson  
New Mexico State  
University

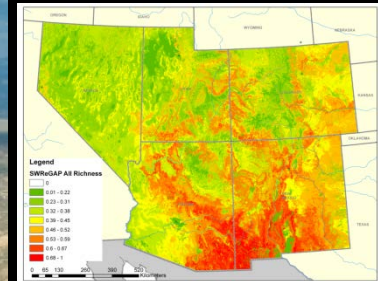




# Ecosystem Services

The benefits humans derive from ecosystems (MEA 2005) as soil formation, photosynthesis, and nutrient cycling

| <u>Provisioning</u>      | <u>Regulating</u>              | <u>Cultural</u>                                 | <u>Supporting</u>                                    | <u>Biodiversity</u>               |
|--------------------------|--------------------------------|---|--|-----------------------------------|
| Food, Water, Fiber, Fuel | Climate, Flood, Disease, Water | Aesthetic, Spiritual, Educational, Recreational | Nutrient cycling, soil formation, primary production | Life on Earth<br>Species Richness |



# USGS Gap Analysis Program Products and Data - Southwest Region

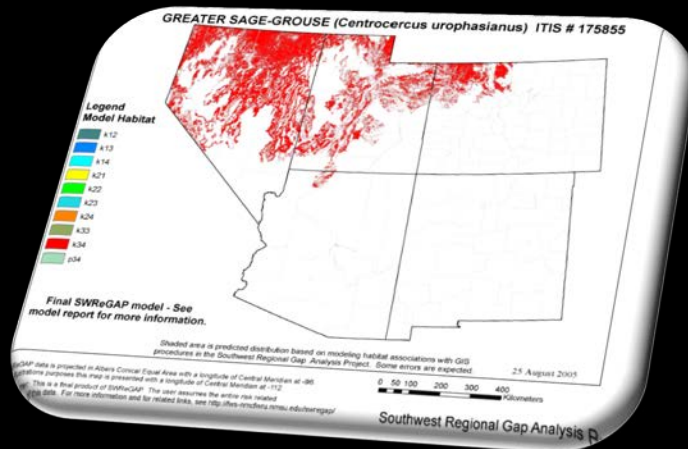
## Deductive Terrestrial Vertebrate Habitat Models (817 spp)

- Knowledge based/expert based
- Wildlife Habitat Relationships
- Habitat based
- Top down - general to specific

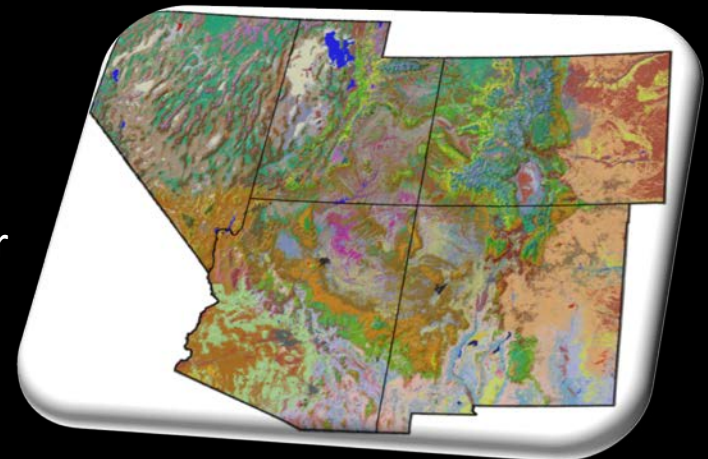


Habitat Models

Land Ownership/Stewardship



Land Cover



# 20 Biodiversity Metrics

(Boykin et al. 2013)

## Total Vertebrate Species

- Reptiles
- Amphibians
- Birds
- Mammals
- Bats

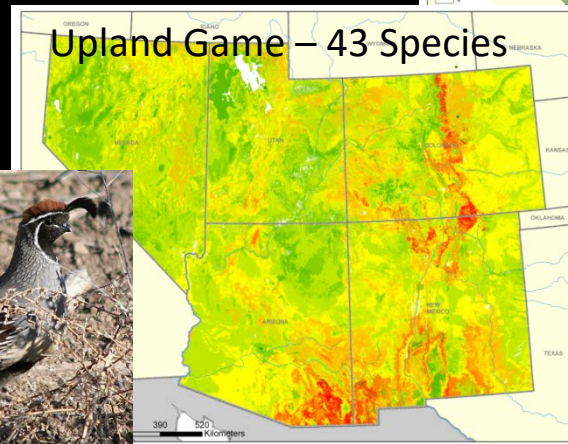
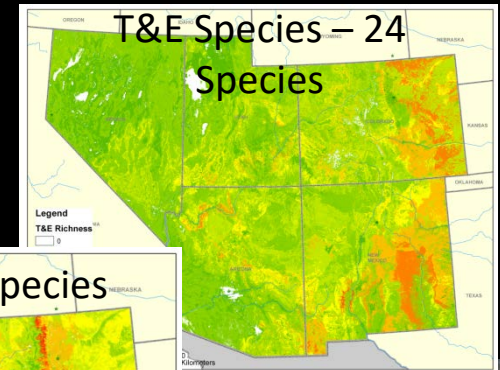
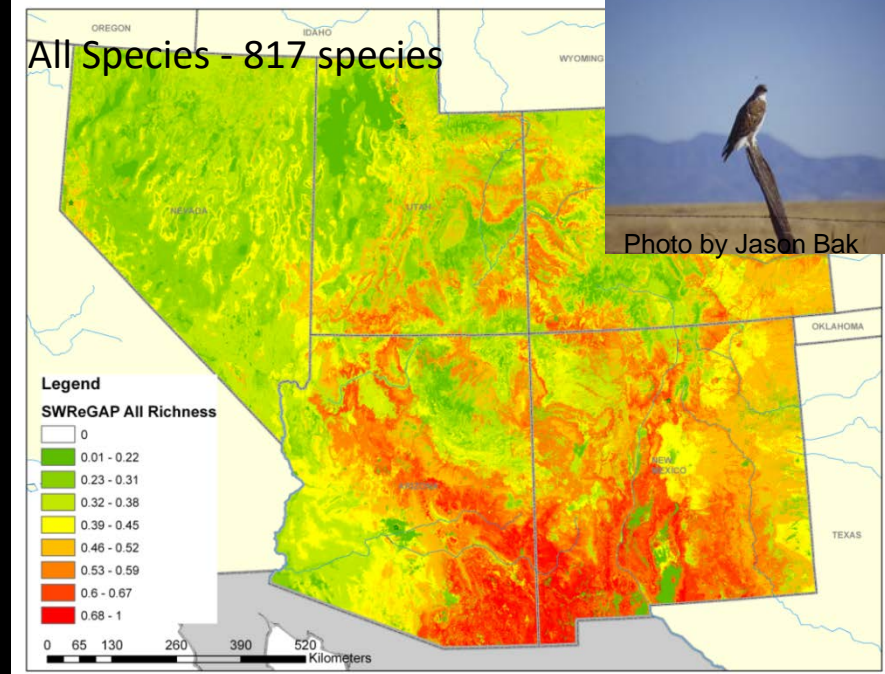
## Threatened and Endangered Species

### Total Species of Greatest Conservation Need

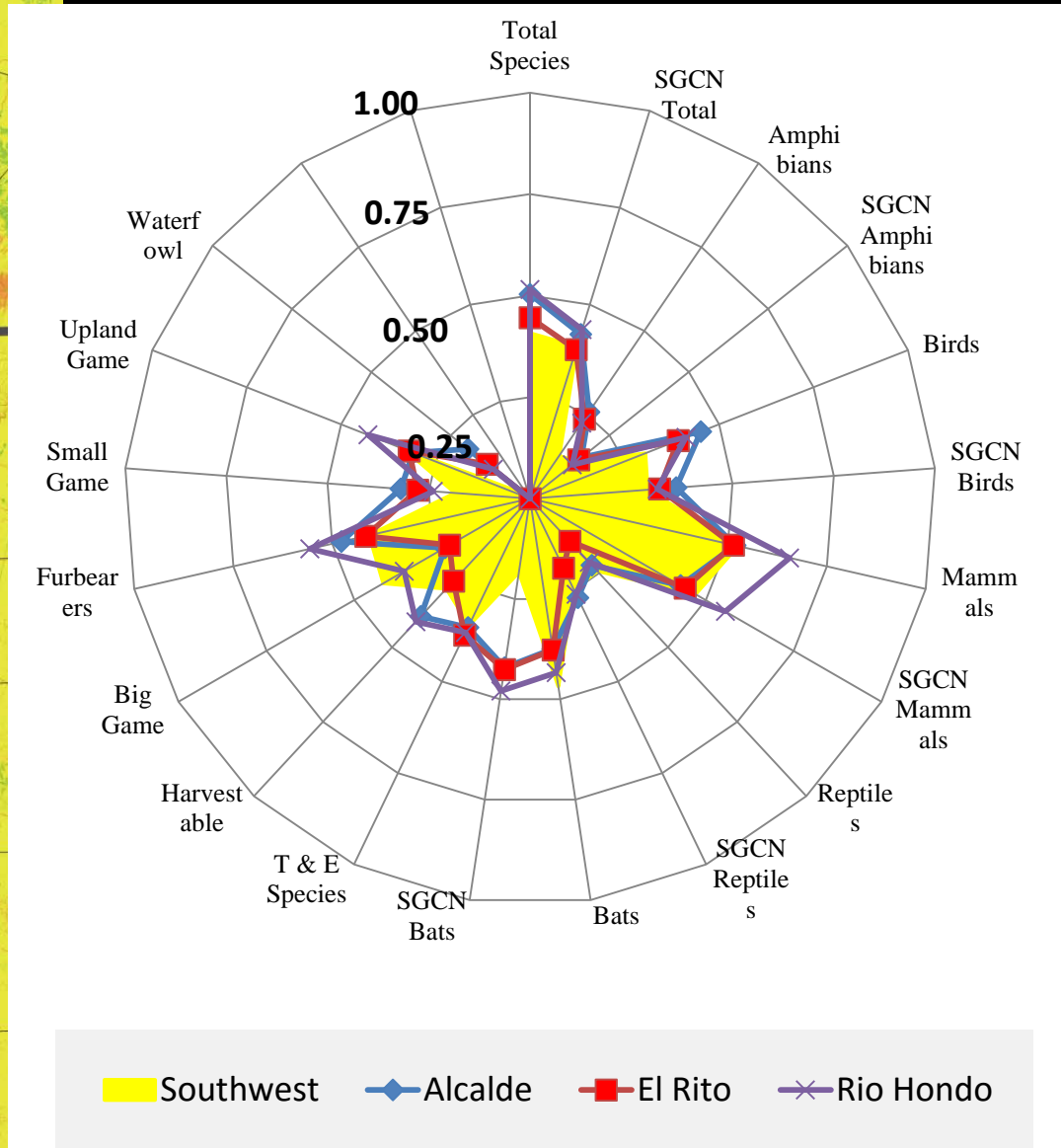
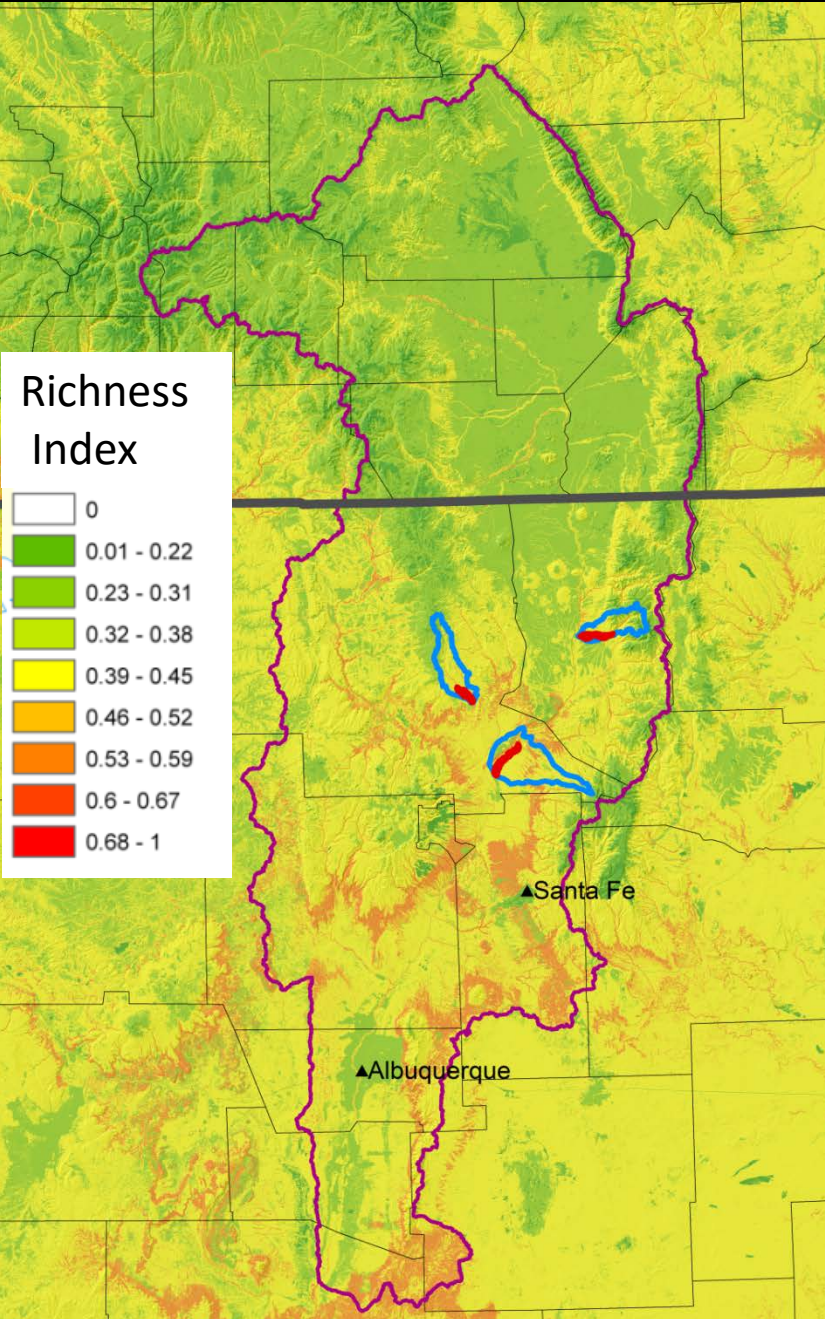
- Reptile Species of Greatest Conservation Need
- Amphibian Species of Greatest Conservation Need
- Bird Species of Greatest Conservation Need
- Mammal Species of Greatest Conservation Need
- Bat Species of Greatest Conservation Need

### Total Harvestable Species

- Harvestable Upland Game Species
- Harvestable Big Game species
- Harvestable Small Game Species
- Harvestable Furbearer Species
- Harvestable Waterfowl Species
- Ecosystem Diversity



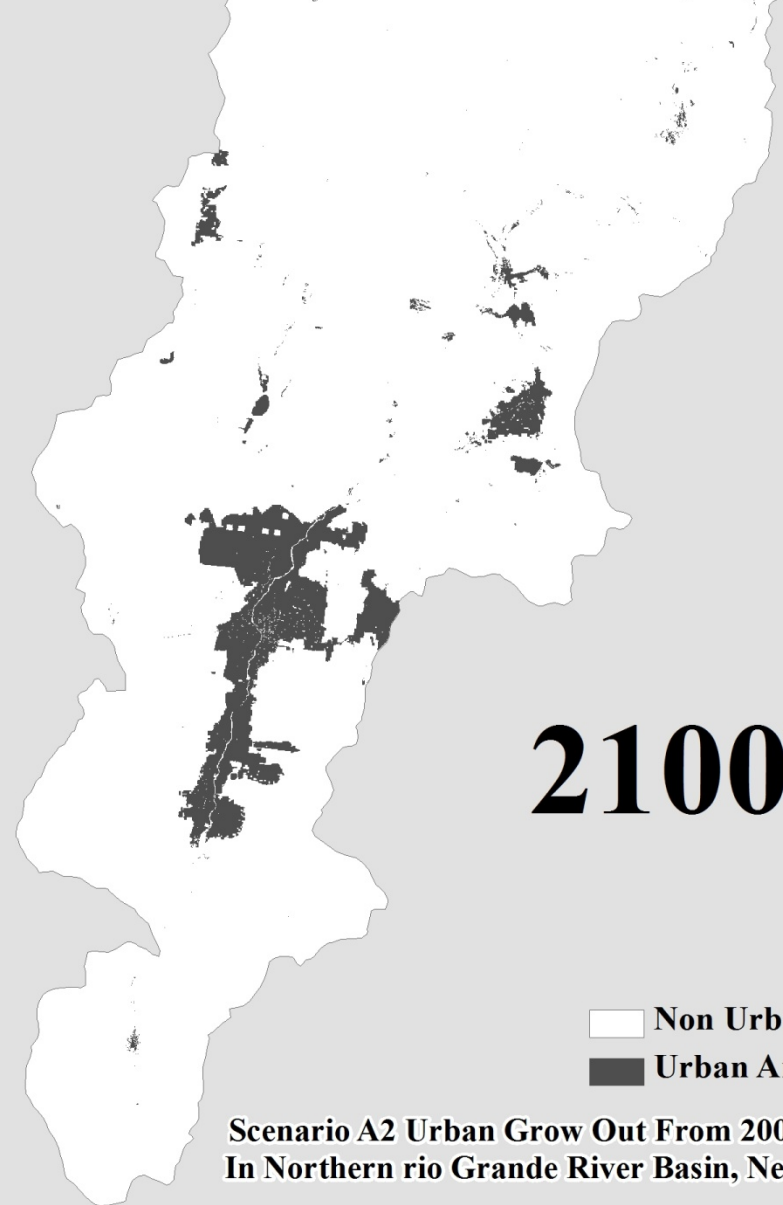
# Radar Graph



- Provides seamless land use scenarios for the **conterminous United States** consistent with IPCC emission storylines.
- Demography and population at county level
- Housing density allocated at 1 ha resolution
- Estimated % impervious surface at 1 km<sup>2</sup> resolution

*(EPA Global Change Research Program  
EPA/600/R-08/076F June 2009)*

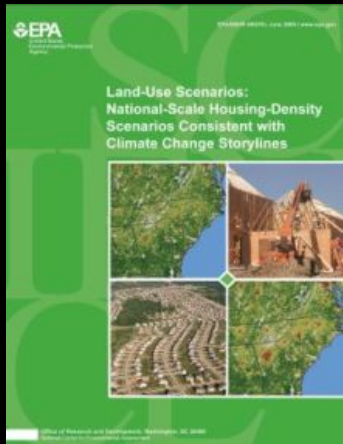
# ICLUS: *Integrated Climate and Land-Use Scenarios*



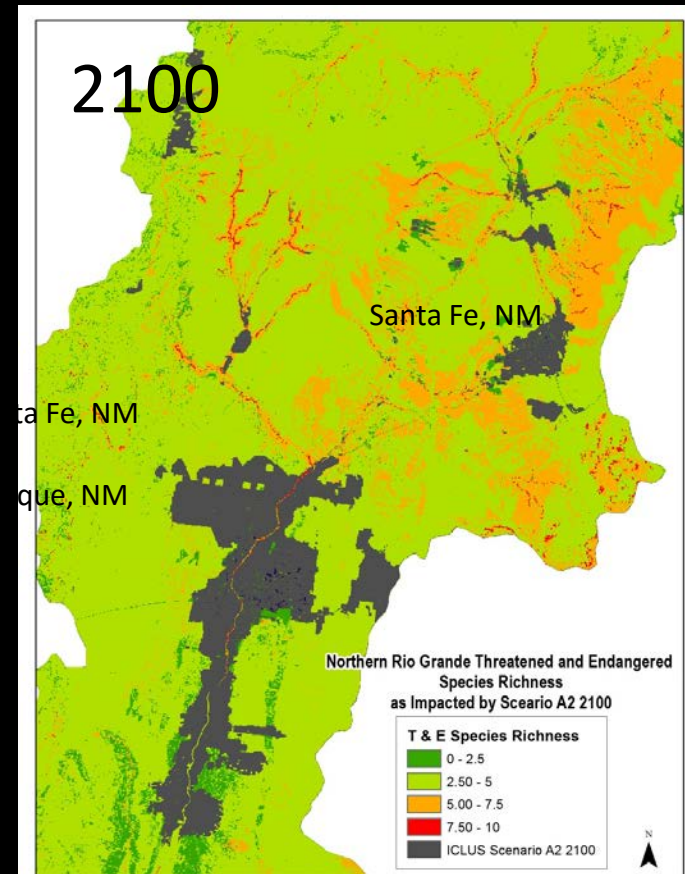
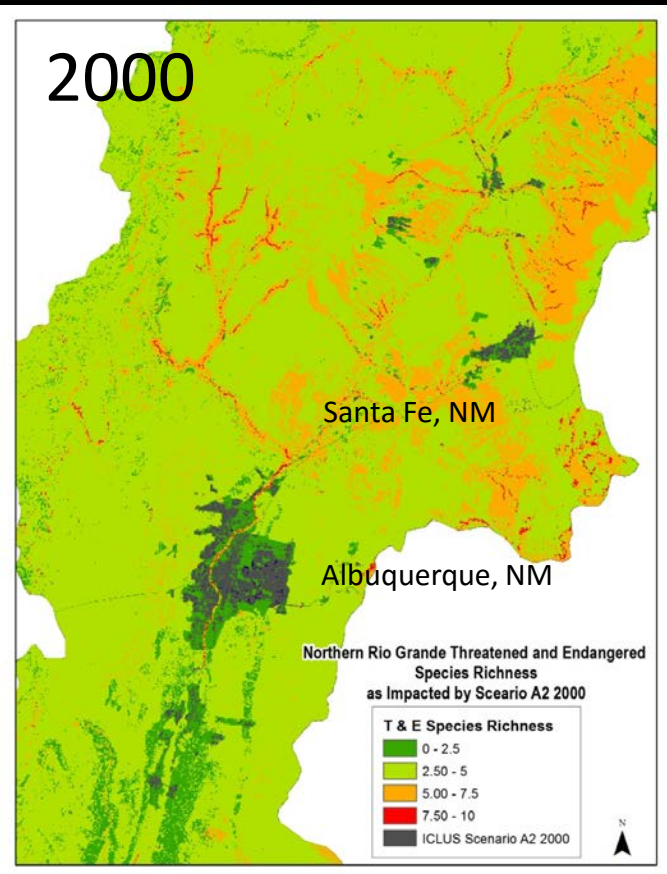
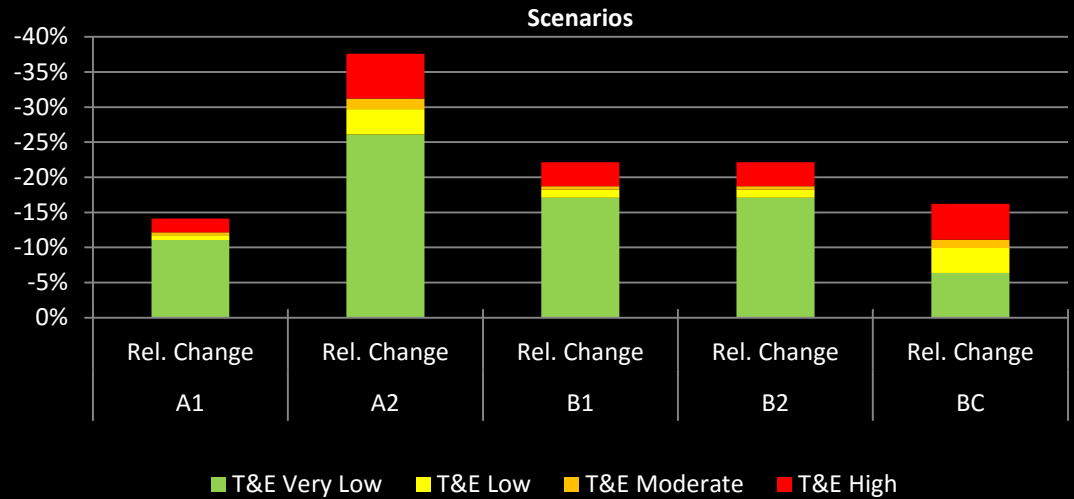
**2100**

Non Urban Area  
 Urban Area

**Scenario A2 Urban Grow Out From 2000 to 2100  
In Northern rio Grande River Basin, New Mexico**



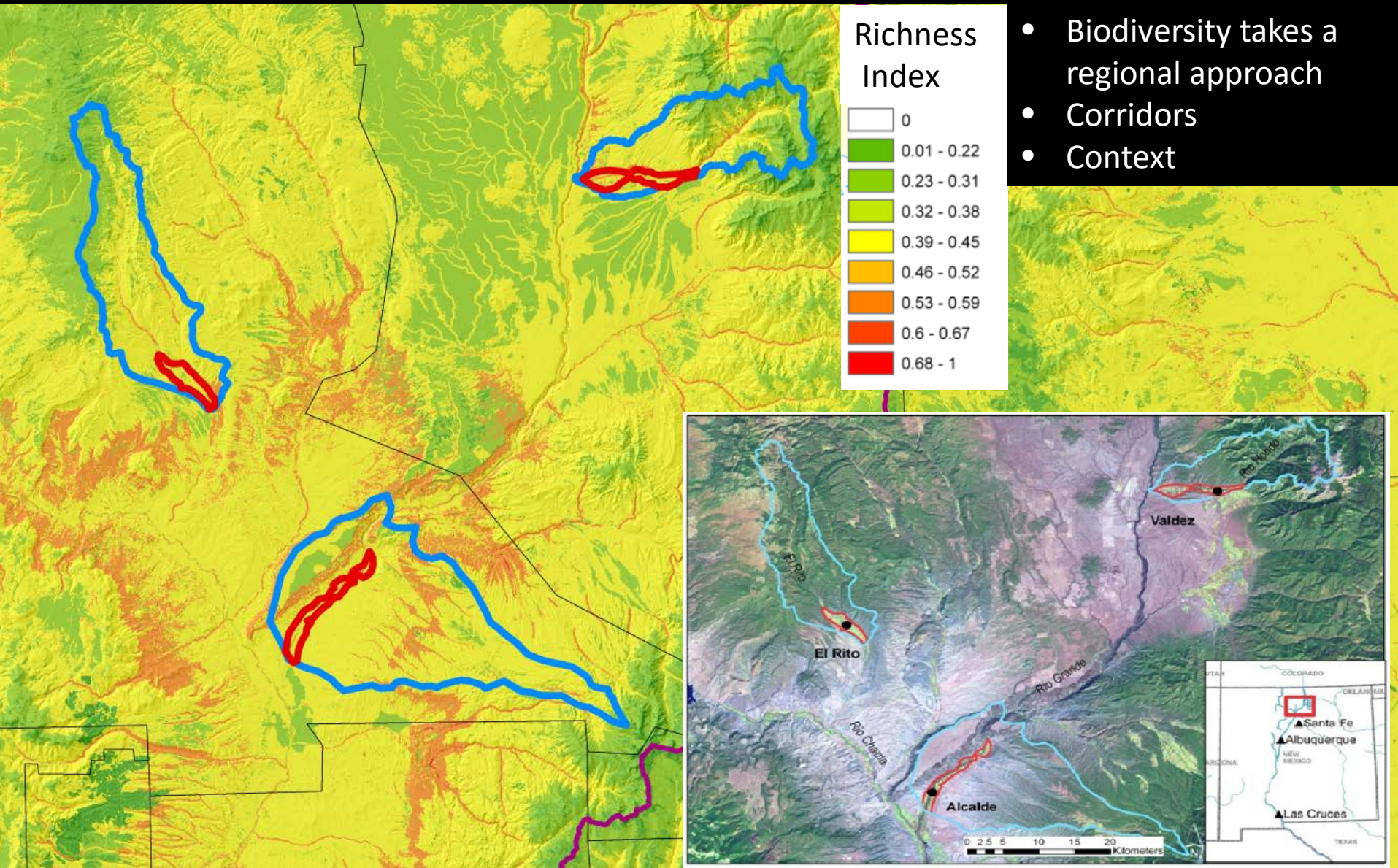
# Total Threatened and Endangered Species Richness as Affected by Scenario A2



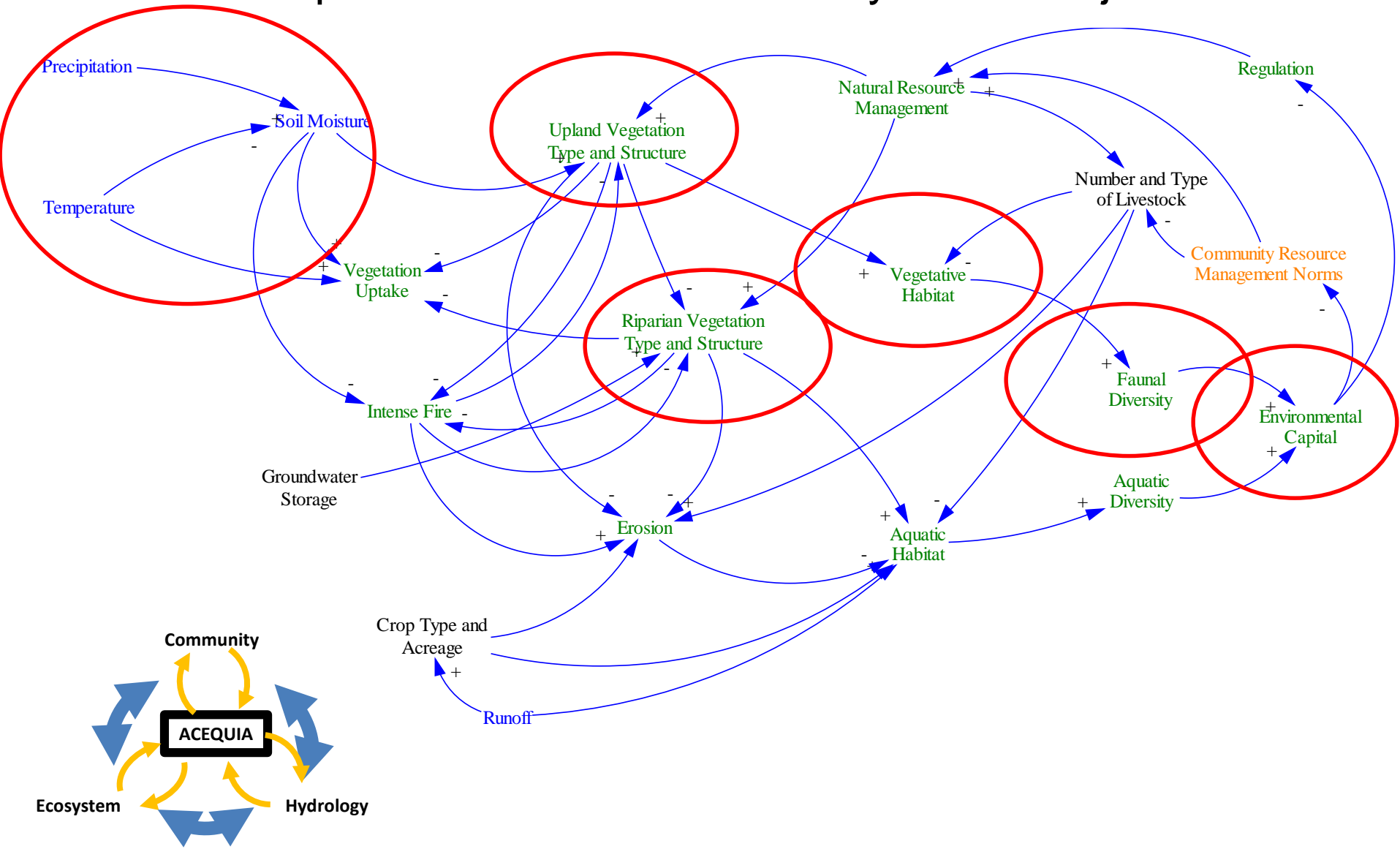


# Across Scales

Alcalde, Rio Hondo, and El Rito Watersheds, New Mexico



# Ecosystem Component: Coupled Natural and Human Systems Project



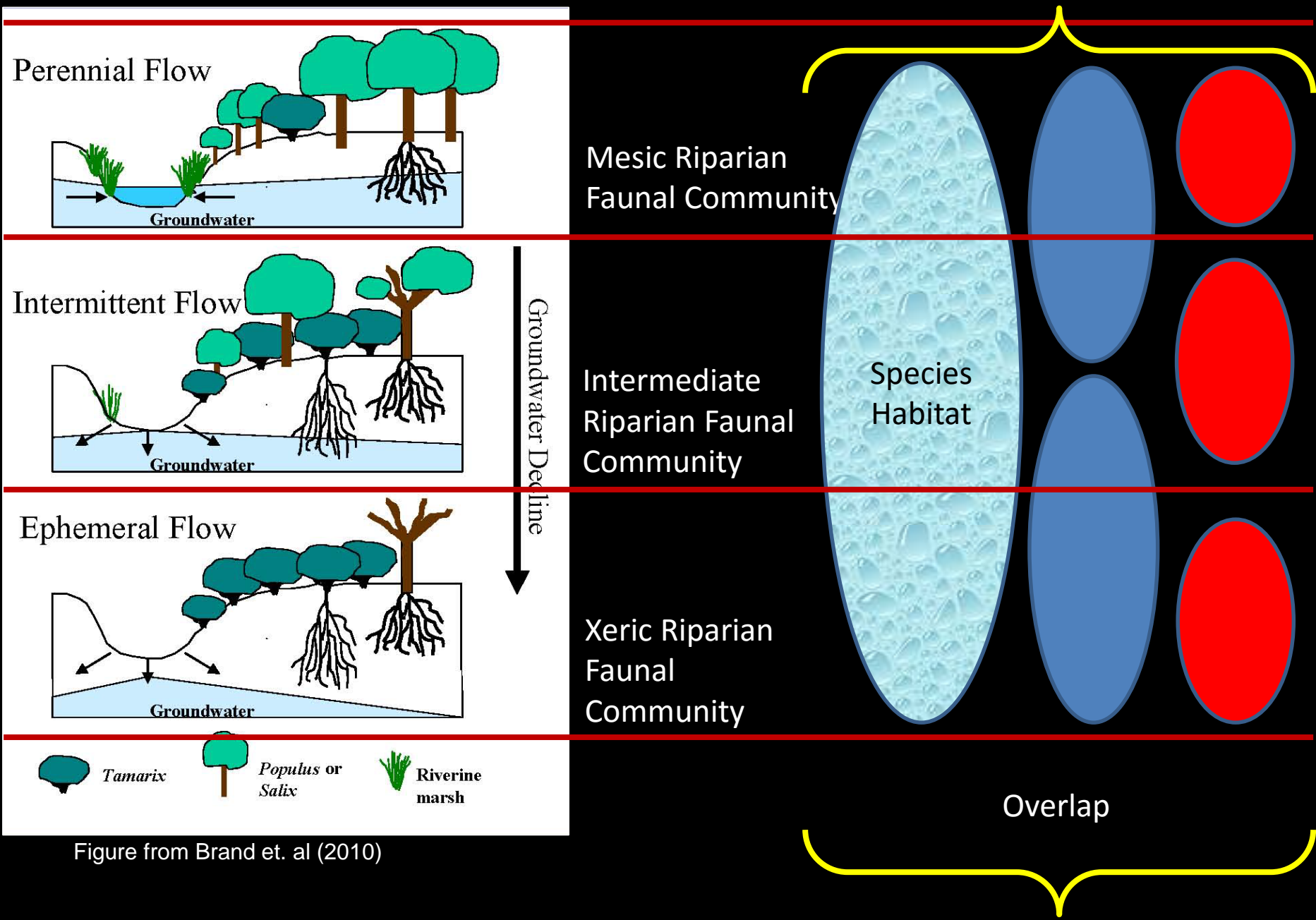
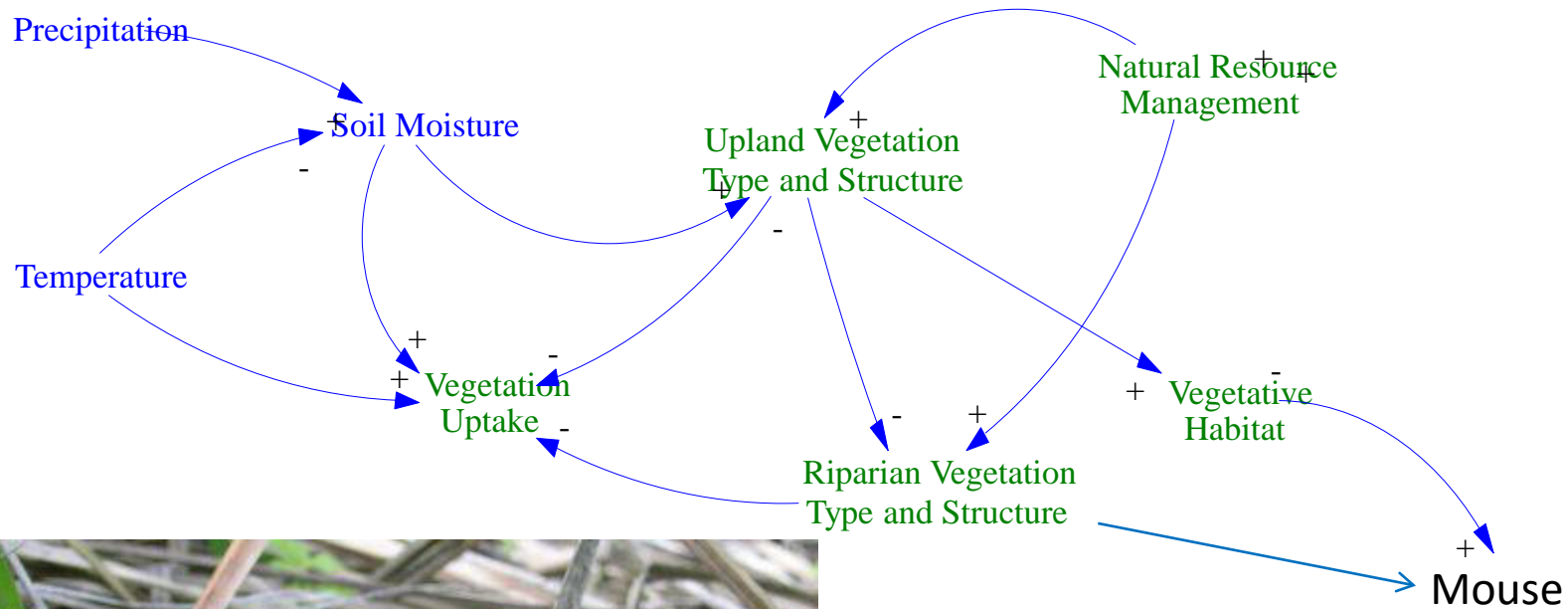


Figure from Brand et. al (2010)

# New Mexico meadow jumping mouse (*Zapus hudsonius luteus*)



# Current Perspectives

- USGS Gap Analysis Program data provides the regional perspective on wildlife, biodiversity, and related ecosystem services
- ICLUS provides the regional perspective on climate change and urban grow-out
- Systems Dynamic Model provides the information necessary at fine scales.
- What ecosystem services do acequias provide for wildlife?





# Acknowledgements



## EPA

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## NSF Team

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CNH Team Members

## CASE, NMSU

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Darin Kopp  
Rachel Guy

## Concurrent Projects

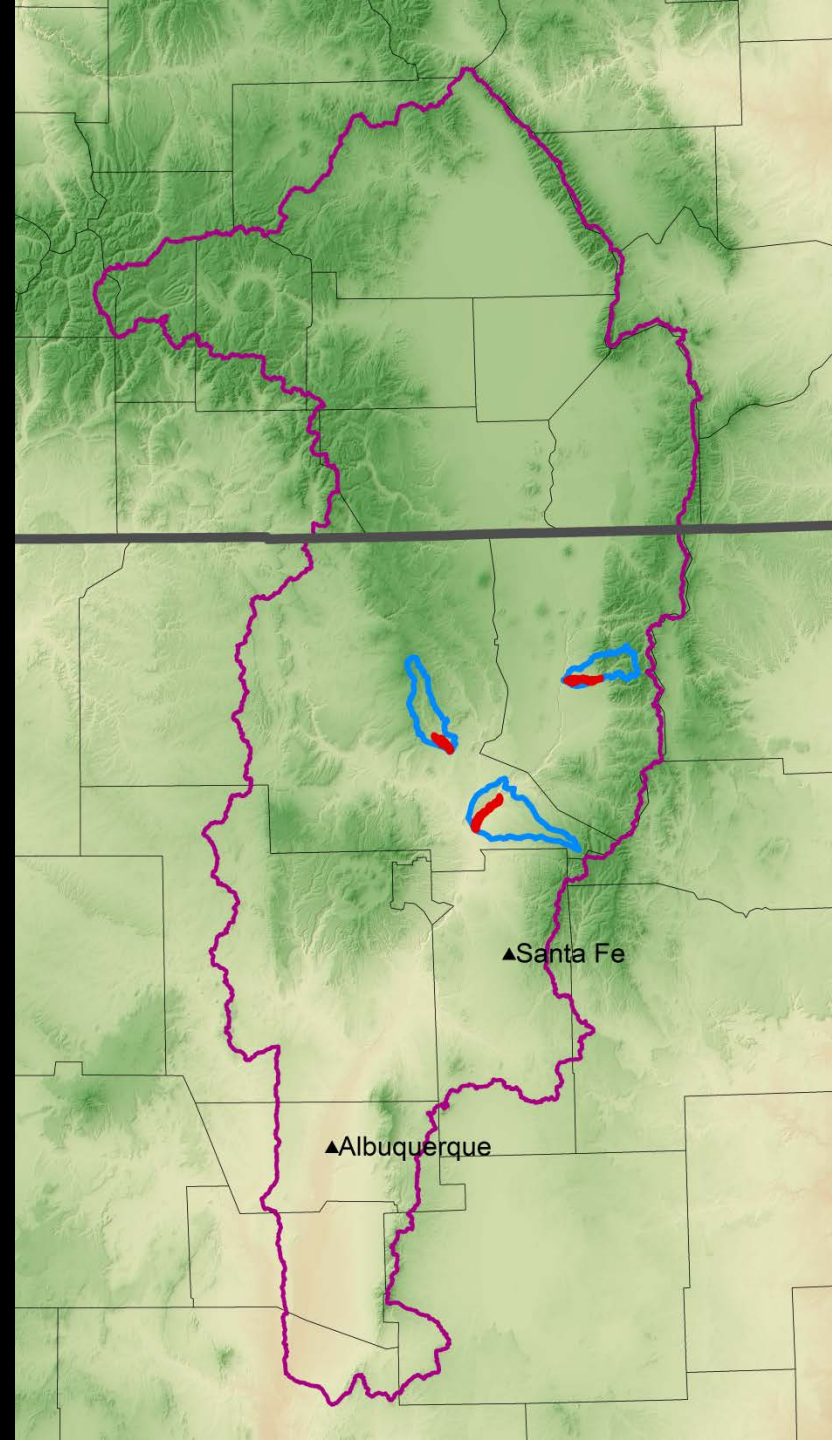
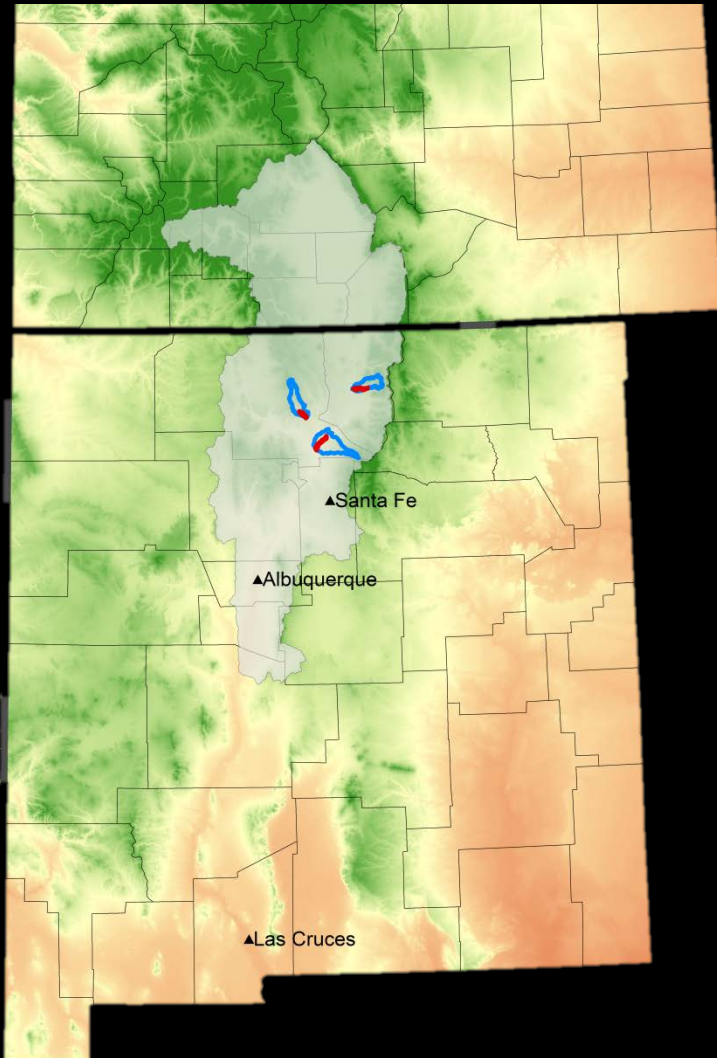
- *Mapping Biodiversity Metrics at Multiple Scales*



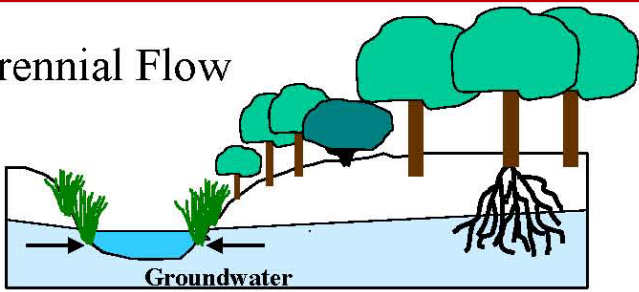
- *Developing Spatially Explicit Biodiversity Metrics in Support of CEAP: A Focus on Wildlife*



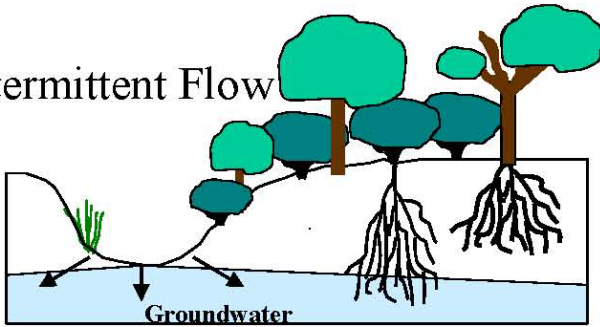
# Regional Study Area Upper Rio Grande River Basin



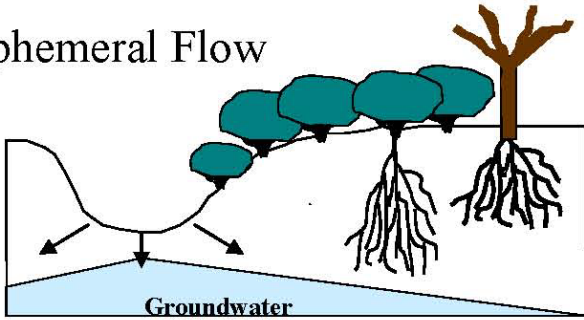
Perennial Flow



Intermittent Flow



Ephemeral Flow



Groundwater Decline



Mesic Riparian Faunal Community

Intermediate Riparian Faunal Community

Xeric Riparian Faunal Community



Figure from Brand et. al (2010)