

Identifying Bird and Reptile Vulnerabilities to Climate Change



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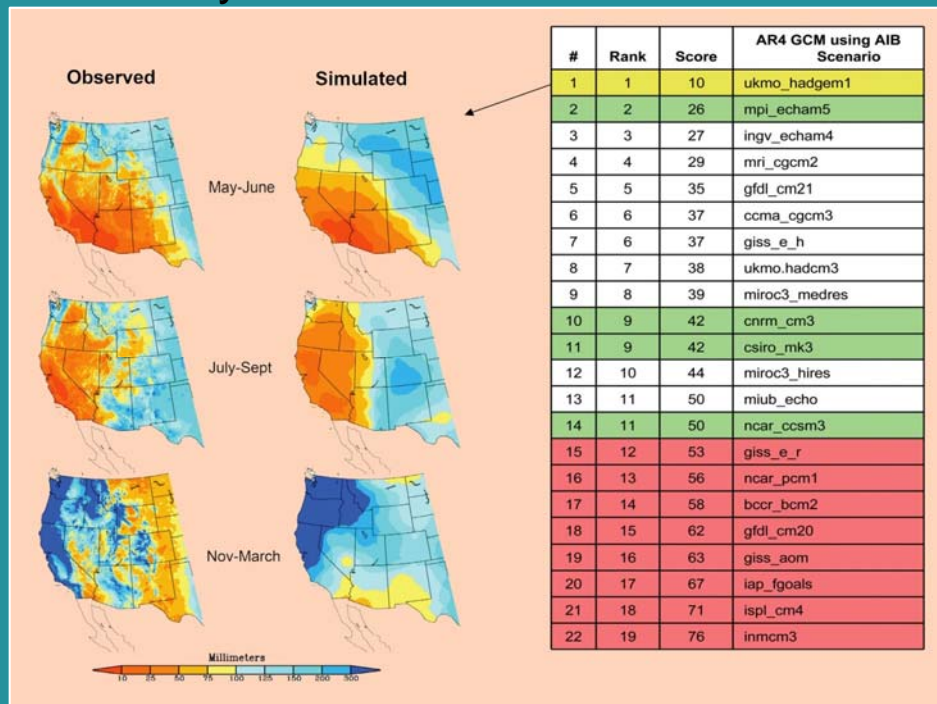


Project Goals

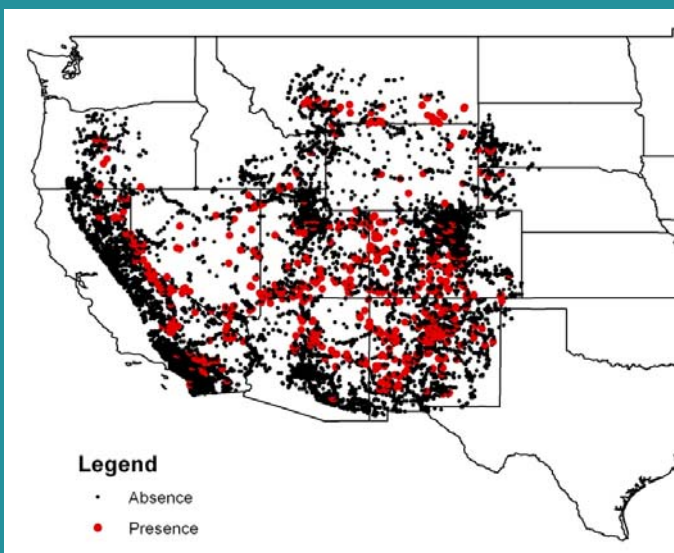
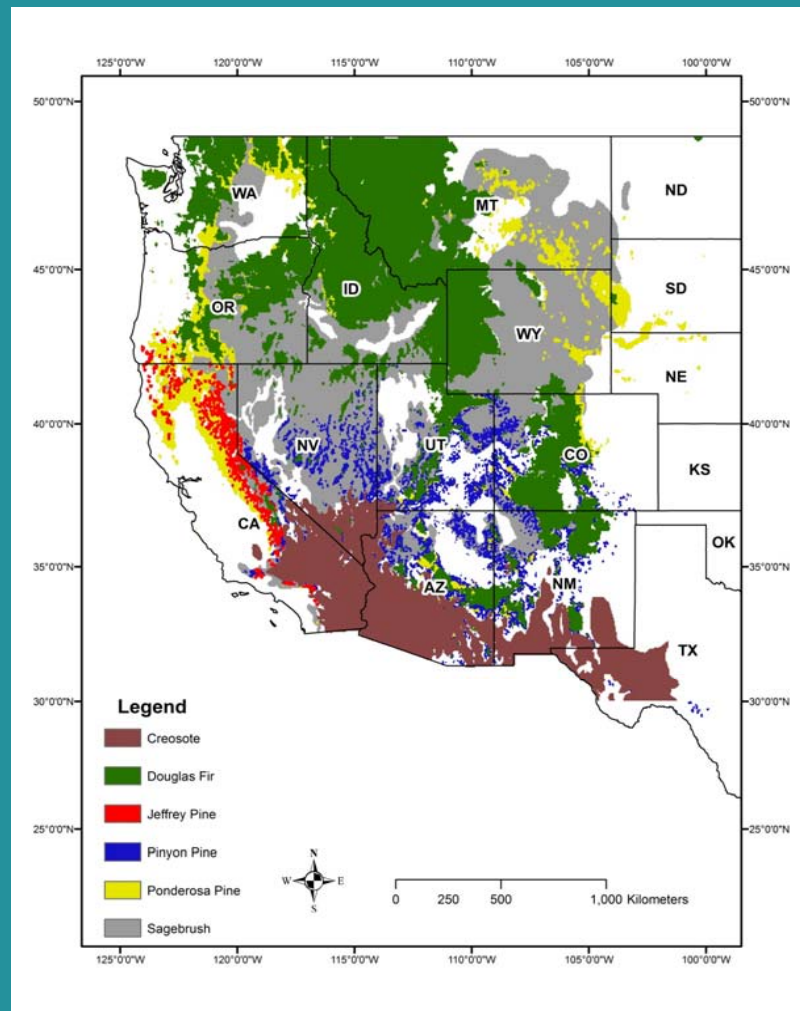
- (1) Identify bird and reptile sensitivities and vulnerabilities to climate change
- (2) Develop a list of drivers (biotic, climatic, landscape) associated with contemporary and future species' ranges
- (3) Provide managers with useful, actionable science that can potentially minimize range contractions for sensitive species

Why the Southwest?

Statistically downscaled GCM data available



Good info on plant distributions



Abundant wildlife distribution data

Selection of Bird and Reptile species

Criteria for Species selection

- Bulk of the species range is within our study area
- The species has not been widely extirpated, or we have good information on its historic distribution
- Range information is well documented by available data
- Represents different functional groups, but likely to be sensitive to climate change

Bird and Reptile Focal Species

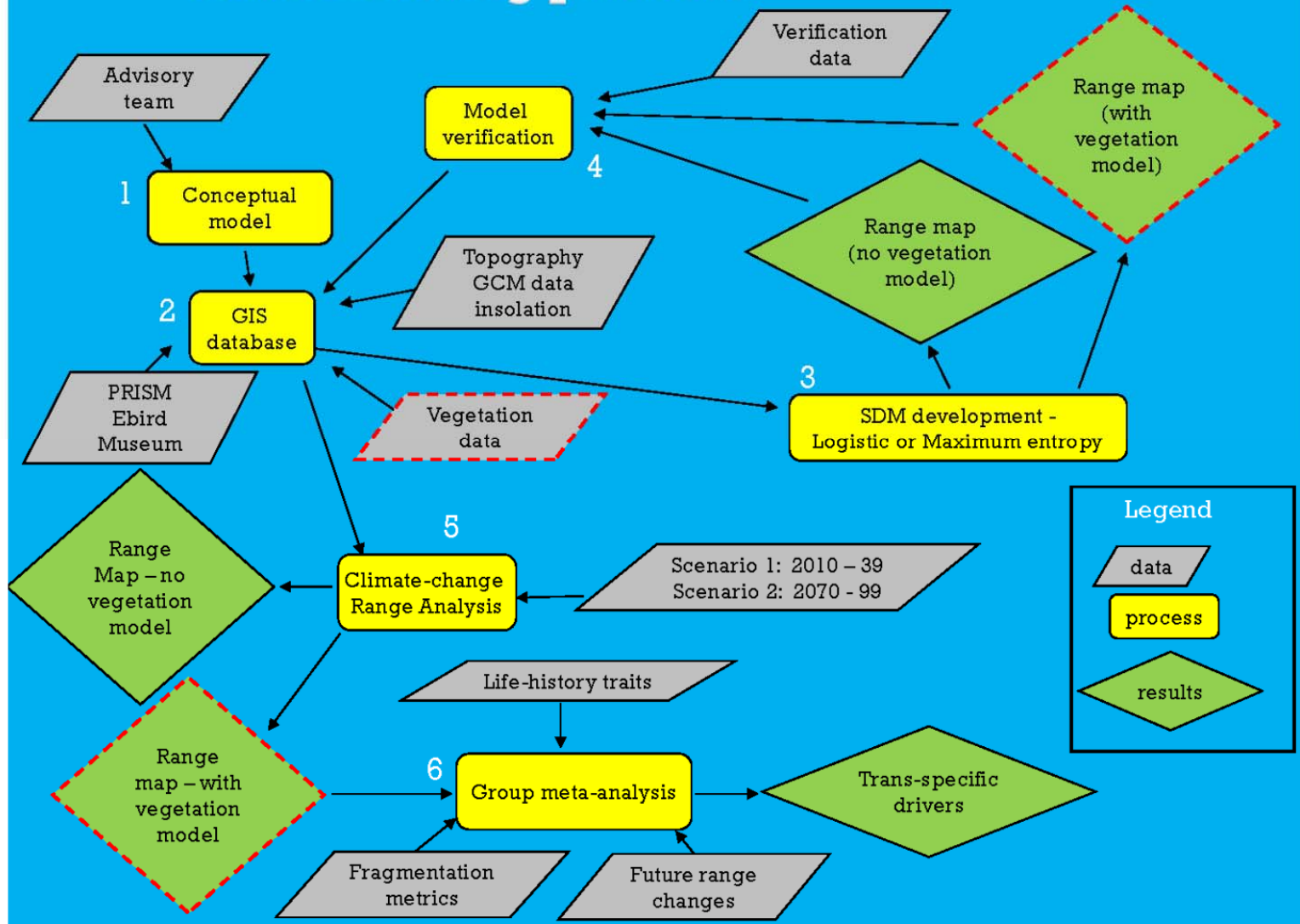
Birds

Common Name
Black-throated gray warbler
Black-throated sparrow
Brewer's sparrow
Flammulated owl
Gray flycatcher
Gray vireo
Juniper titmouse
Le Conte's thrasher
Pinyon jay
Pygmy nuthatch
Red-naped sapsucker
Sagebrush sparrow
Sage thrasher
Virginia's warbler
Williamson's sapsucker

Reptiles

Common Name
Glossy Snake
Gila Spotted Whiptail
New Mexico Whiptail
Tiger Whiptail
Plateau Striped Whiptail
Arizona Black Rattlesnake
Rock Rattlesnake
Desert Iguana
Madrean Alligator Lizard
Desert Tortoise
Gila Monster
Common Lesser Earless Lizard
Greater Short-horned Lizard
Chuckwalla
Sagebrush Lizard
Ornate Box Turtle

The modeling process



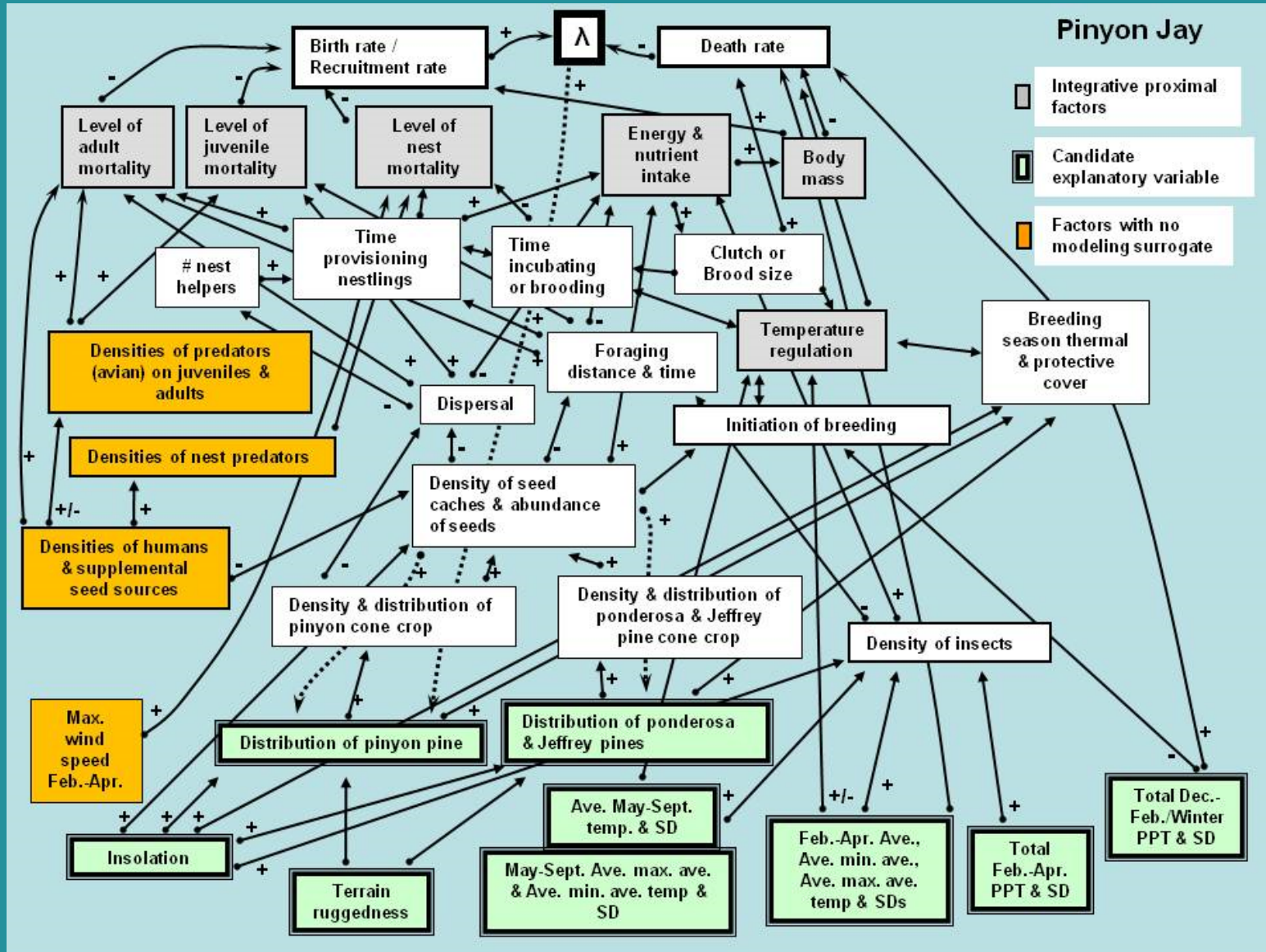
Example of entire modeling process for one focal species

Pinyon jay

- ◉ Endemic to the interior mountain West
- ◉ Coevolutionary relationship with piñon pines
- ◉ One of earliest nesting passerines in the U.S.
- ◉ Non-migratory



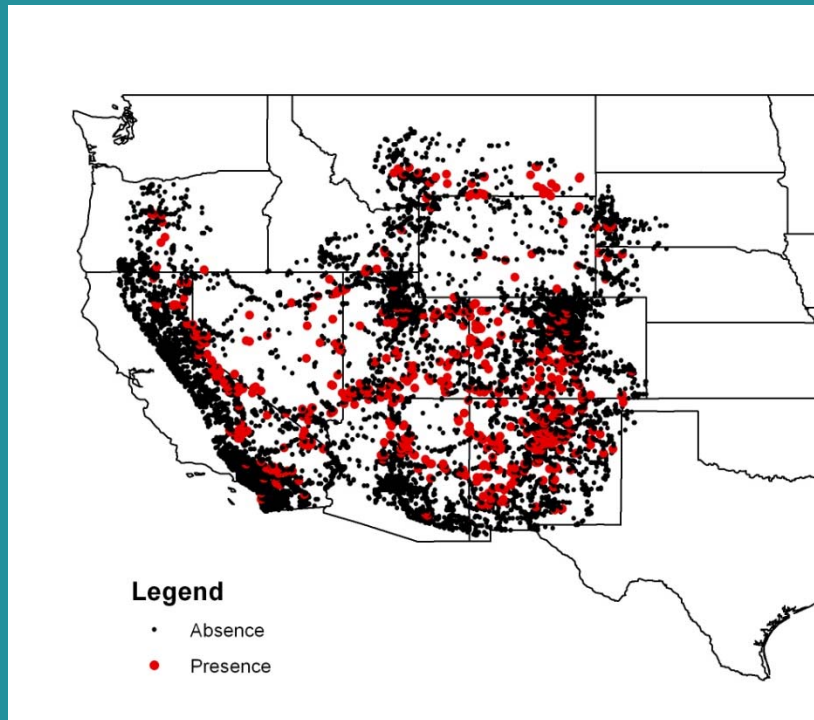
Pinyon Jay Conceptual Model



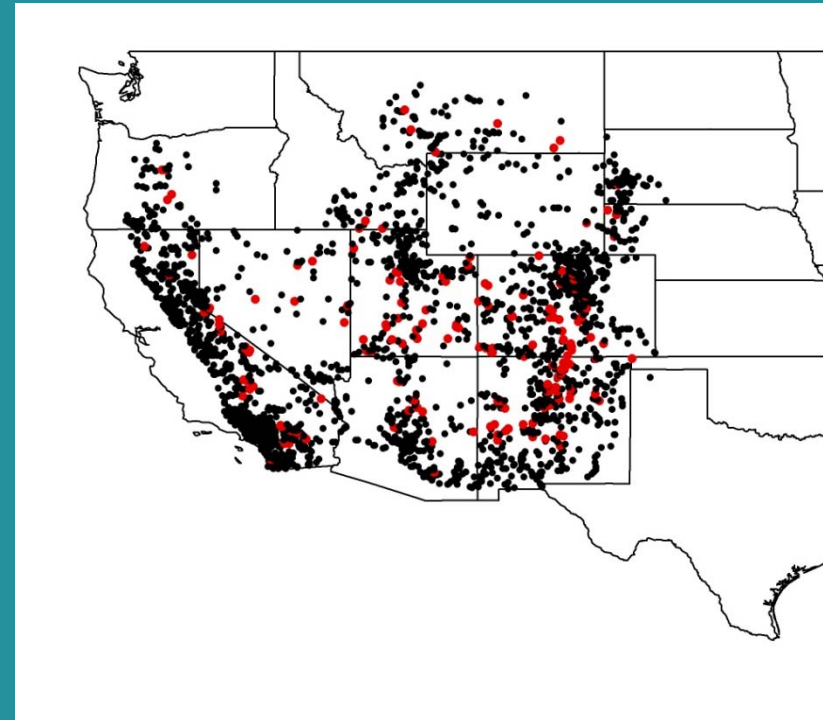
Baseline Model Development

Presence/Absence: 1990 - 2009

Build



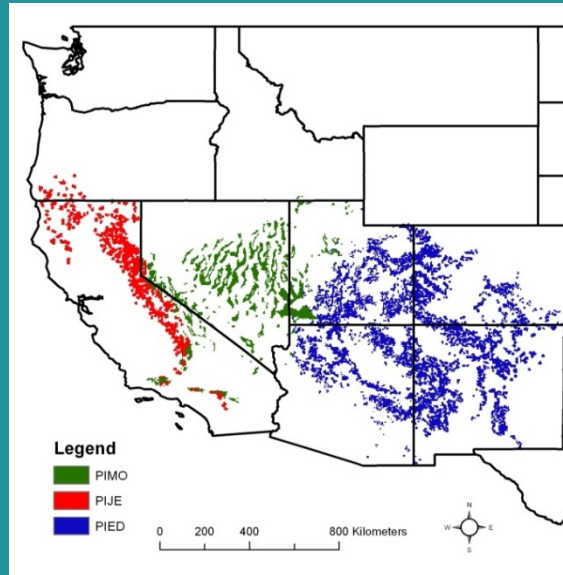
Verify



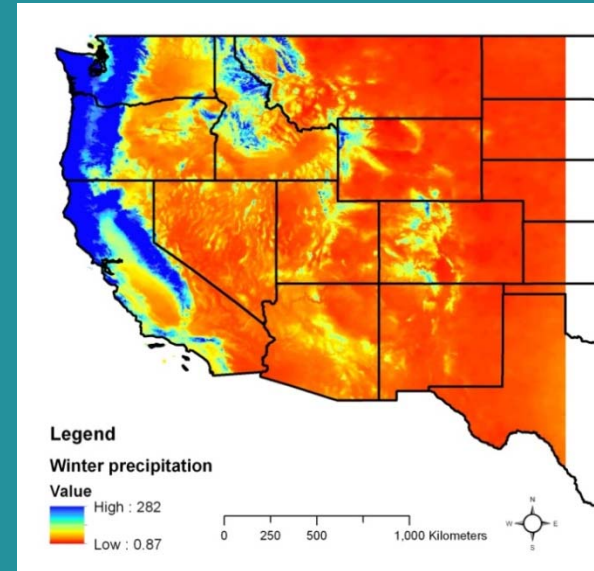
Data come from the Avian Knowledge Network
(<http://www.avianknowledge.net>)

Baseline Exploratory Variables

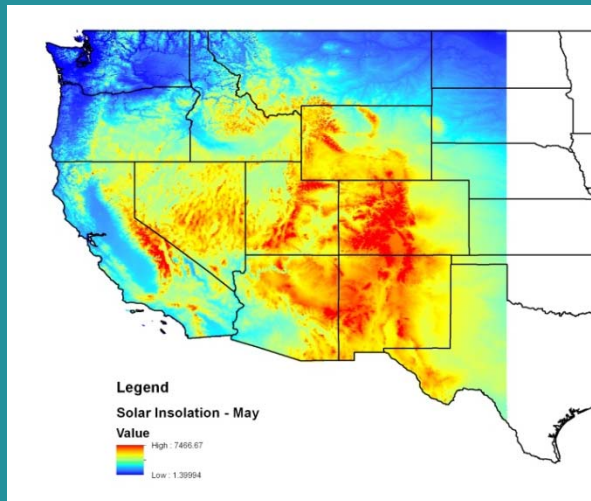
Vegetation



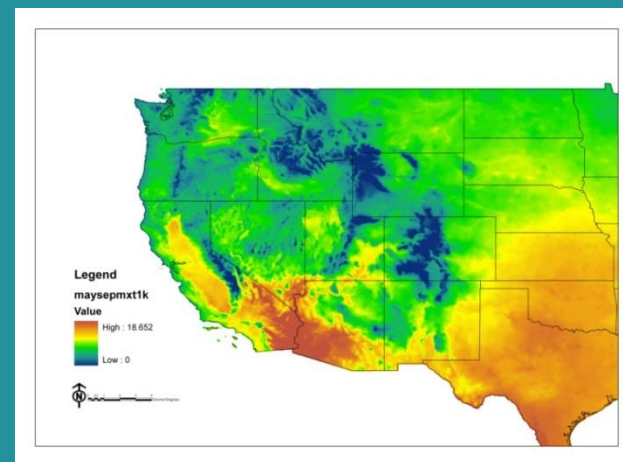
Winter Precipitation



Insolation (May)



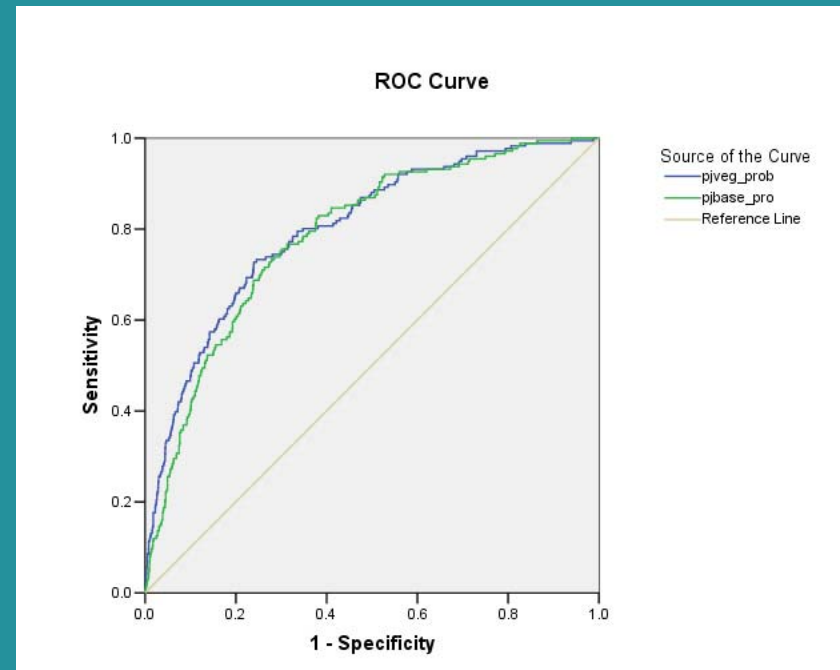
Summer Mean High Temps



Pinyon Jay Baseline Model Testing

Best-fit Model

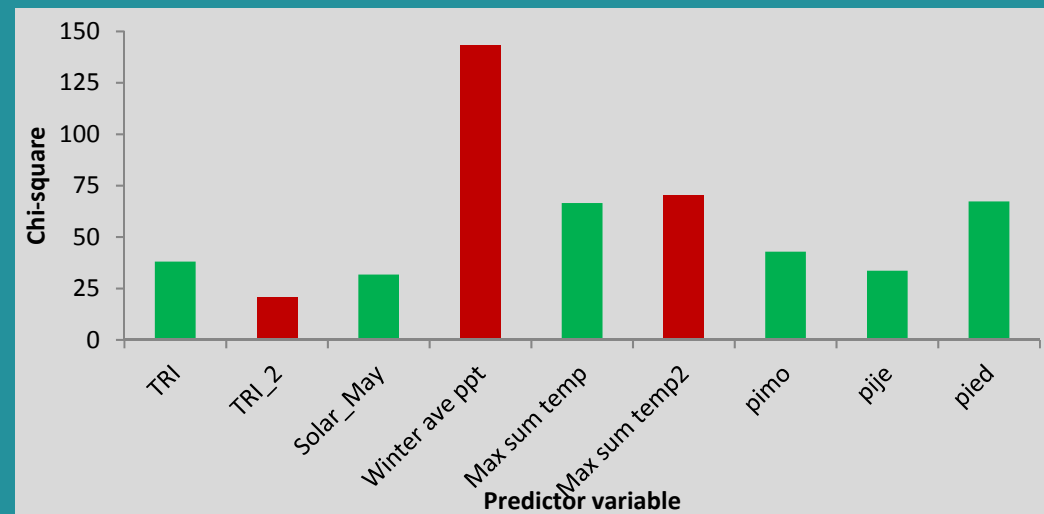
- Overall accuracy ~ 73%
- Important variables (in descending order)**
- Mean winter precipitation (Dec – Feb)
- Mean maximum temps (May – Sept)
- Vegetation:
 - PIED
 - PIMO
 - PIJE
- Terrain ruggedness (4-km radius)
- Solar insolation (May)



Area Under the Curve

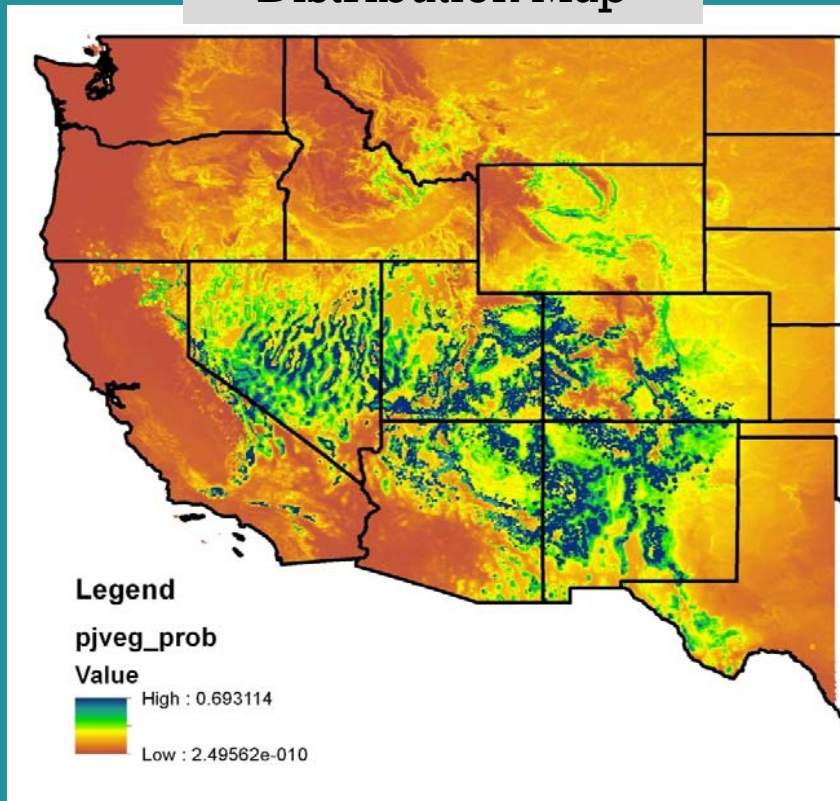
```
pjveg_prob .80
pjbase_pro .79
*****
```

- a Under the nonparametric assumption
- b Null hypothesis: true area = 0.5

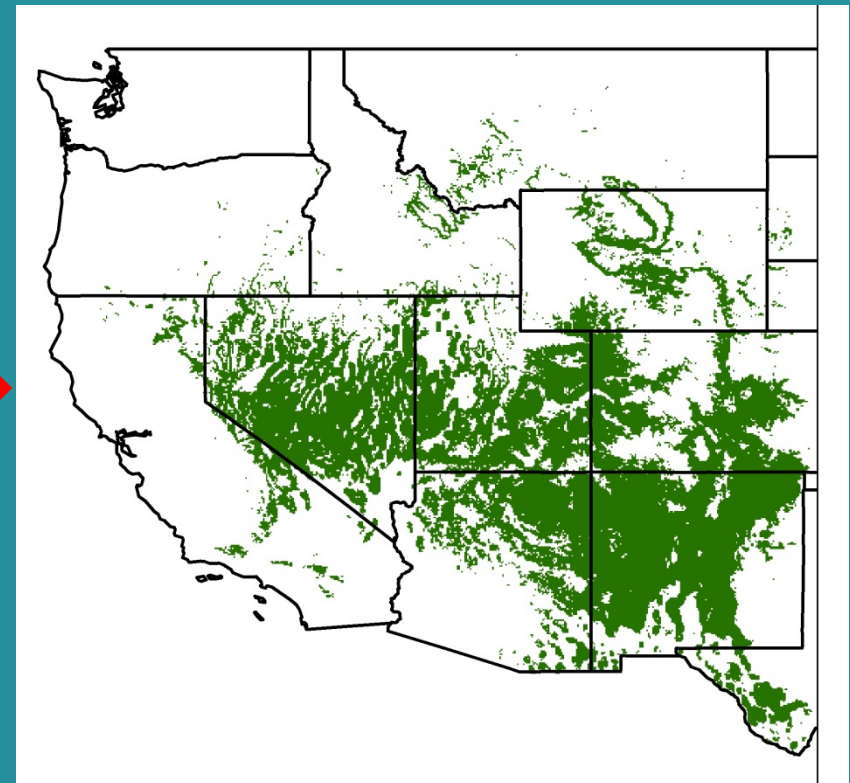


Pinyon Jay Probability Maps (Contemporary)

Plant-based Species
Distribution Map

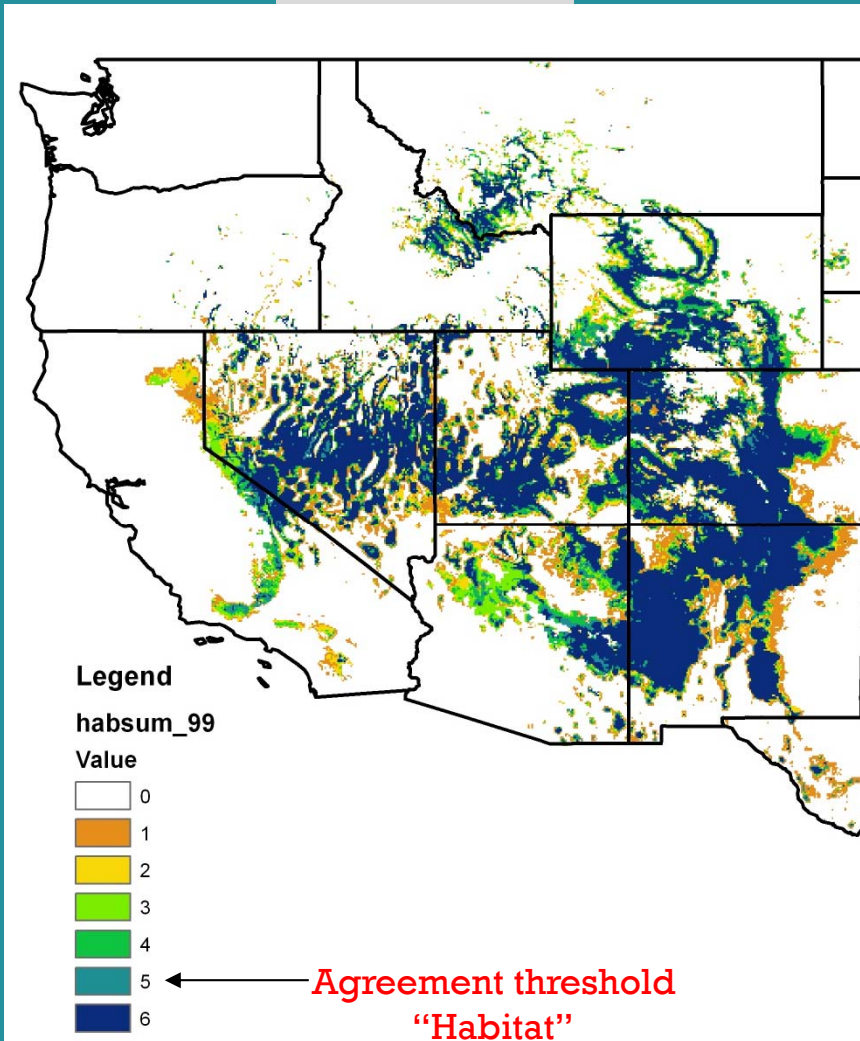


Binary Range Map



Dealing with Uncertainty in Future Range Projections

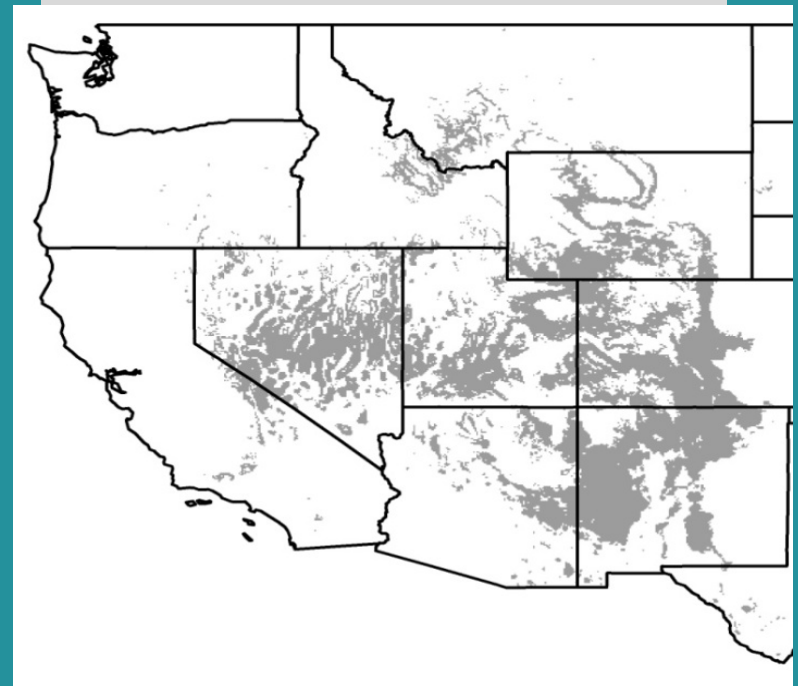
2070 - 2099



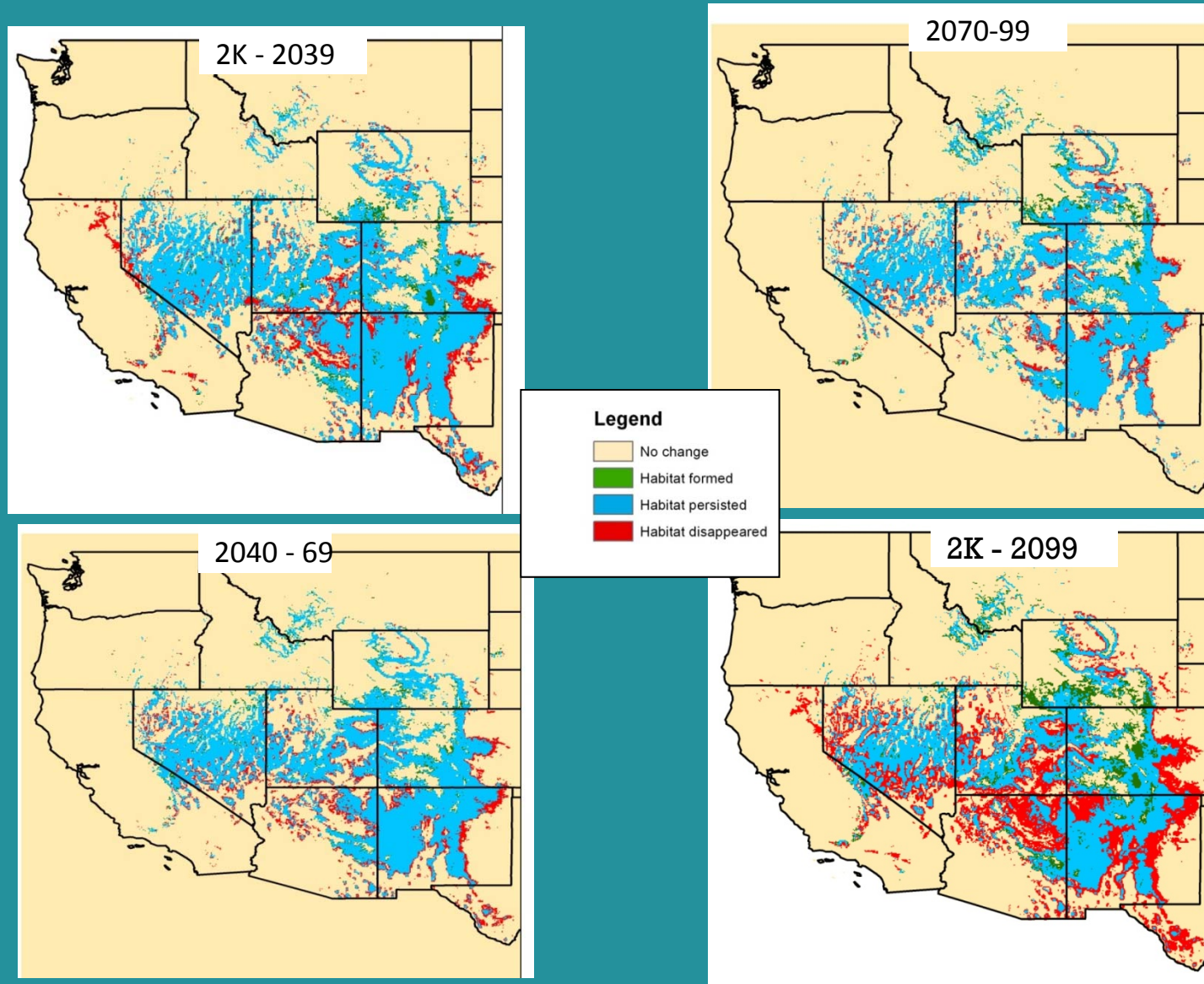
Finding agreement among six GCM-based range maps

Where 5 or more GCM-based range maps agreed that a location is suitable range, we classified it as future range (>80% agreement)

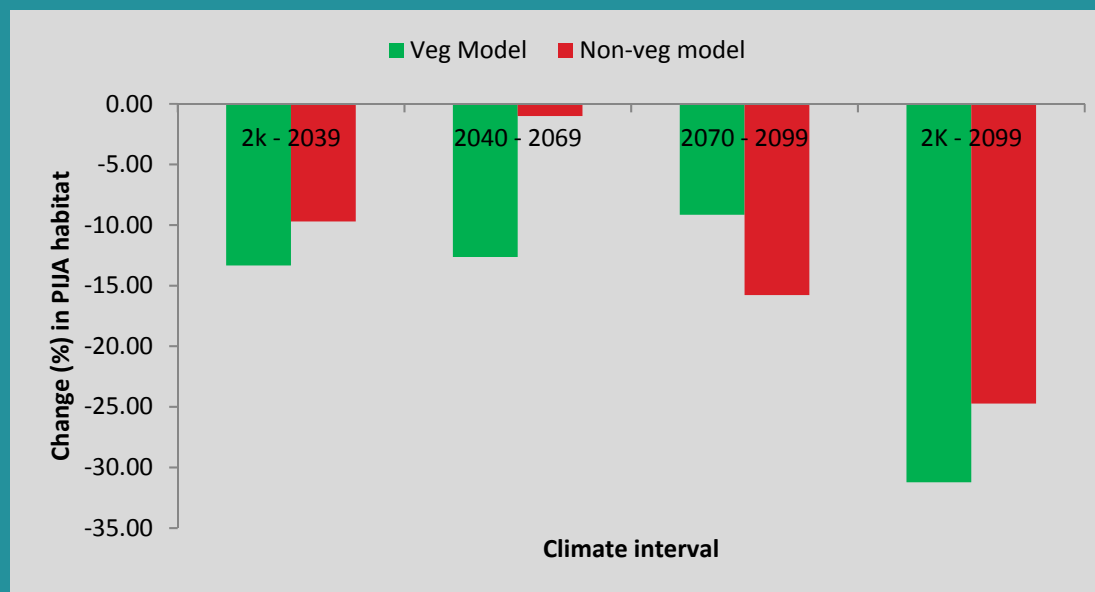
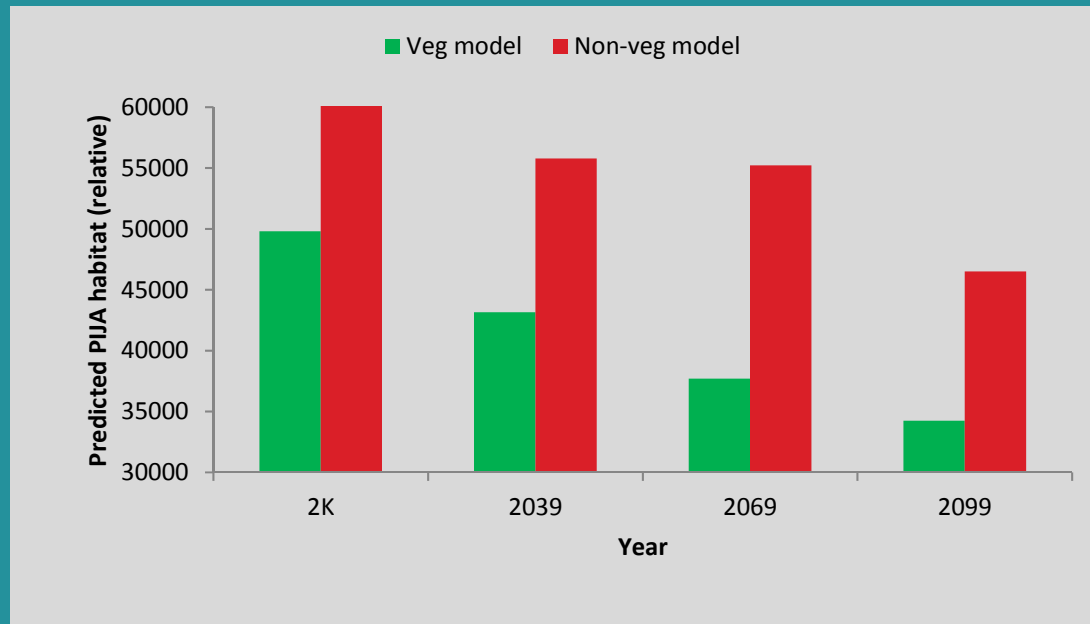
Projected Future Range: 2099



Pinyon Jay Future Habitat Changes (Best-fit Veg Model)

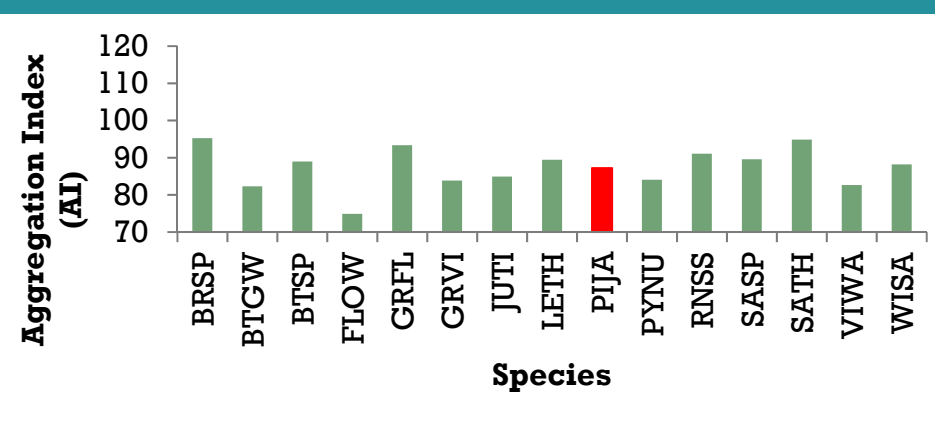
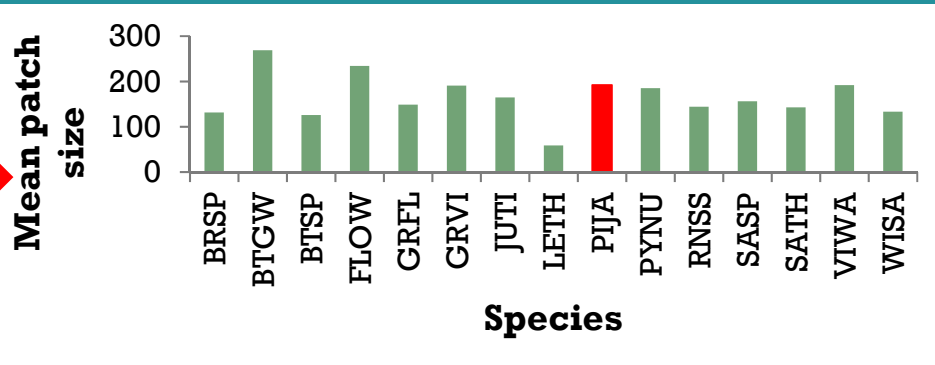
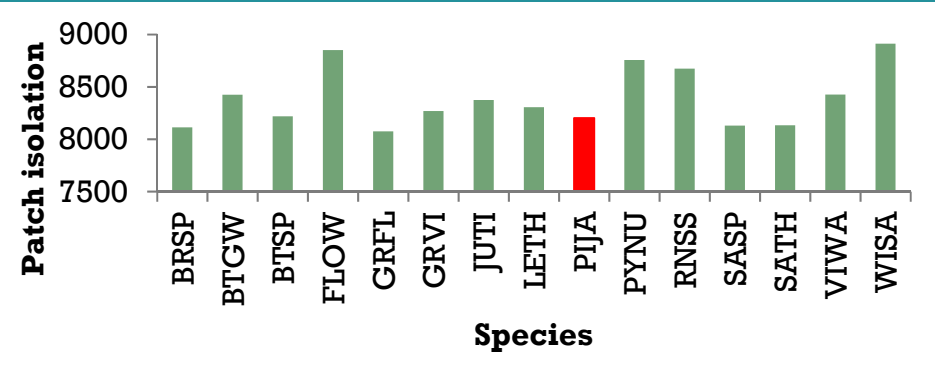
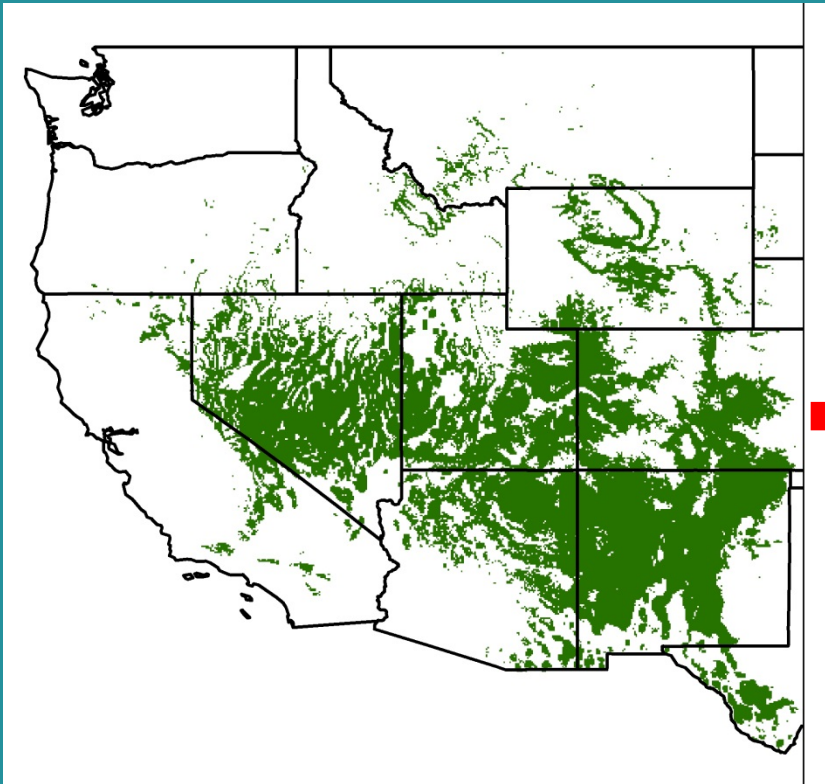


Pinyon Jay Future Habitat Changes



Pinyon Jay Fragmentation Analysis

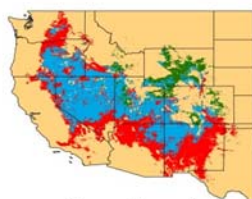
PIJA Contemporary Range



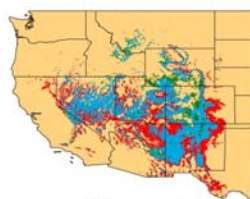
Projected changes in range for 15 bird species: 2009 - 2099



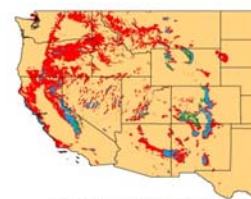
Gray Vireo



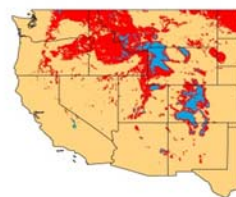
Gray Flycatcher



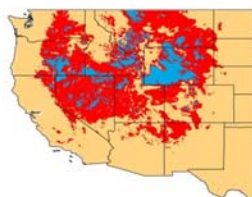
Pinyon Jay



Pygmy Nuthatch



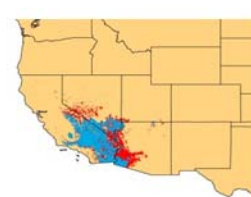
Red-naped
Sapsucker



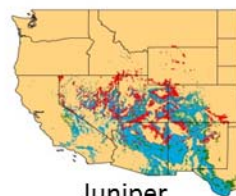
Sage Thrasher



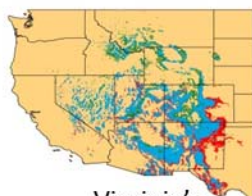
Black-throated
Sparrow



LeConte's
Thrasher



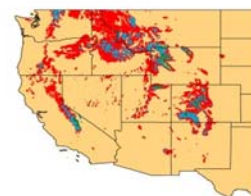
Juniper
Titmouse



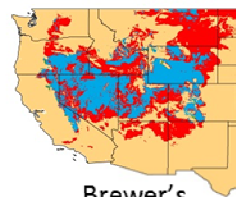
Virginia's
Warbler



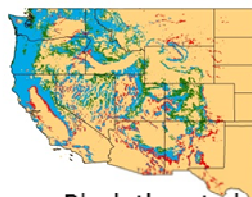
Flammulated
Owl



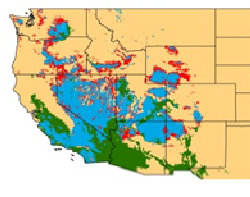
Williamson's
Sapsucker



Brewer's
Sparrow



Black-throated
Gray Warbler

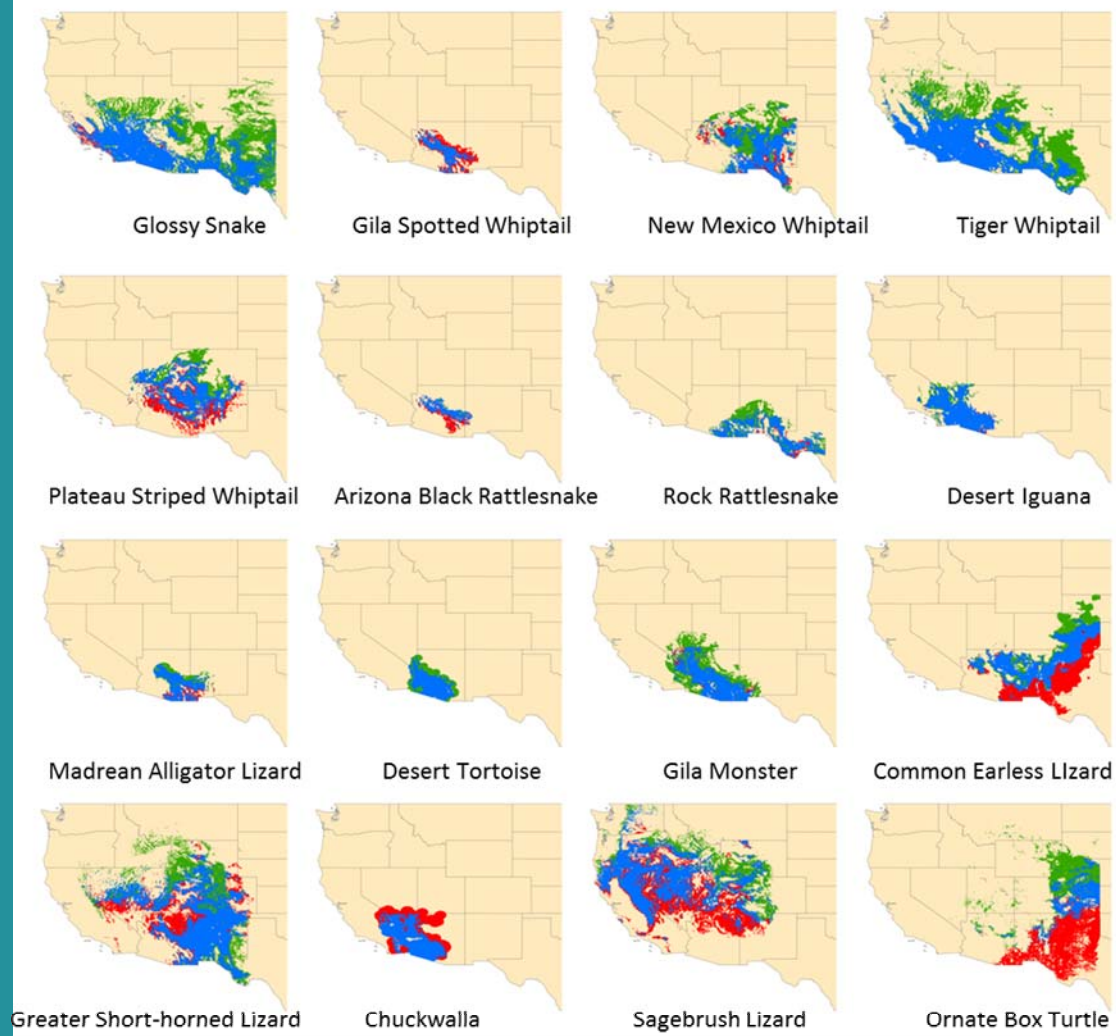


Sage Sparrow

Changes in Range

- Expansion
- Contraction
- Refuge
- Non-suitable area

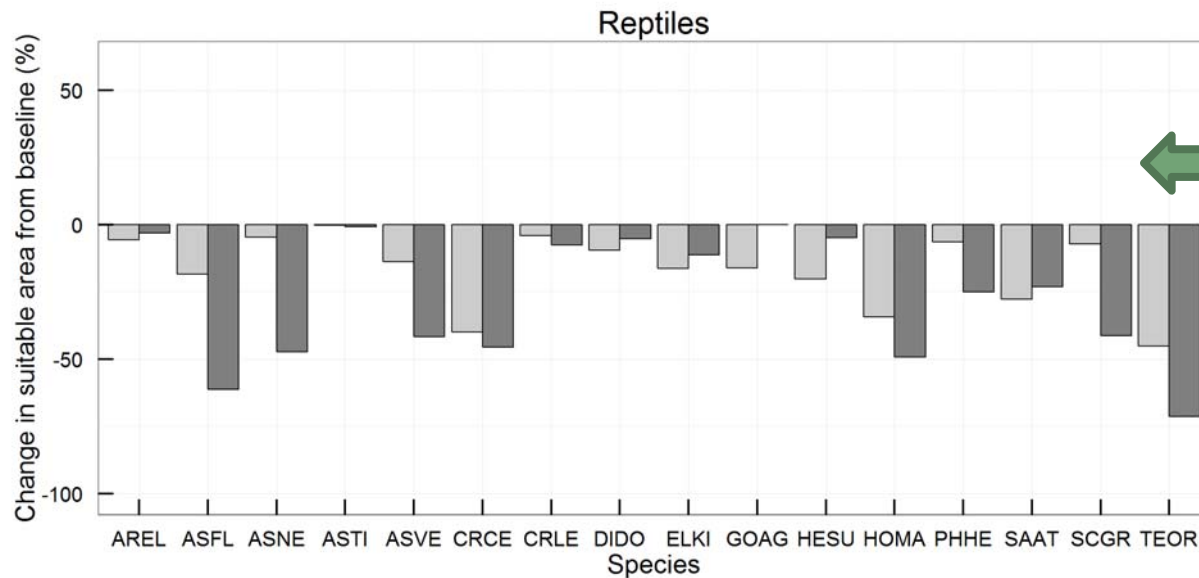
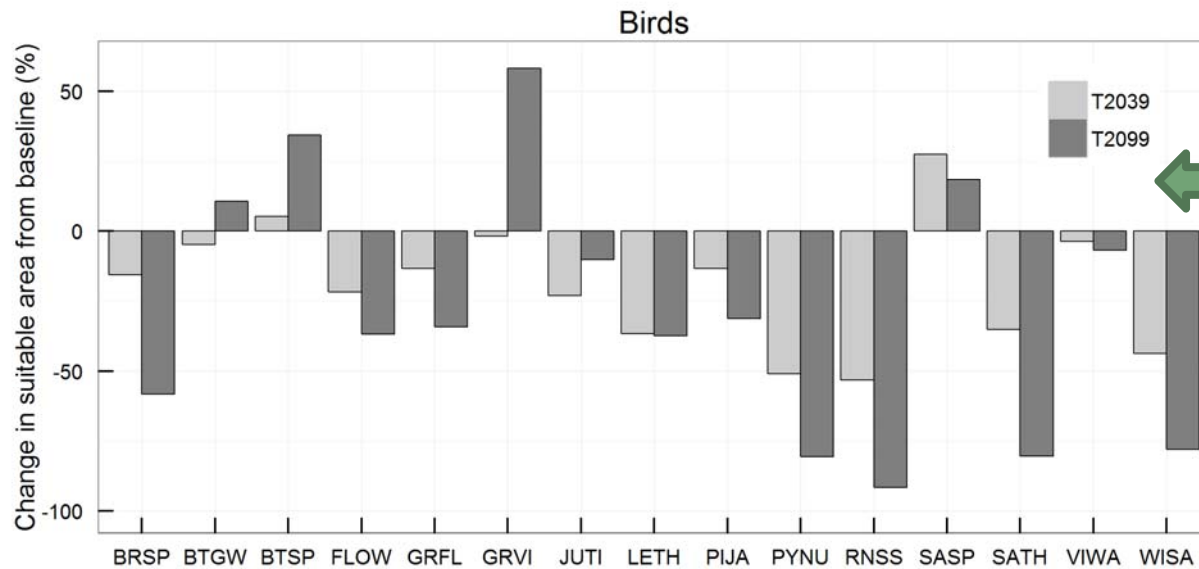
Projected changes in range for 16 reptile species: 2009 - 2099



Changes in Range

- Expansion
- Contraction
- Refuge
- Non-suitable area

Projected Changes in Range: (2009 – 2099)



Bird ranges

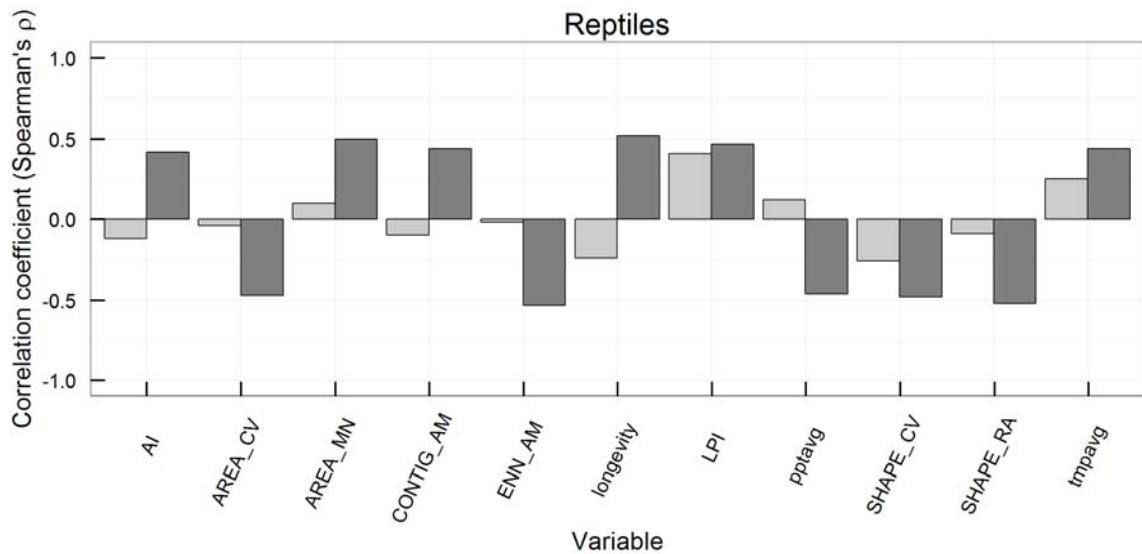
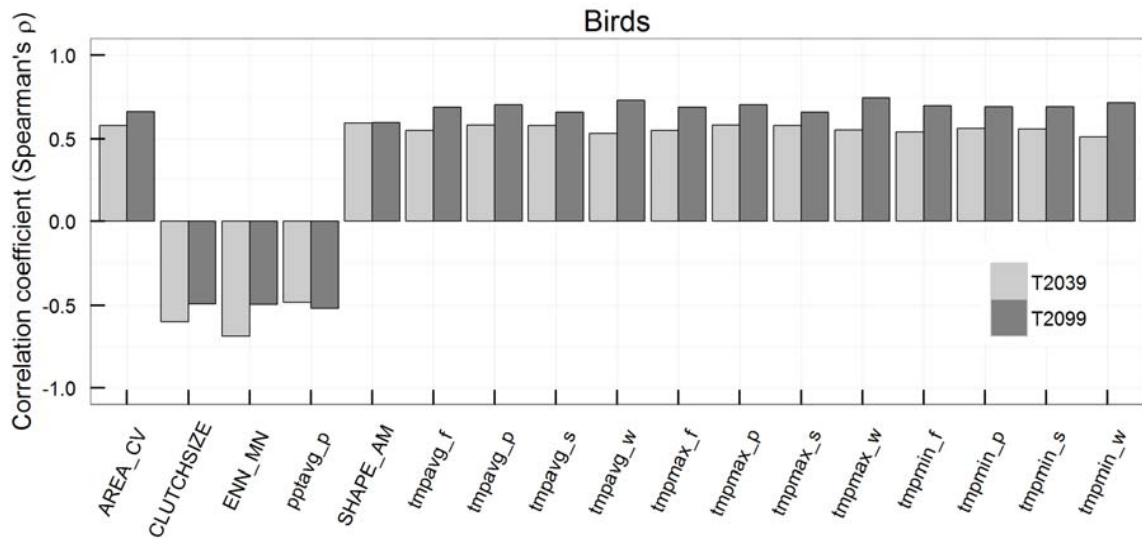
- 25% projected to expand
- 75% projected to contract

Reptile ranges

* We assumed no dispersal for reptiles

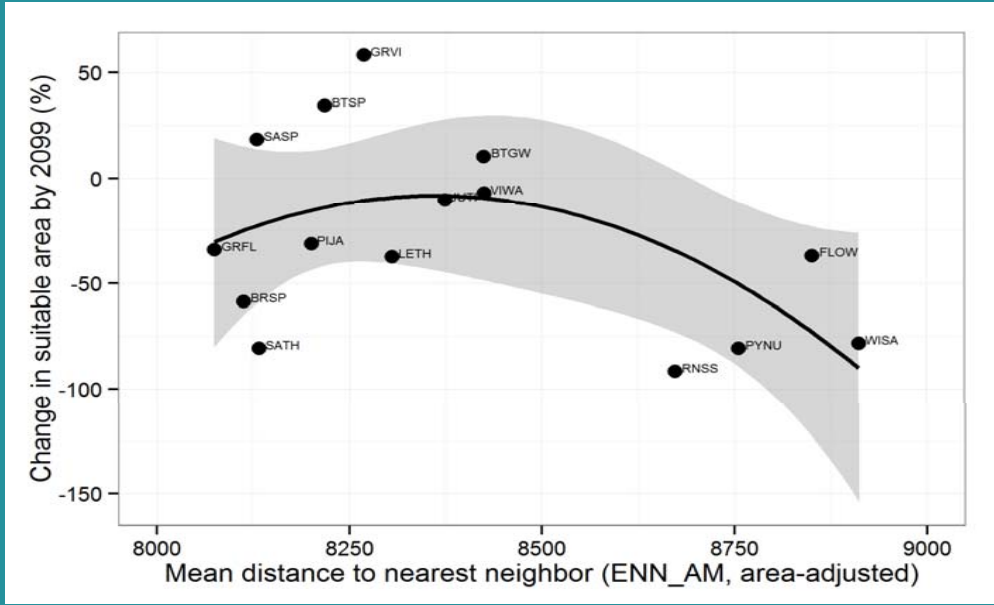
- 50% projected to contract sharply
- 50% projected to change little

Correlations between contemporary range characteristics and projected range for birds and reptiles

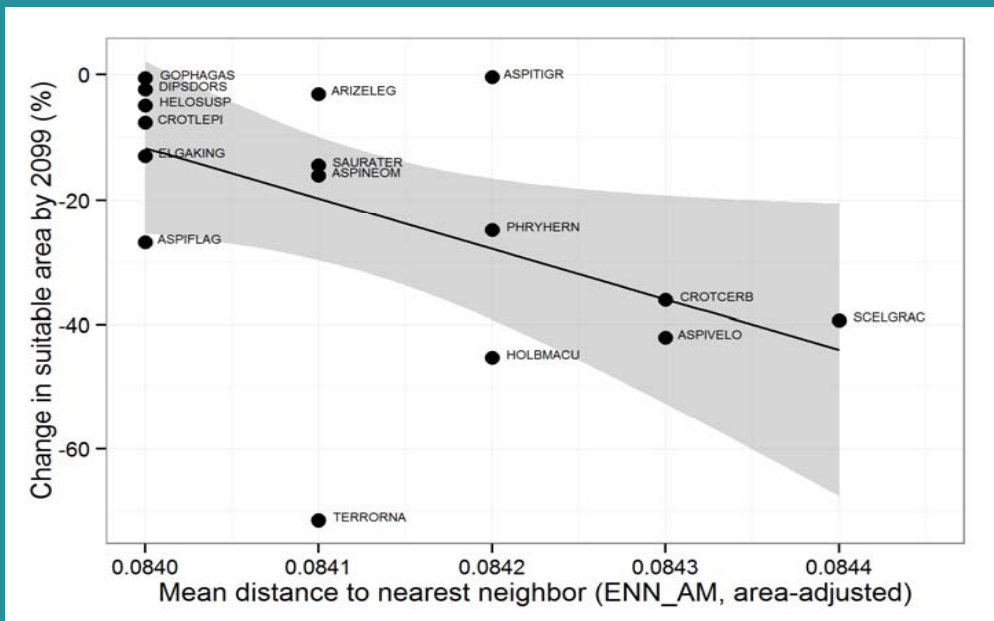


- Birds and reptiles that favor warmer locations (any season) will experience range expansions
- Birds and reptiles that favor wetter locations (spring or summer) will experience range contractions
- Increased patch isolation (fragmentation) results in greater projected range contractions for birds and reptiles

Contemporary patch isolation vs projected future range



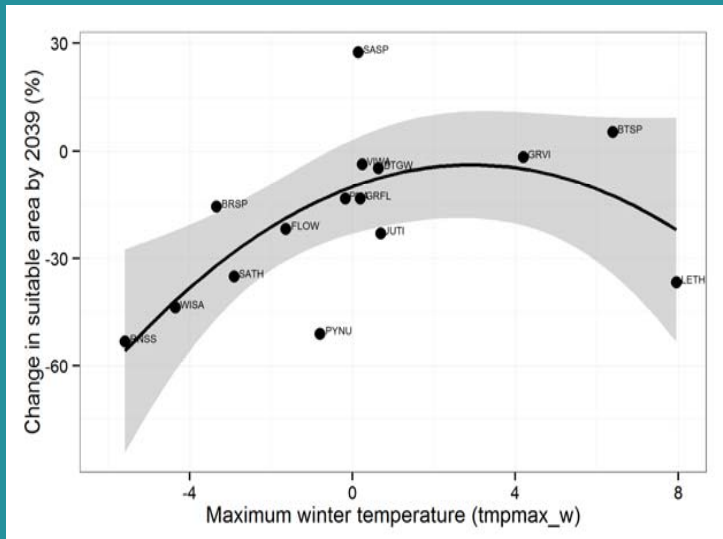
Birds: 2009 vs 2009



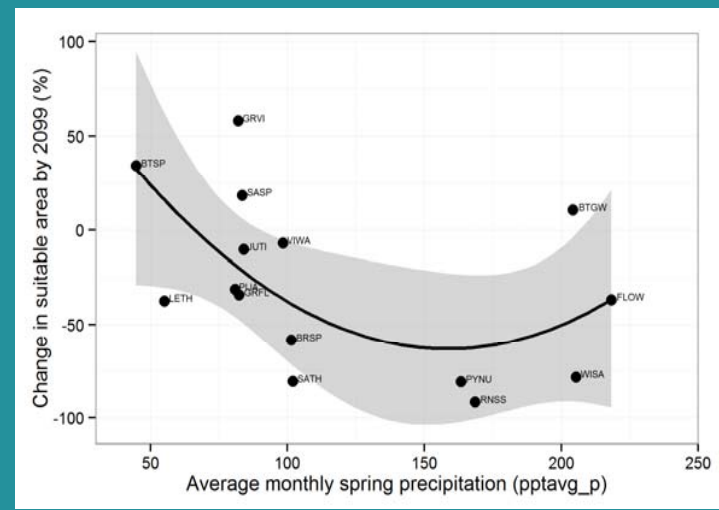
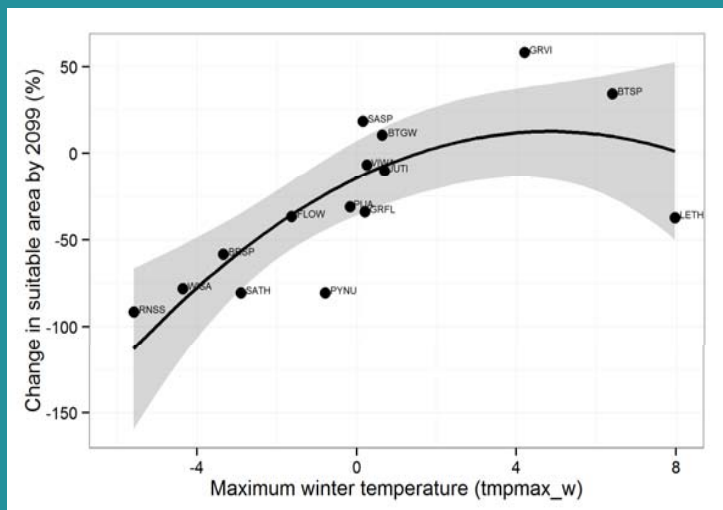
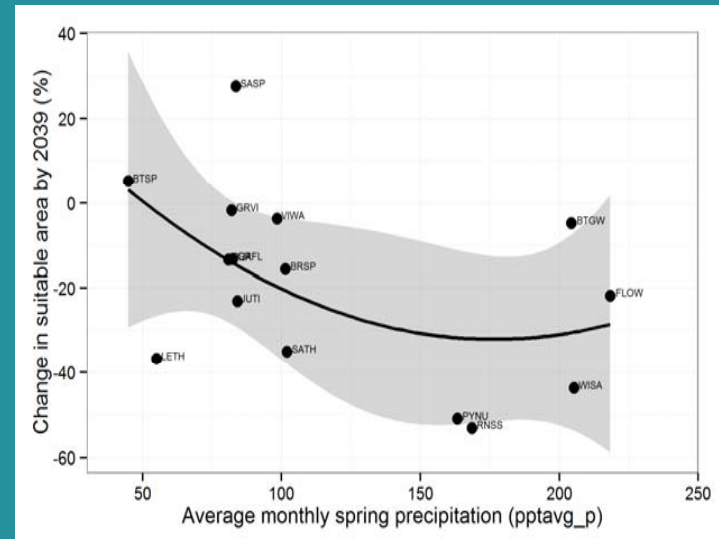
Reptiles: 2009 vs 2009

Contemporary climate (temperature and precipitation) vs projected future range for 15 bird species

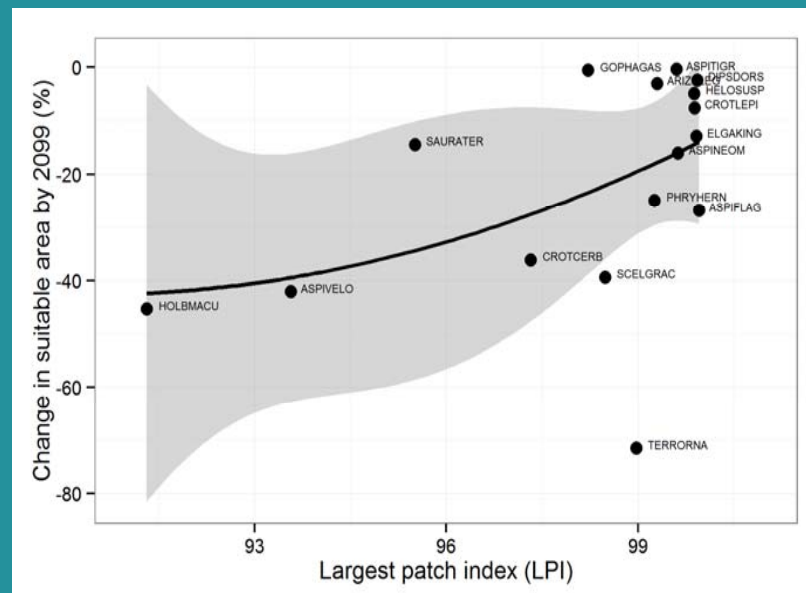
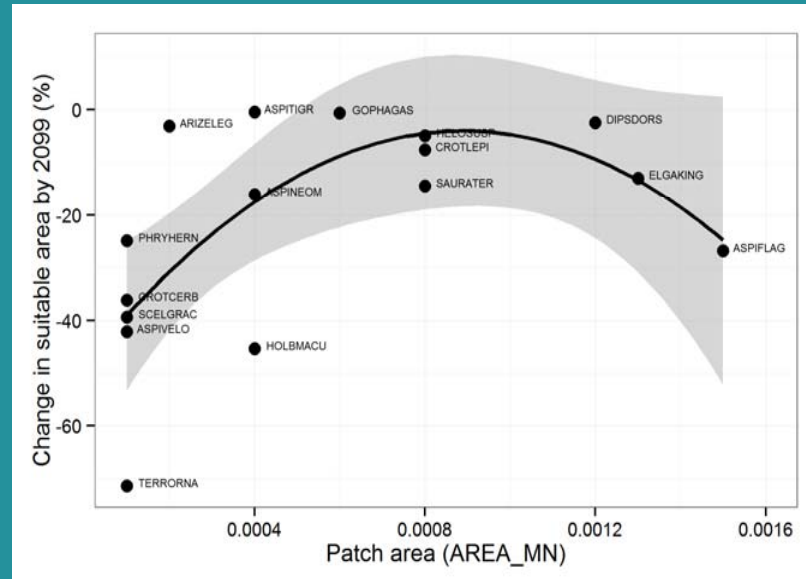
Winter Max Temps



Avg Spring Precipitation



Contemporary patch size versus projected range for 16 reptile species



Conclusions

- Species will respond quite differently to climate change
- Temporally static features and plant dependencies will play a role
- Locally common species (e.g., Pygmy Nuthatch, Arizona Black Rattlesnake) may be at risk in the future
- Forest (e.g., pine, fir) and sagebrush species appear more vulnerable than desert scrub species
- Contemporary patch isolation for reptiles and birds resulted in greater projected range contractions
- Agencies can manage forest and sage ecosystems to reduce habitat fragmentation and species' vulnerabilities to climate change

Acknowledgements

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