# REPRESENTATION OF REPTILE BIODIVERSITY AND ECOSYSTEM SERVICES WITHIN THE PROTECTED AREAS OF THE CONTERMINOUS UNITED STATES


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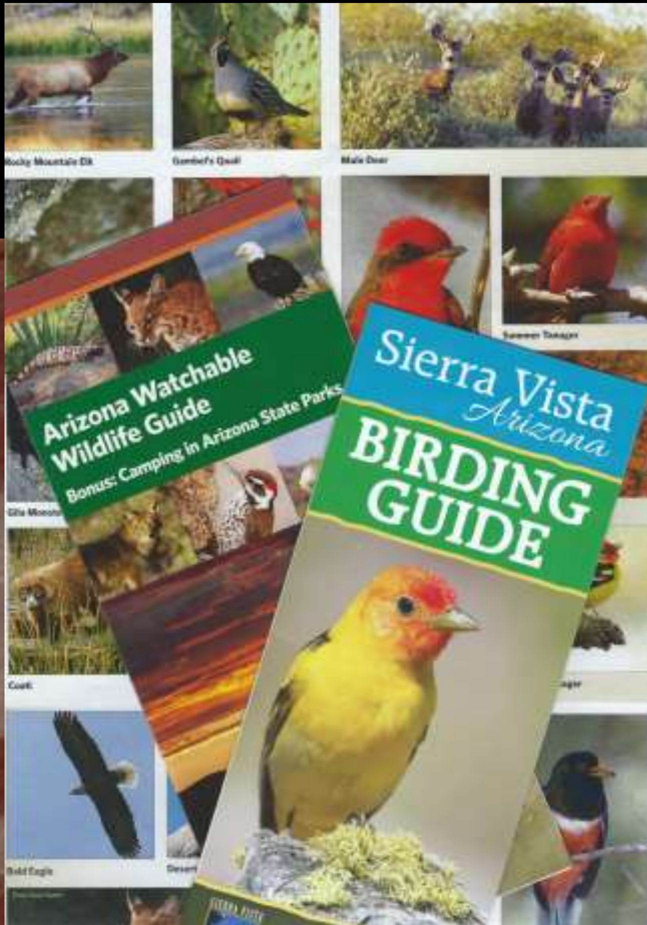
**A Community on Ecosystem Services**
**December 8, 2016**
**Jacksonville, FL**





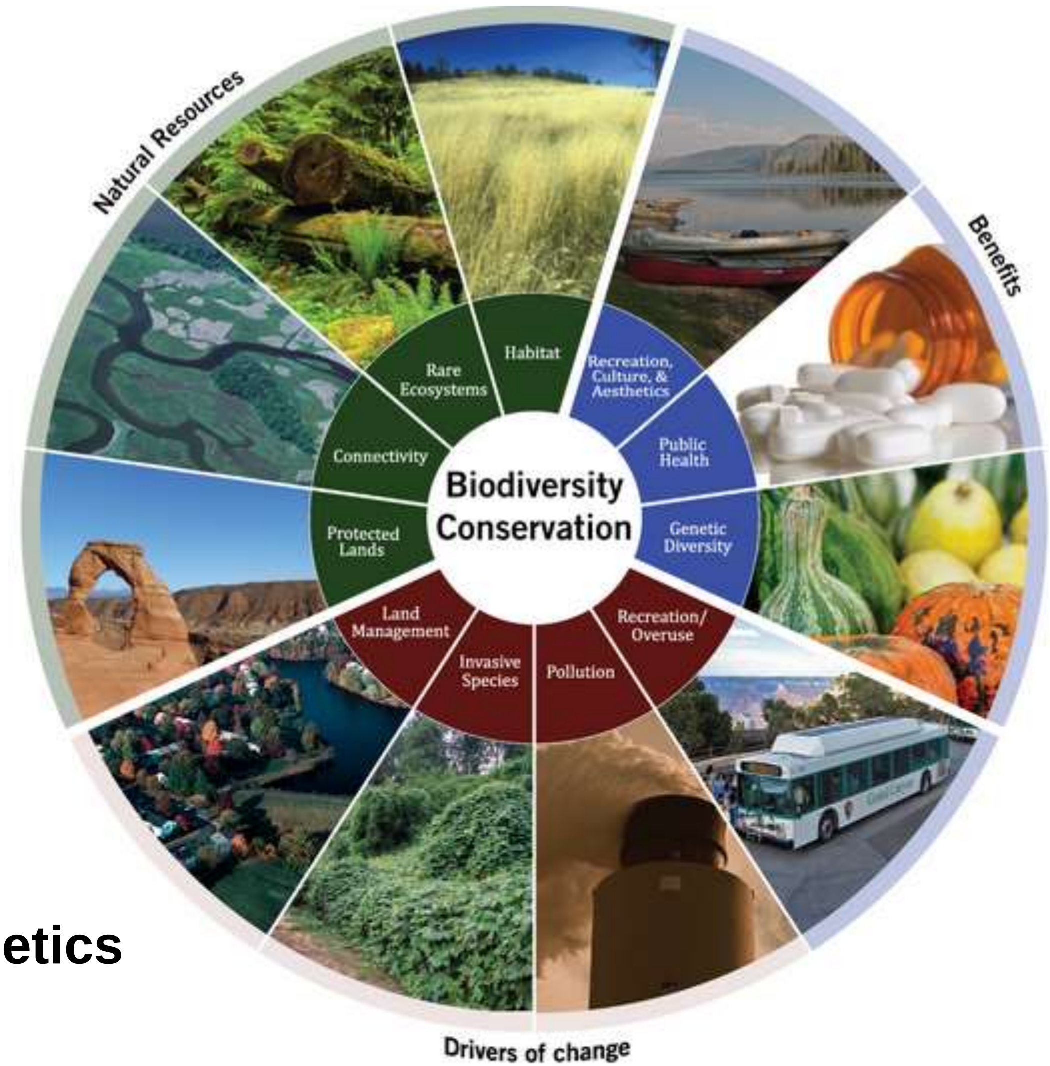
# What about Reptiles?

**Total Species**

***Reptile Spp = 322***

# EnviroAtlas -- Nature's Benefits Categories

- **Clean Air**
- **Clean & Plentiful Water**
- **Biodiversity Conservation**
- **Natural Hazard Mitigation**
- **Climate Stabilization**
- **Food, Fiber & Materials**
- **Recreation, Culture & Aesthetics**



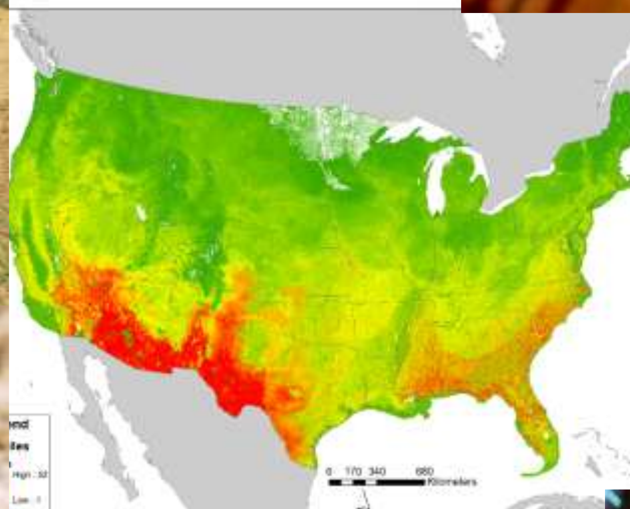
# Gap Analysis Products and Data Sources

- Land Cover
  - 583 classes
  - 556 Natural
  - 27 Land use
- Species Distribution Models
  - Knowledge based/expert based
  - Wildlife Habitat Relationships
  - Habitat based
  - Top down - general to specific
  - 322 Reptile Models
- Protected Areas Database

*http://gapanalysis.usgs.gov/*




Byetta

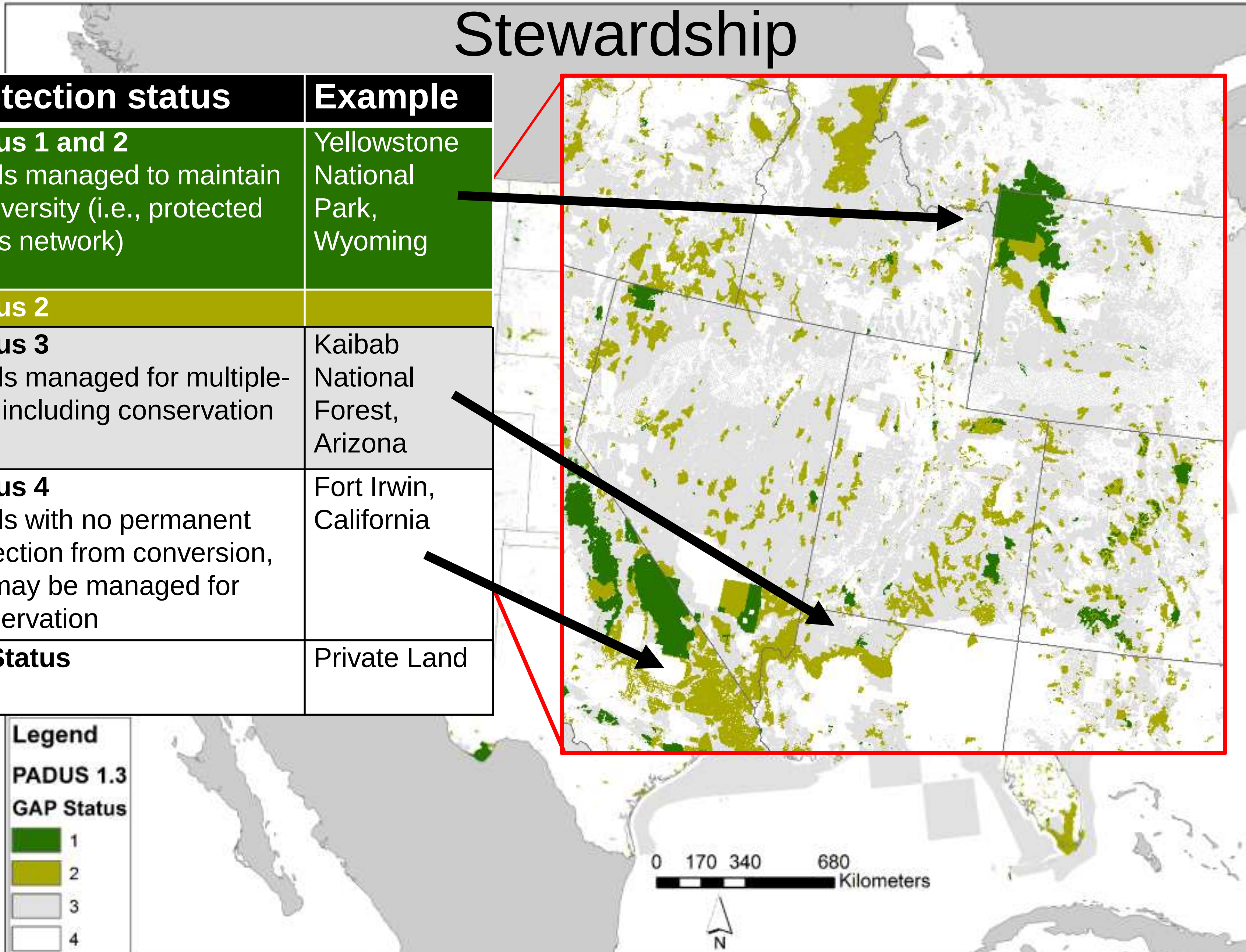


0 170 340 680
Kilometers




National Reptile
Breeders' Expo
Aug. 18th - 20th
The LARGEST REPTILE
MEETING in the WORLD
reptilebreedersexpo.com

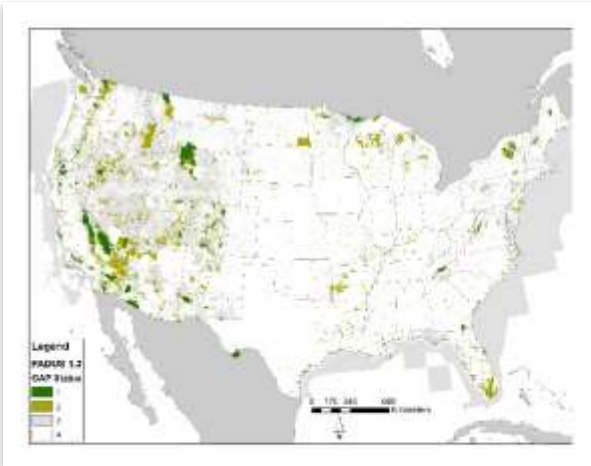

# Stewardship

| Protection status | Example |
|---|---|
| **Status 1 and 2**<br>Lands managed to maintain biodiversity (i.e., protected areas network) | Yellowstone National Park, Wyoming |
| **Status 2** | |
| **Status 3**<br>Lands managed for multiple-use, including conservation | Kaibab National Forest, Arizona |
| **Status 4**<br>Lands with no permanent protection from conversion, but may be managed for conservation | Fort Irwin, California |
| **No Status** | Private Land |



# Approach

National PADUS



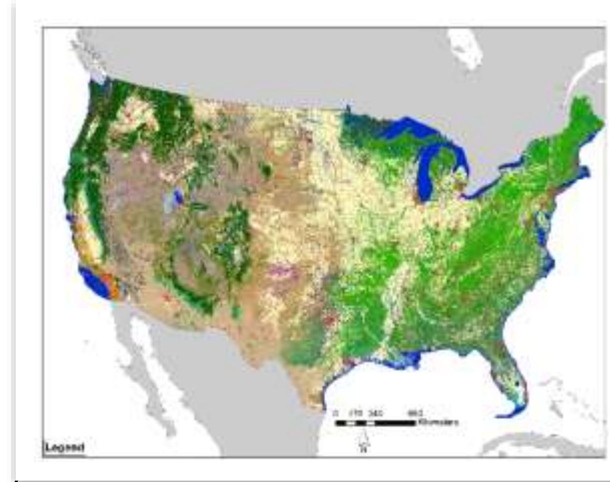
Gap Status

Status 1 & 2 – Protected Lands

Status 3 – Multiple Use Lands

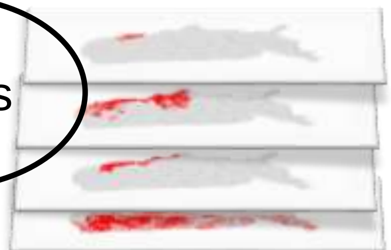
Status 4 and No Status – Other lands

National Land Cover Data Set



National Reptile Data Sets

Models



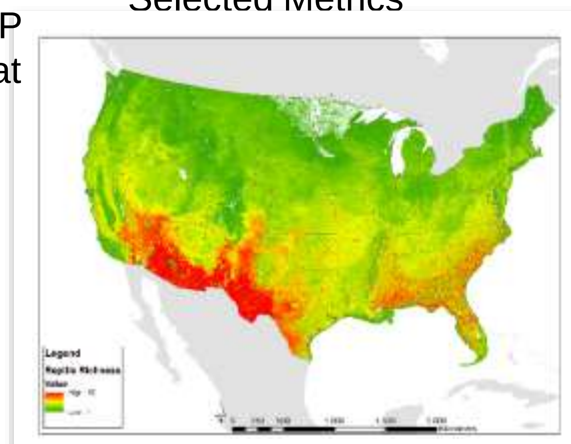
Biodiversity Areas

**Analyze**
areas of species richness of each biodiversity metric by Gap Status areas

Stakeholders

Biodiversity Metrics derived from GAP Deductive Habitat Models

Selected Metrics



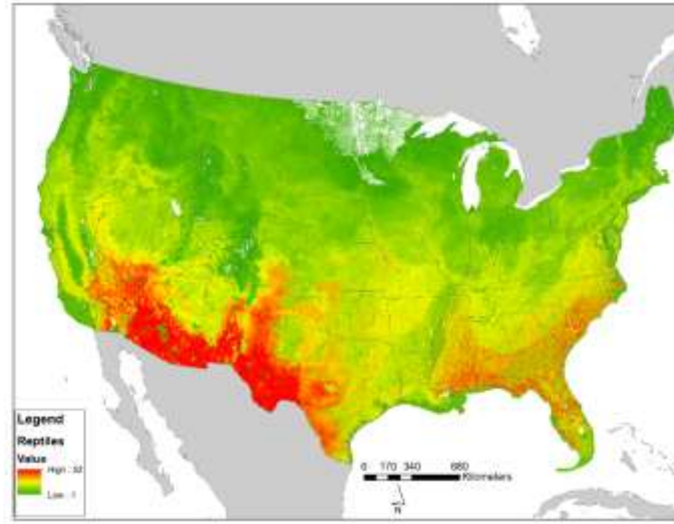
Analysis
- Species Richness
- Aiche Biodiversity (17% protected area)

# Reptile Ecosystem Services

Biodiversity

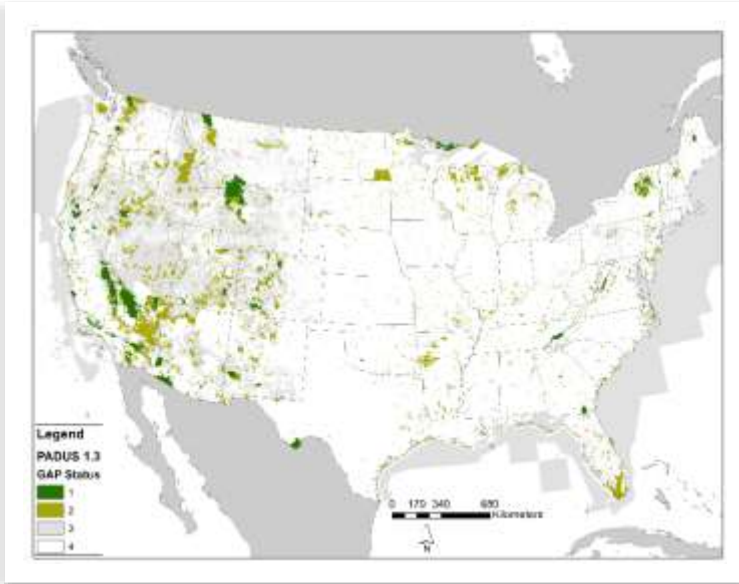
Recreation, culture, aesthetics

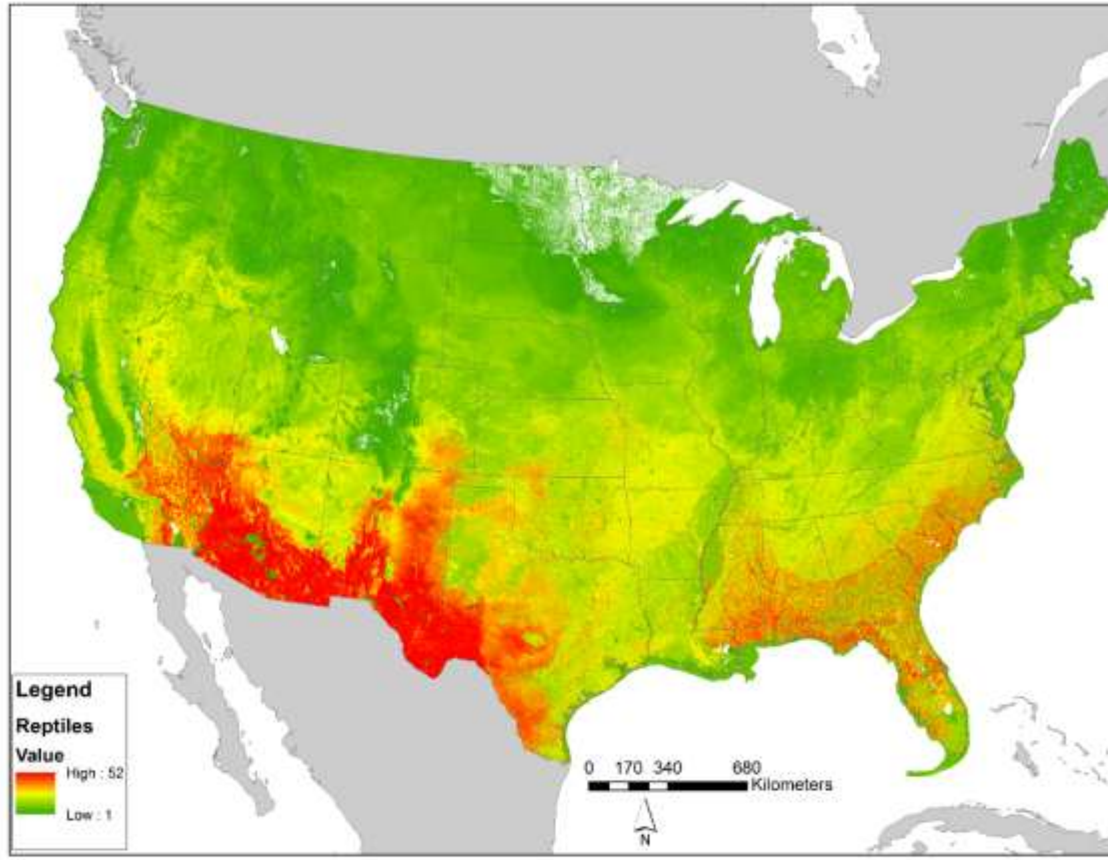
Regulatory (Endangered Species Act)

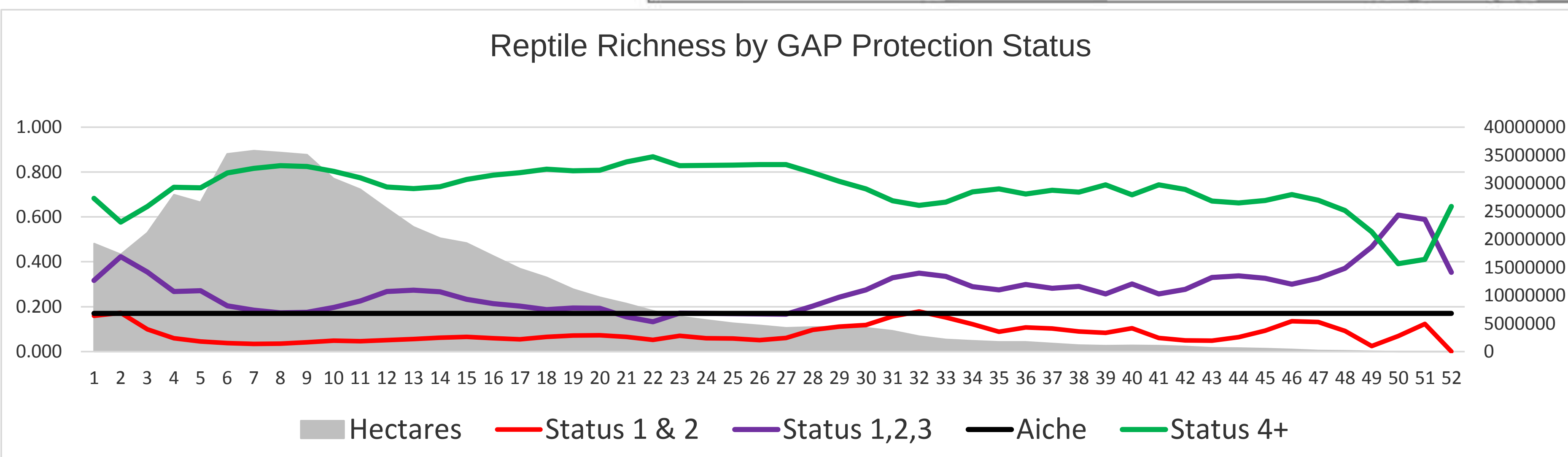



All Reptiles
Lizards
Snakes
Turtles
G1, G2, G3
IUCN
Threatened and Endangered

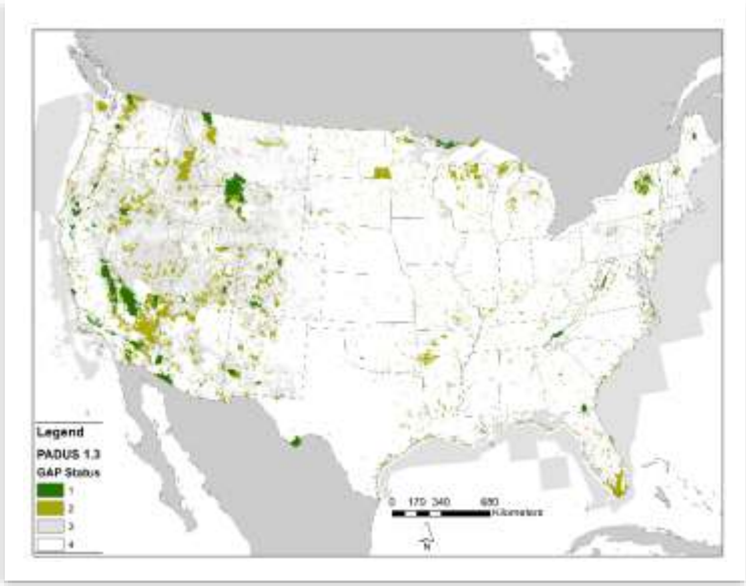
# All Reptiles

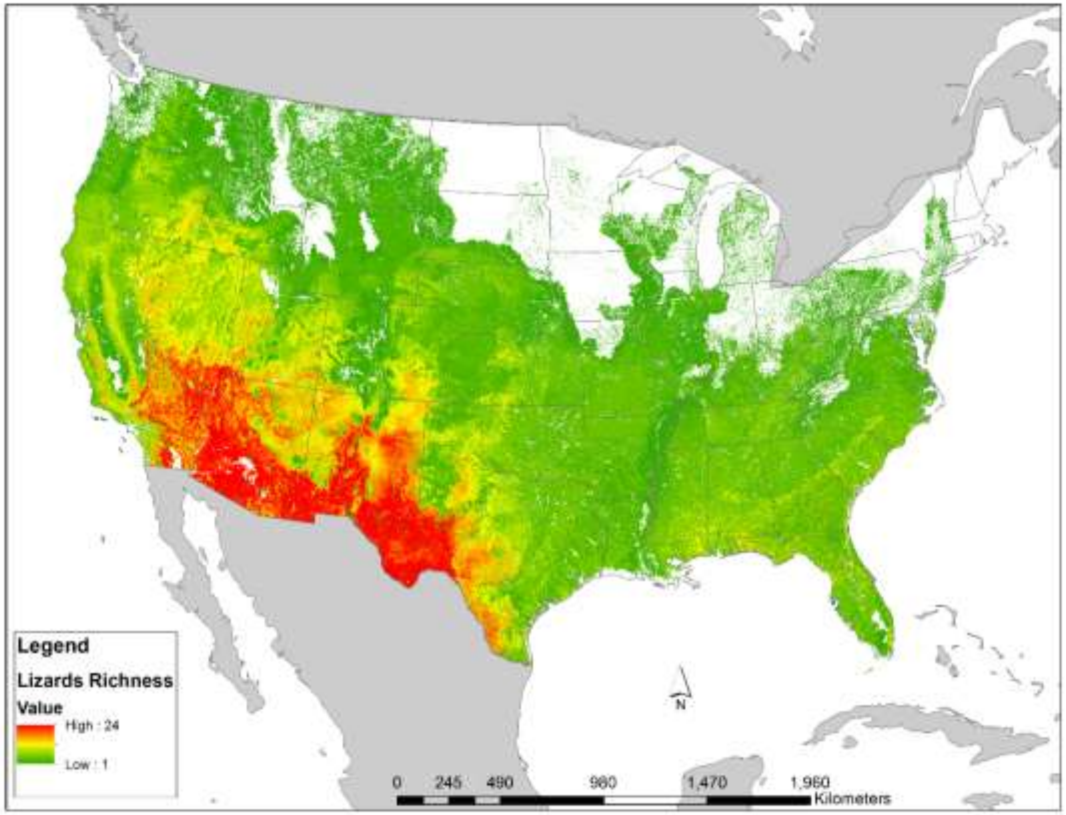


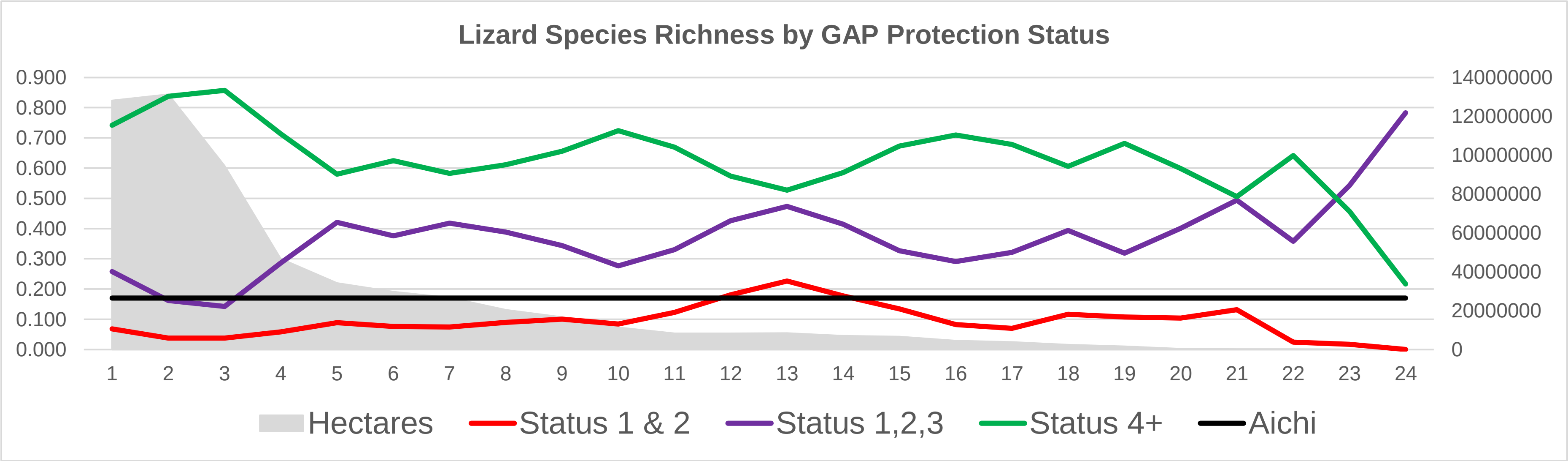



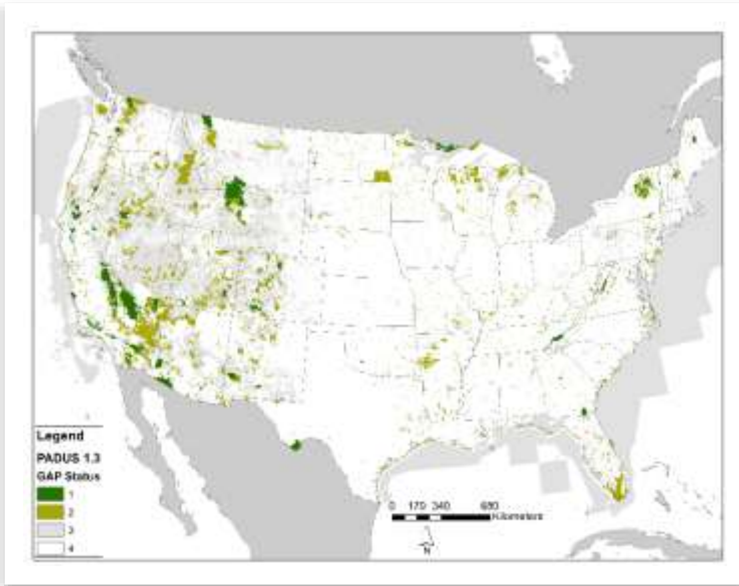
# Lizards

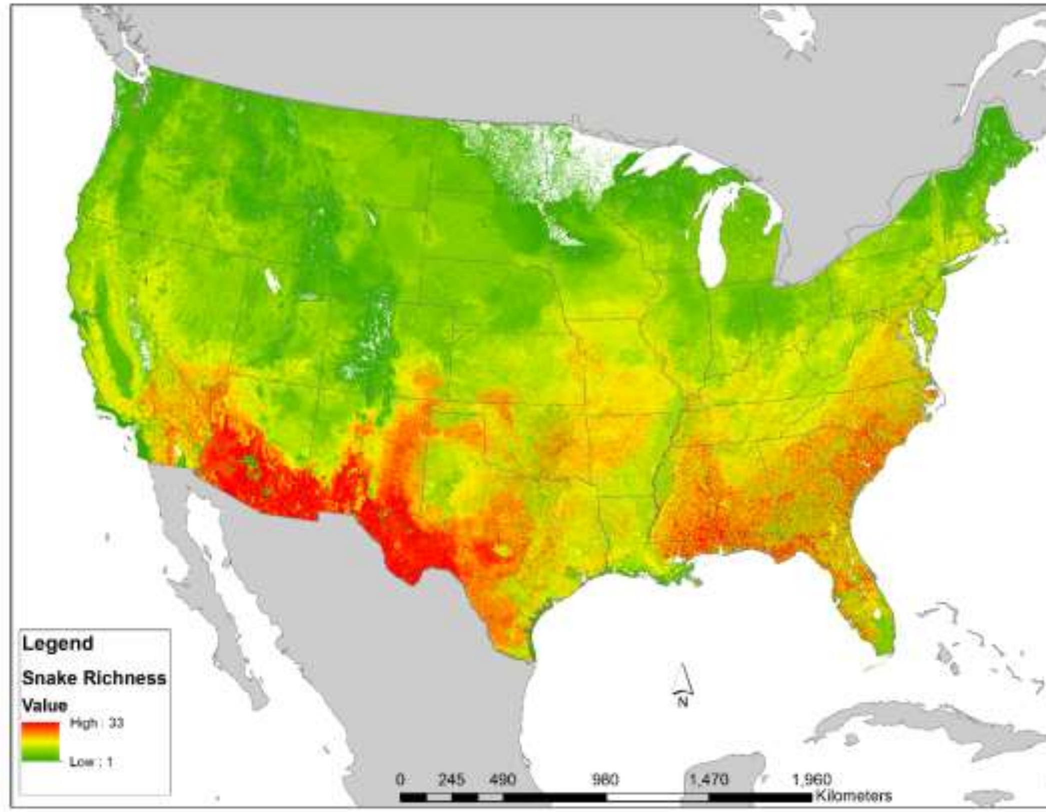

Legend
PADUS 1.3
GAP Status
1
2
3
4
0 170 340 680
Kilometers
N

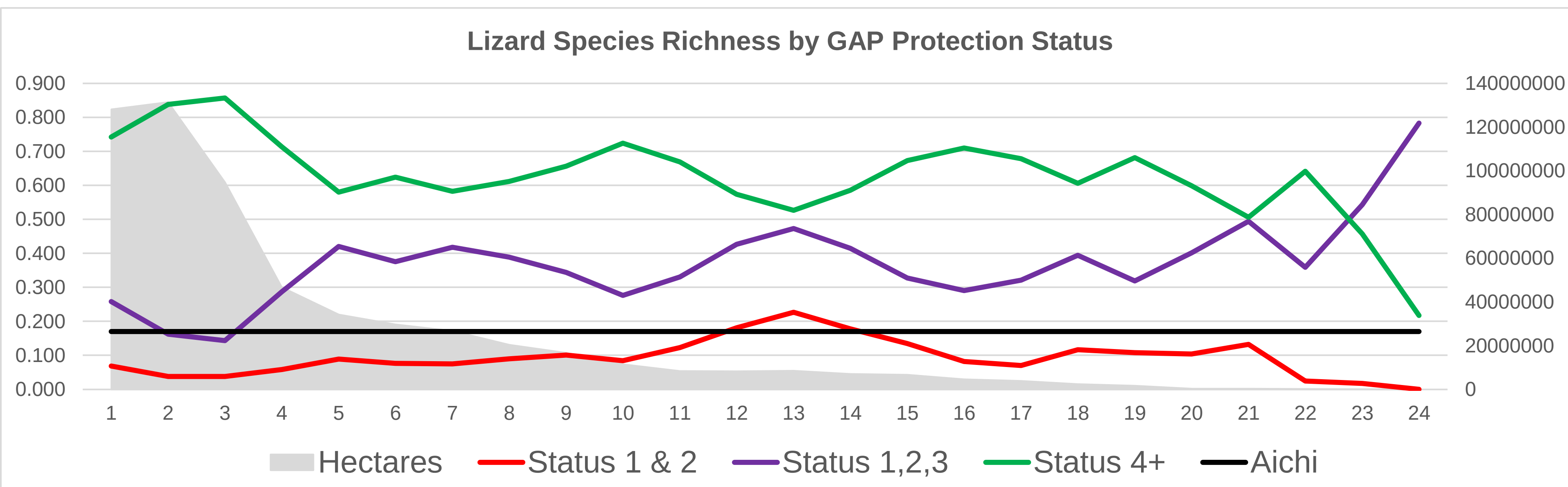

Legend
Lizards Richness
Value
High : 24
Low : 1
0 245 490 980 1,470 1,960
Kilometers
N


Lizard Species Richness by GAP Protection Status
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
140000000
120000000
100000000
80000000
60000000
40000000
20000000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hectares
Status 1 & 2
Status 1,2,3
Status 4+
Aichi

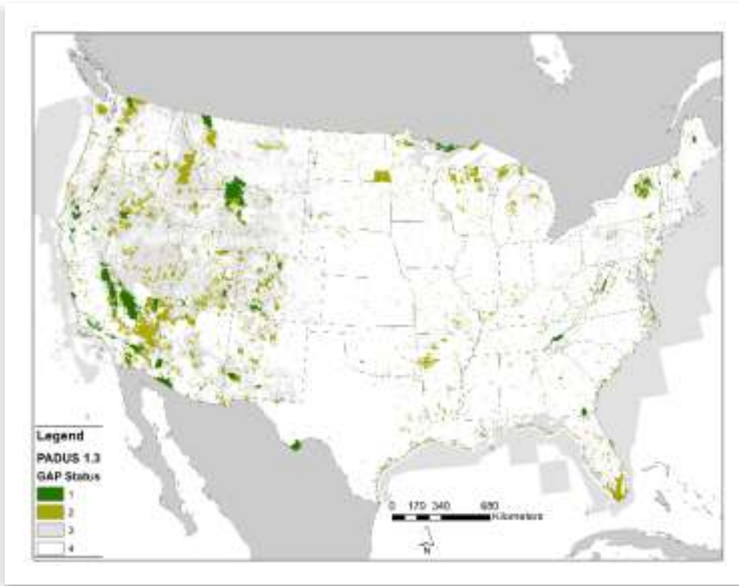
# Snakes

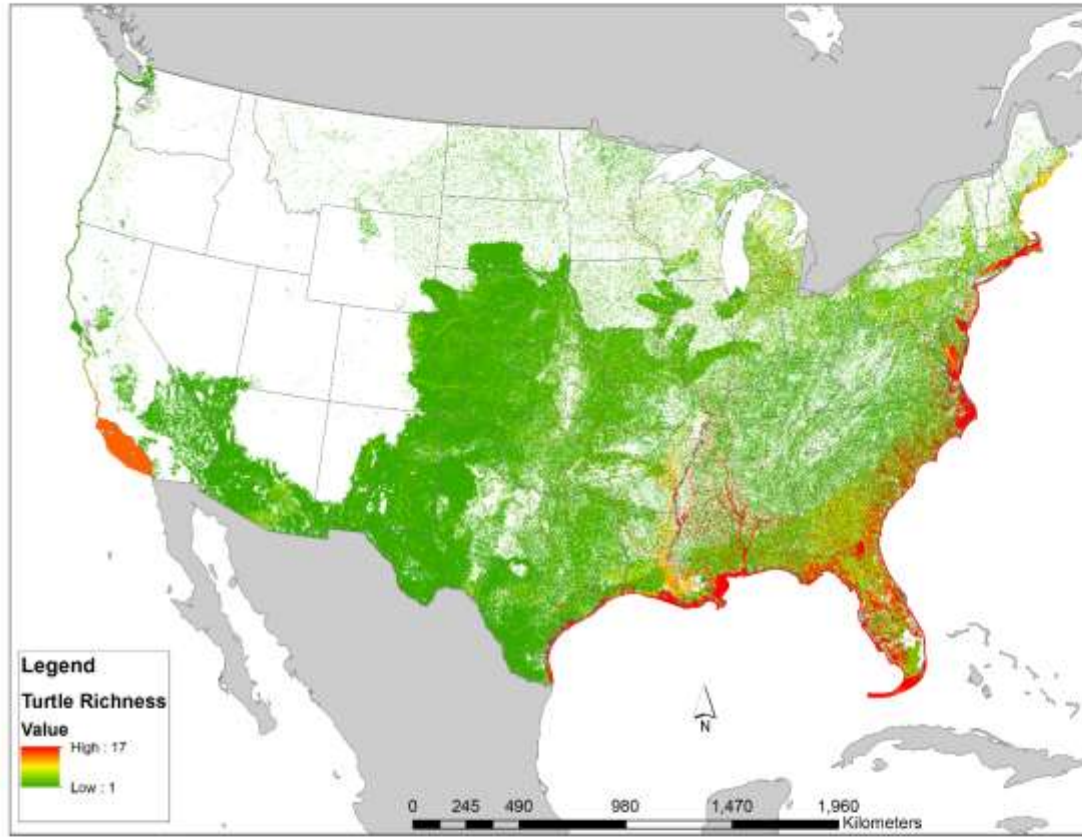

Legend
PADUS 1.3
GAP Status
1
2
3
4
0 170 340 680
Kilometers

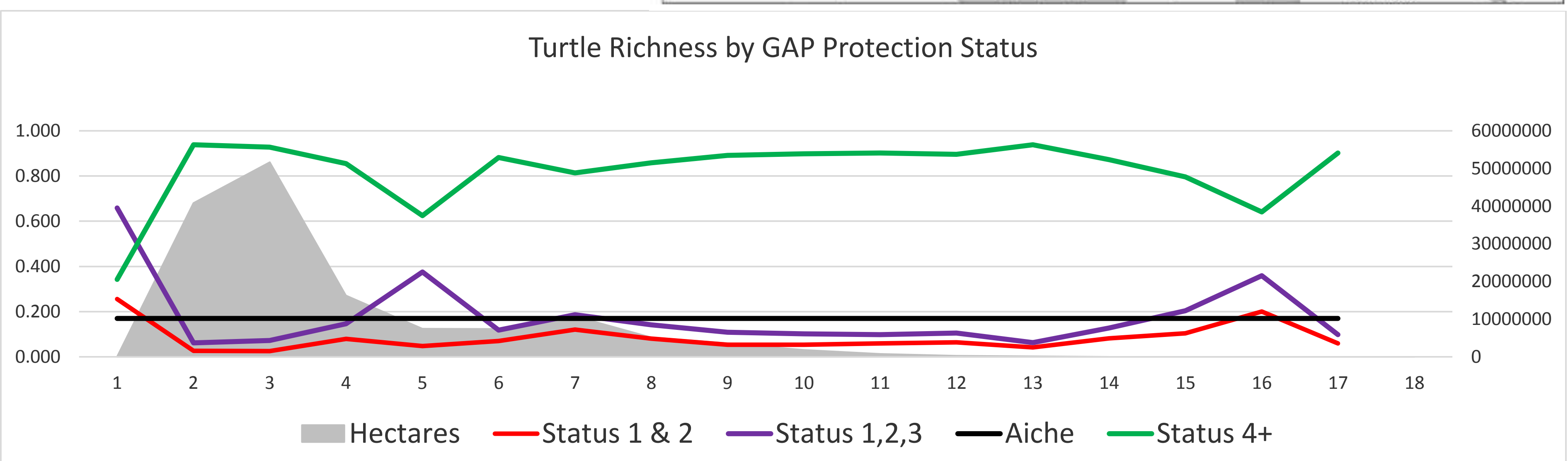

Legend
Snake Richness
Value
High : 33
Low : 1
N
0 245 490 980 1,470 1,960
Kilometers


Lizard Species Richness by GAP Protection Status
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
140000000
120000000
100000000
80000000
60000000
40000000
20000000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hectares
Status 1 & 2
Status 1,2,3
Status 4+
Aichi

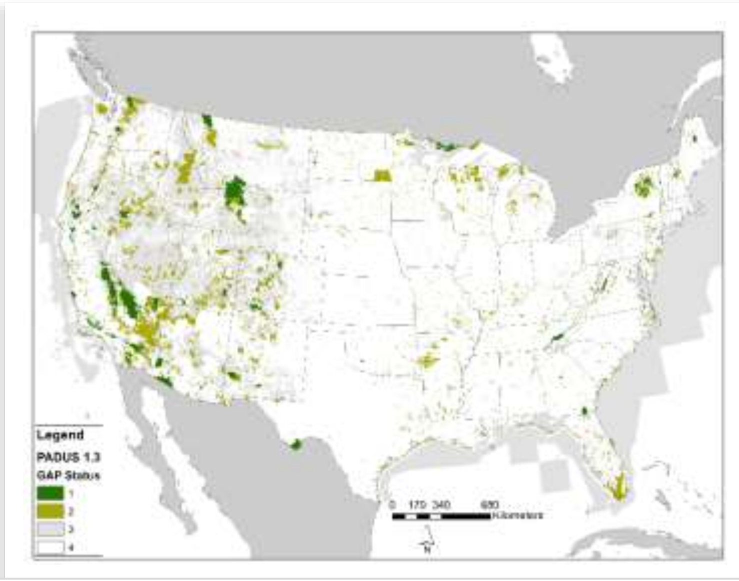
# Turtles

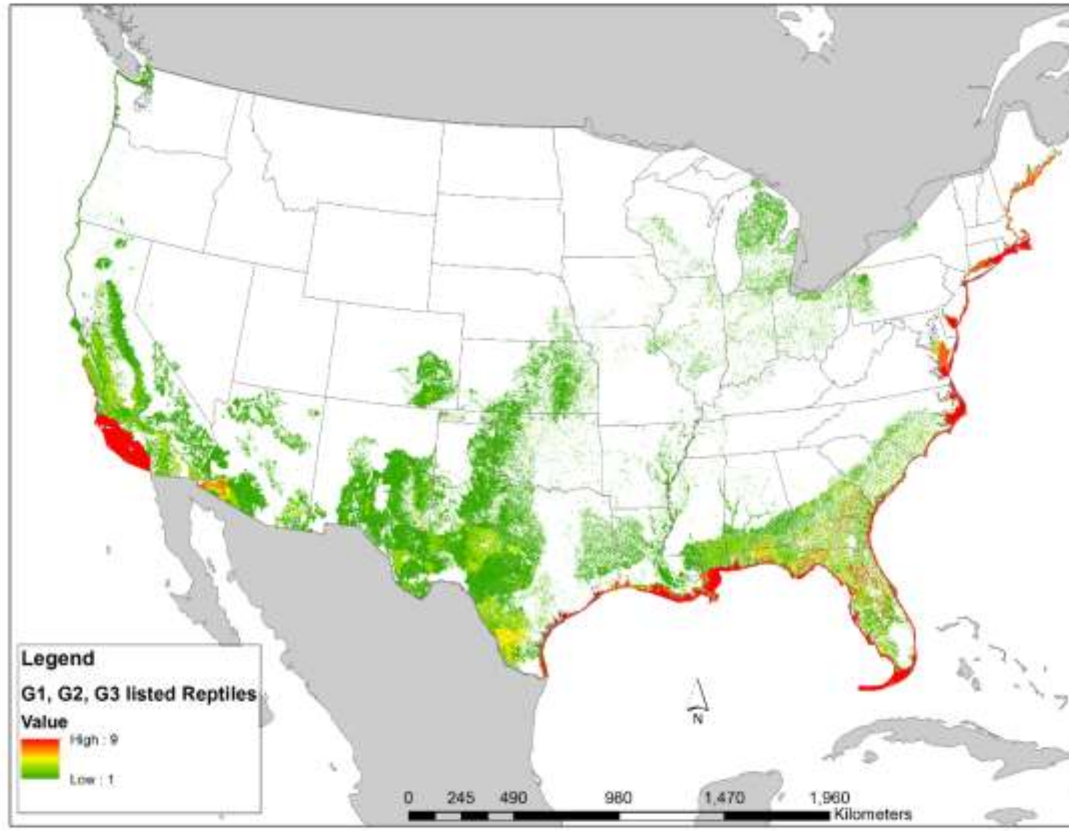

Legend
PADUS 1.3
GAP Status
1
2
3
4
0 170 340 680
Kilometers
N

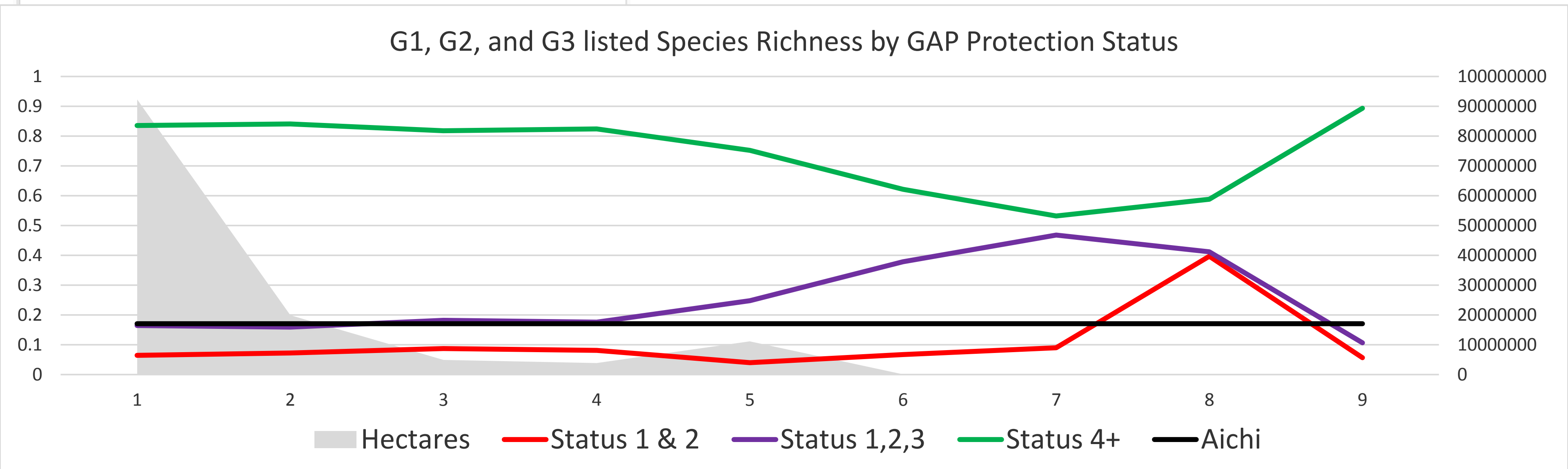

Legend
Turtle Richness
Value
High : 17
Low : 1
0 245 490 980 1,470 1,960
Kilometers
N


Turtle Richness by GAP Protection Status
1.000
0.800
0.600
0.400
0.200
0.000
60000000
50000000
40000000
30000000
20000000
10000000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Hectares
Status 1 & 2
Status 1,2,3
Aiche
Status 4+

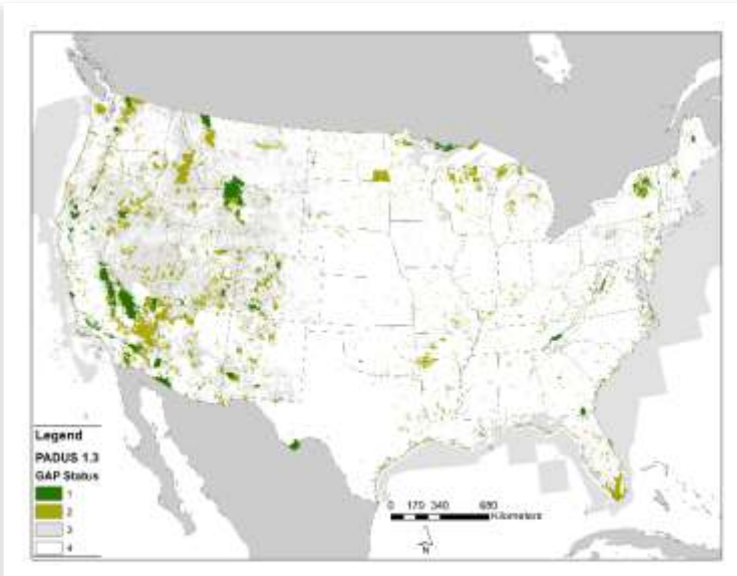
# G1, G2, G3 Species

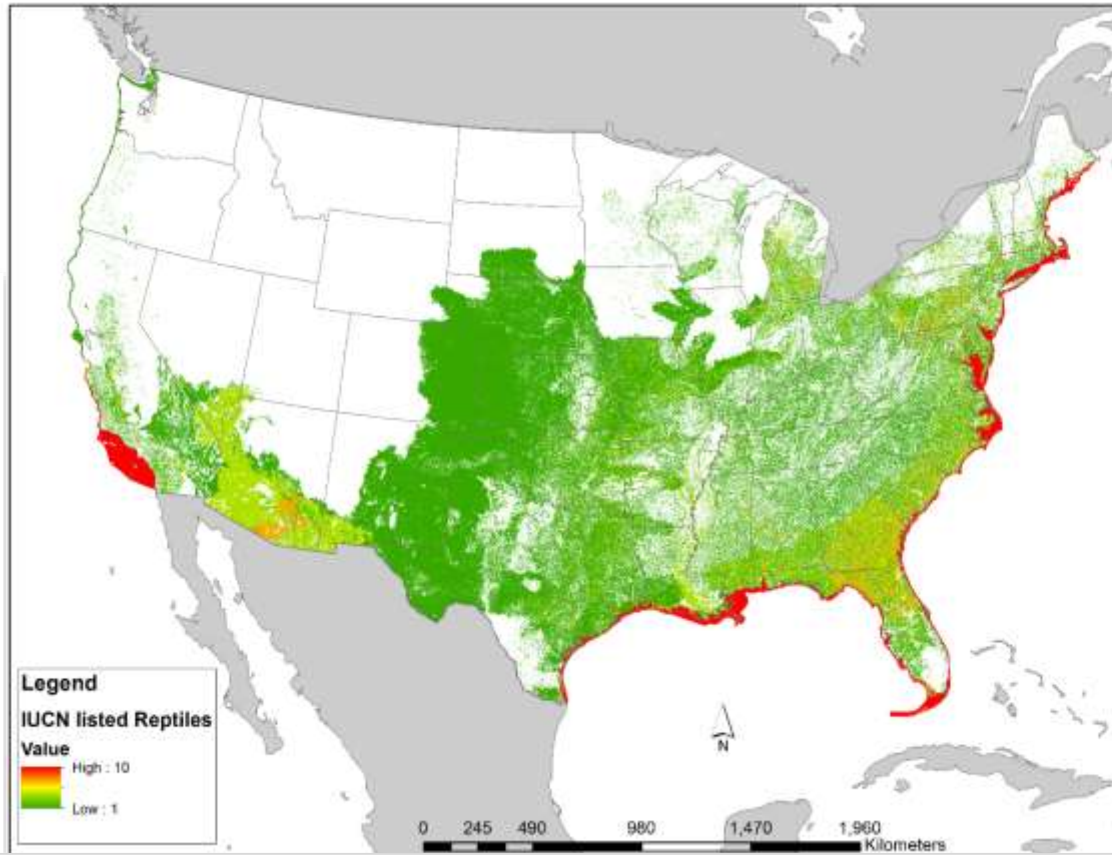


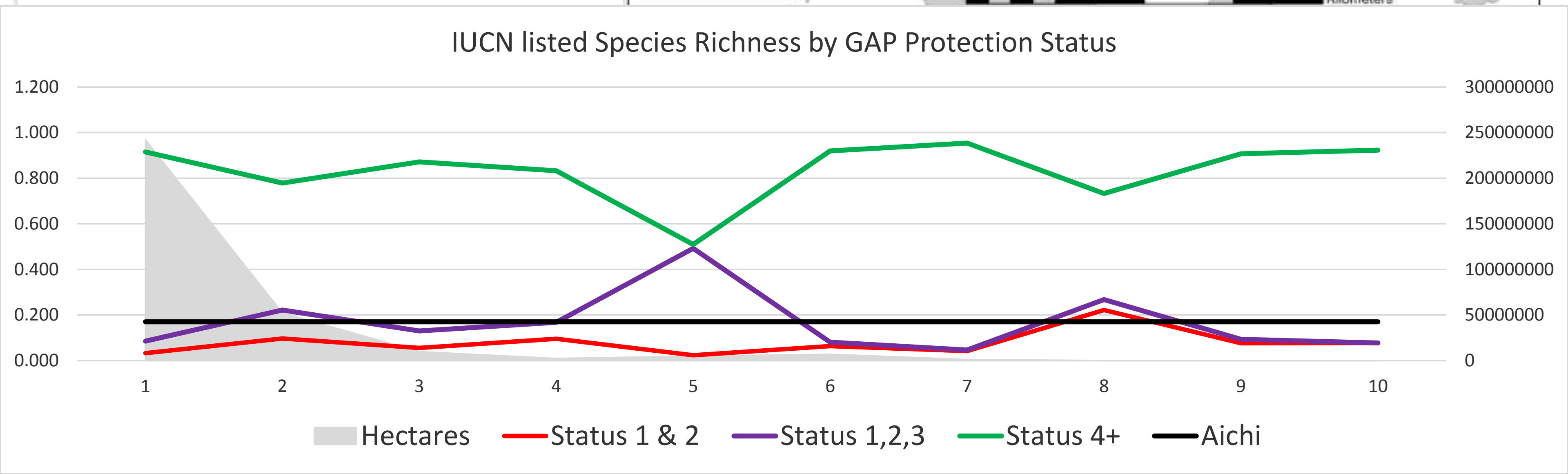



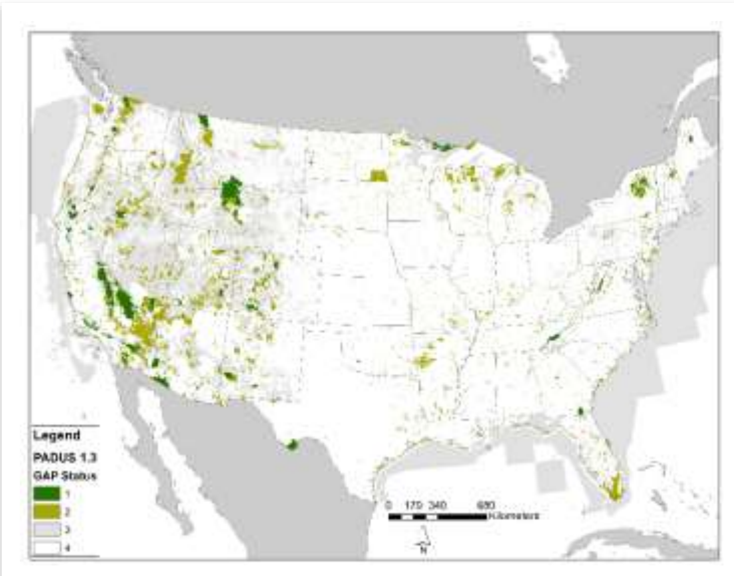
# IUCN Species

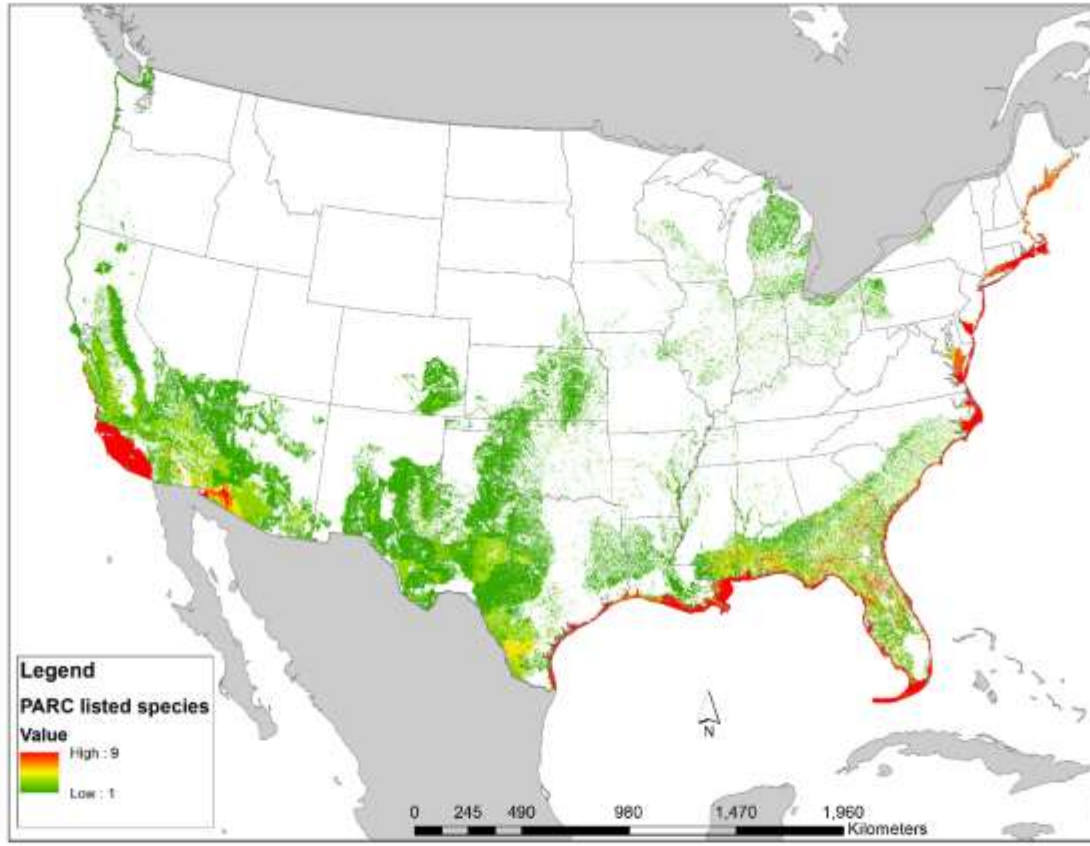


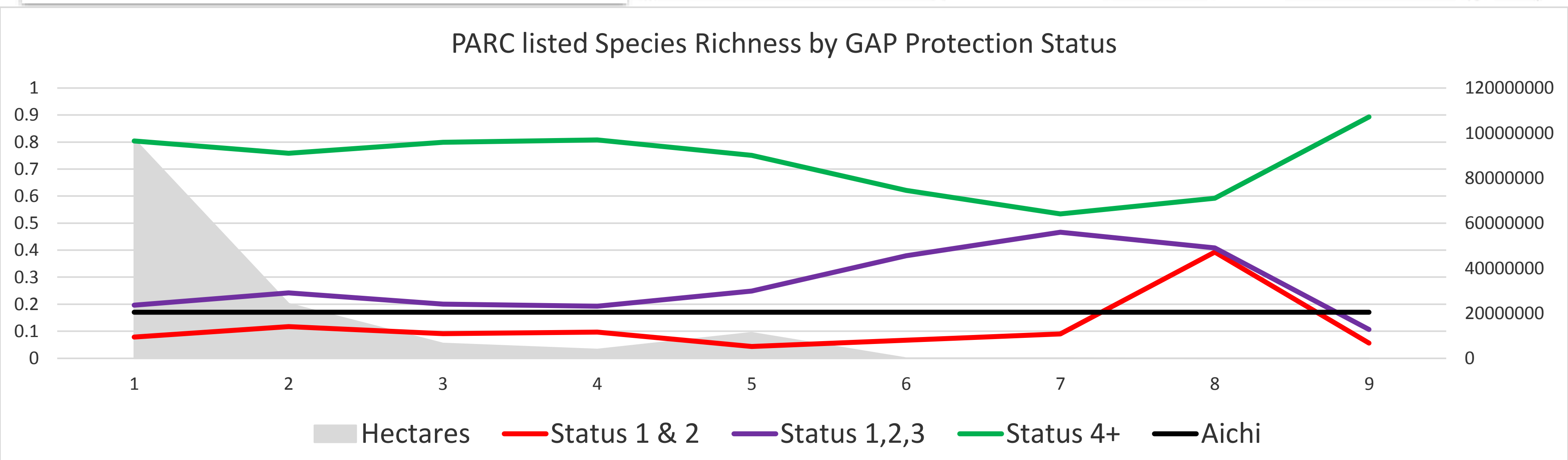



# PARC Species

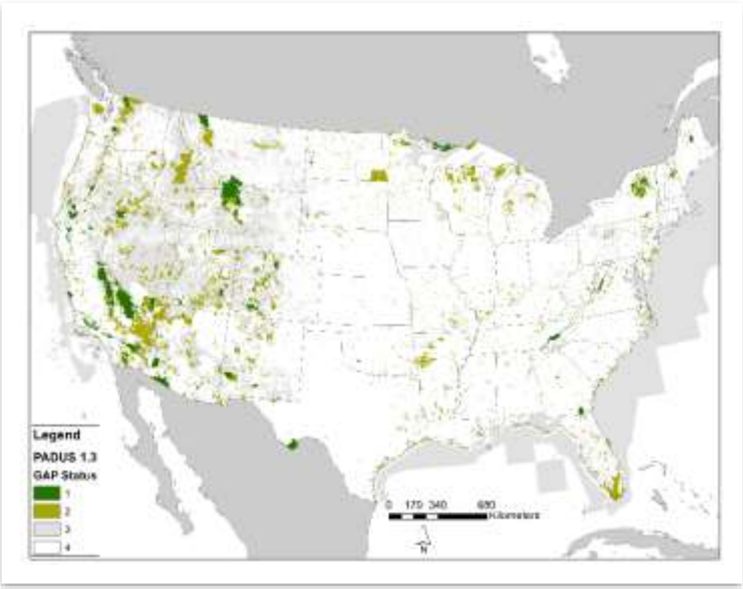


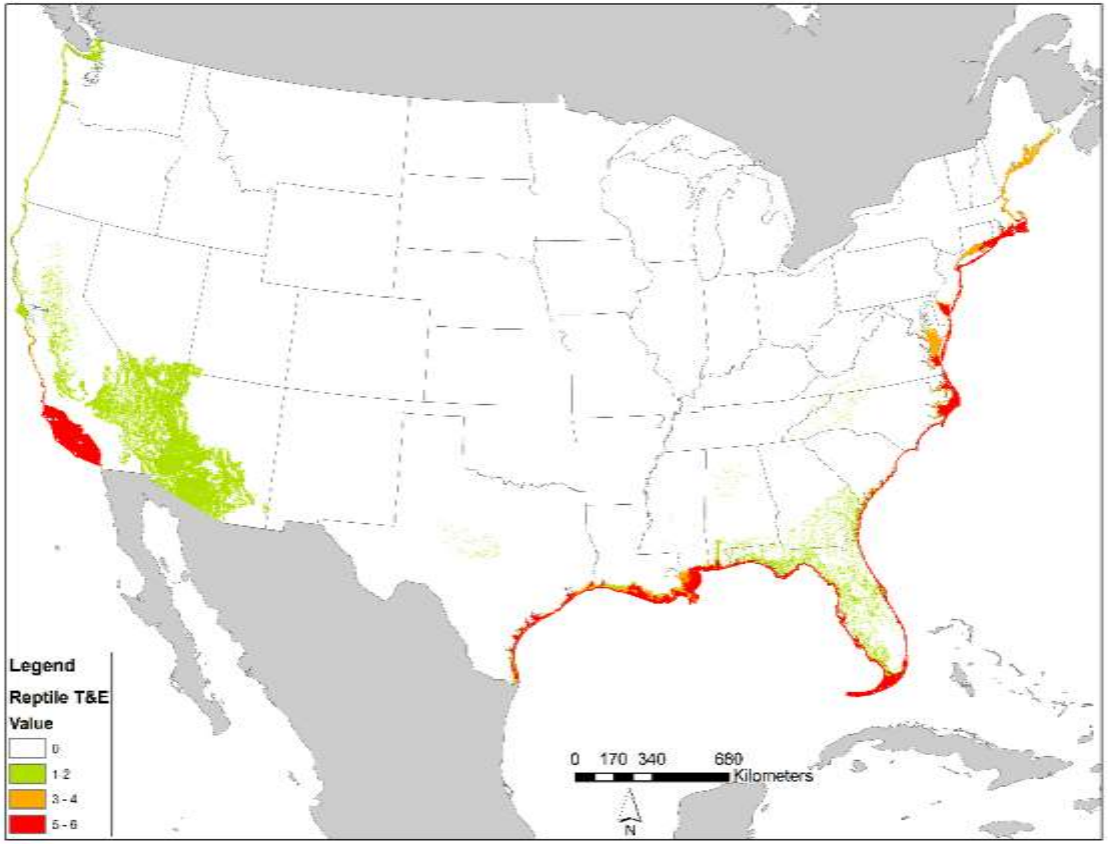



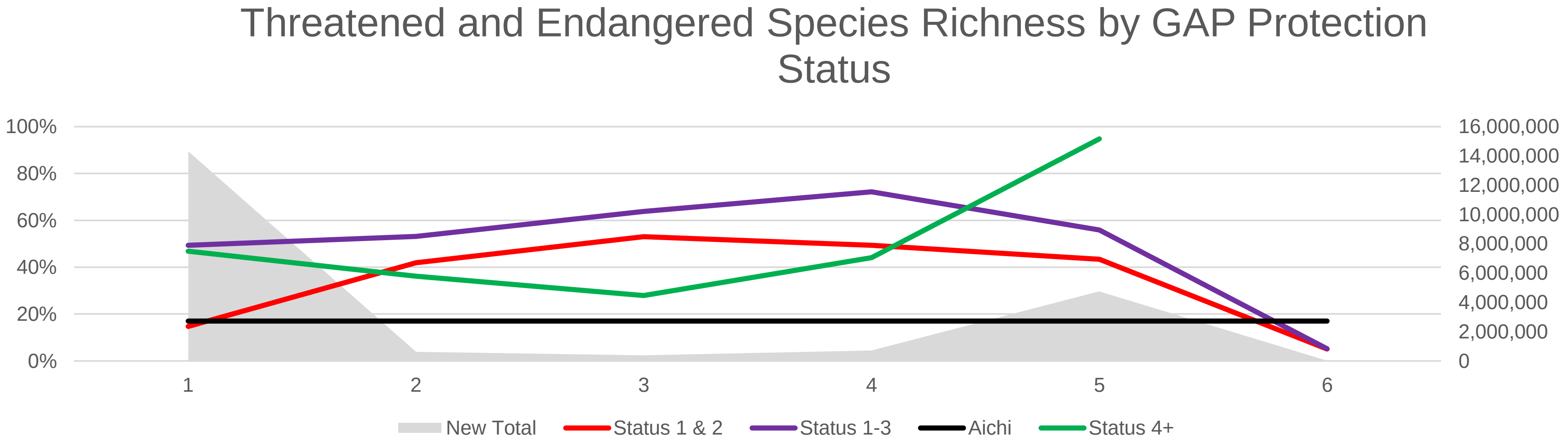



# T & E Species

## Threatened and Endangered



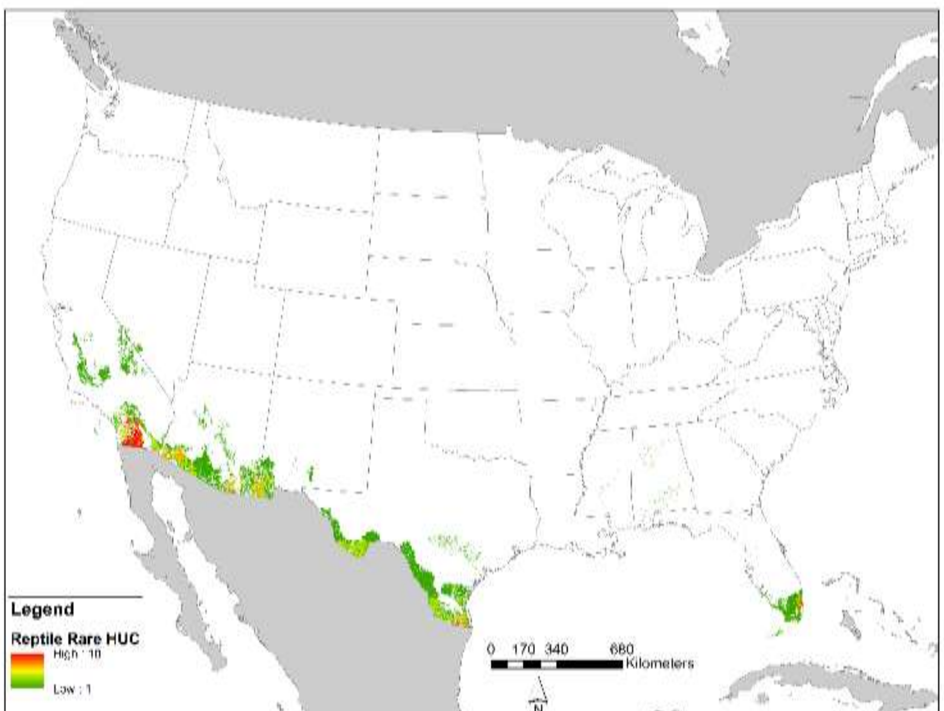



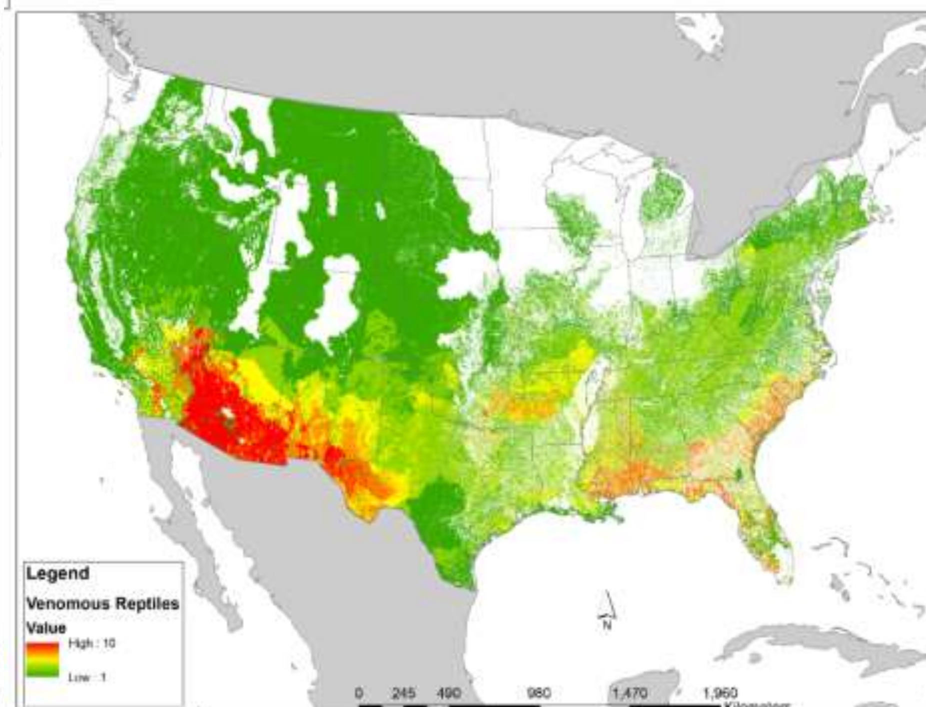



# Other Metrics

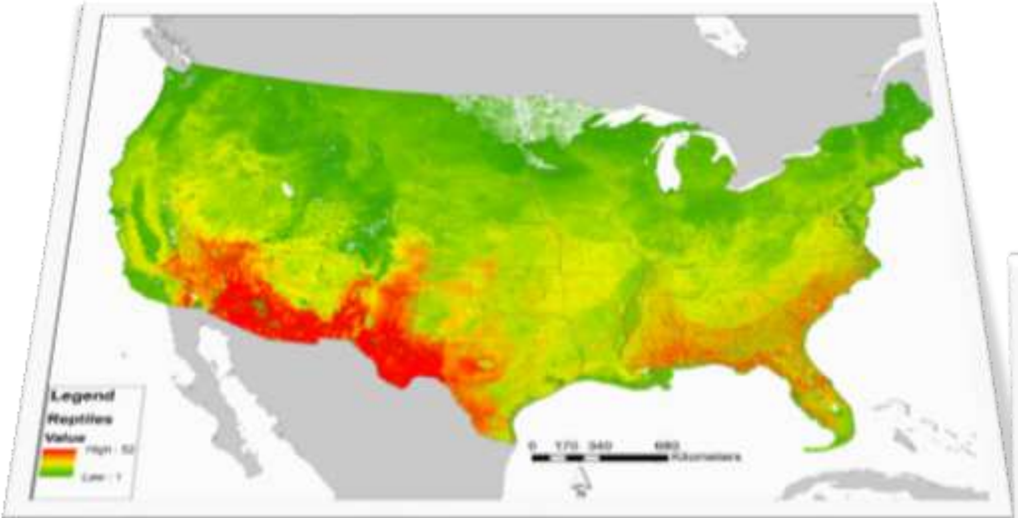

Rare - Area modeled
Rare – Number of HUCs

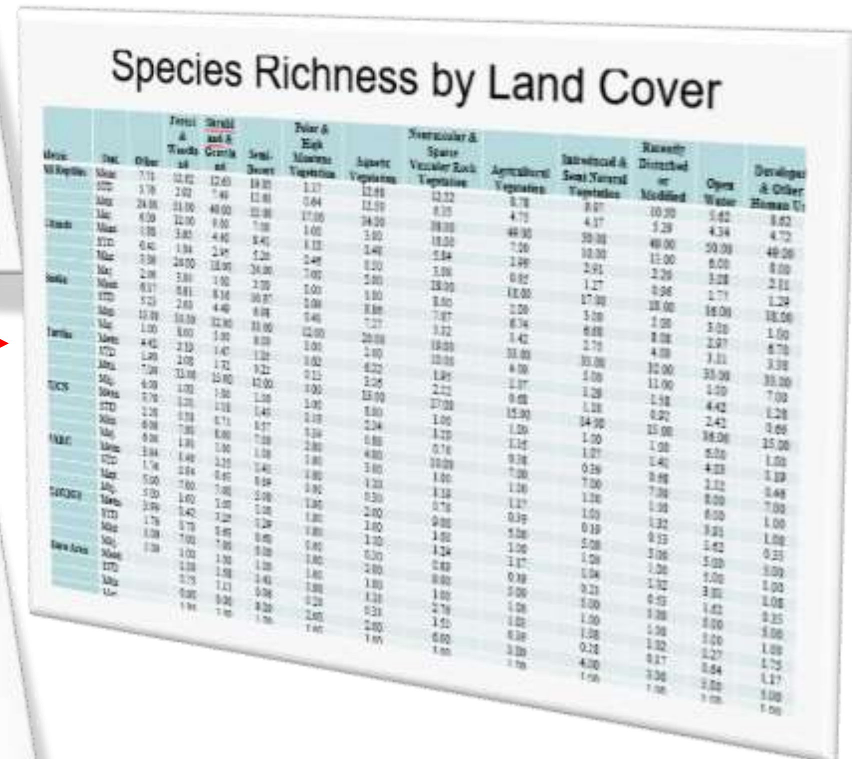
Venomous Reptiles

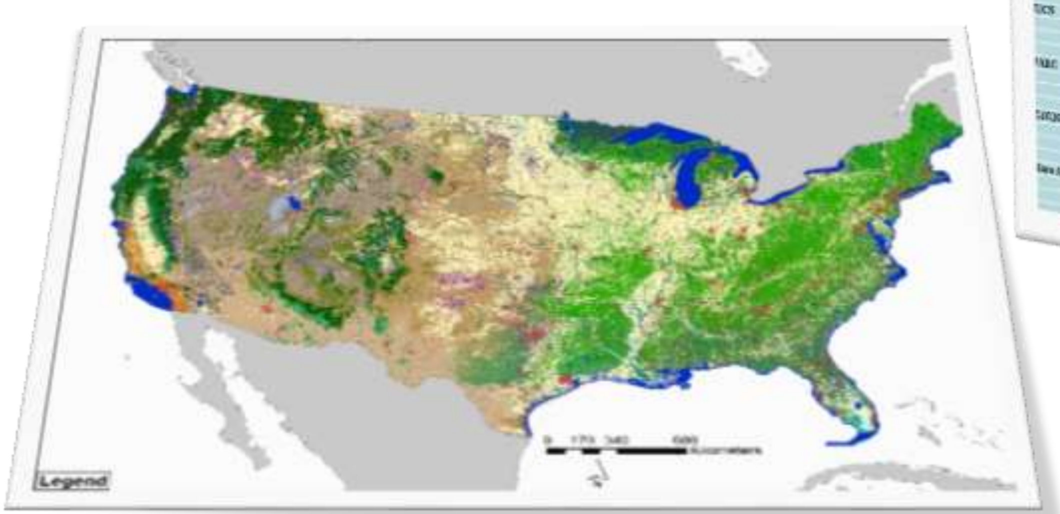


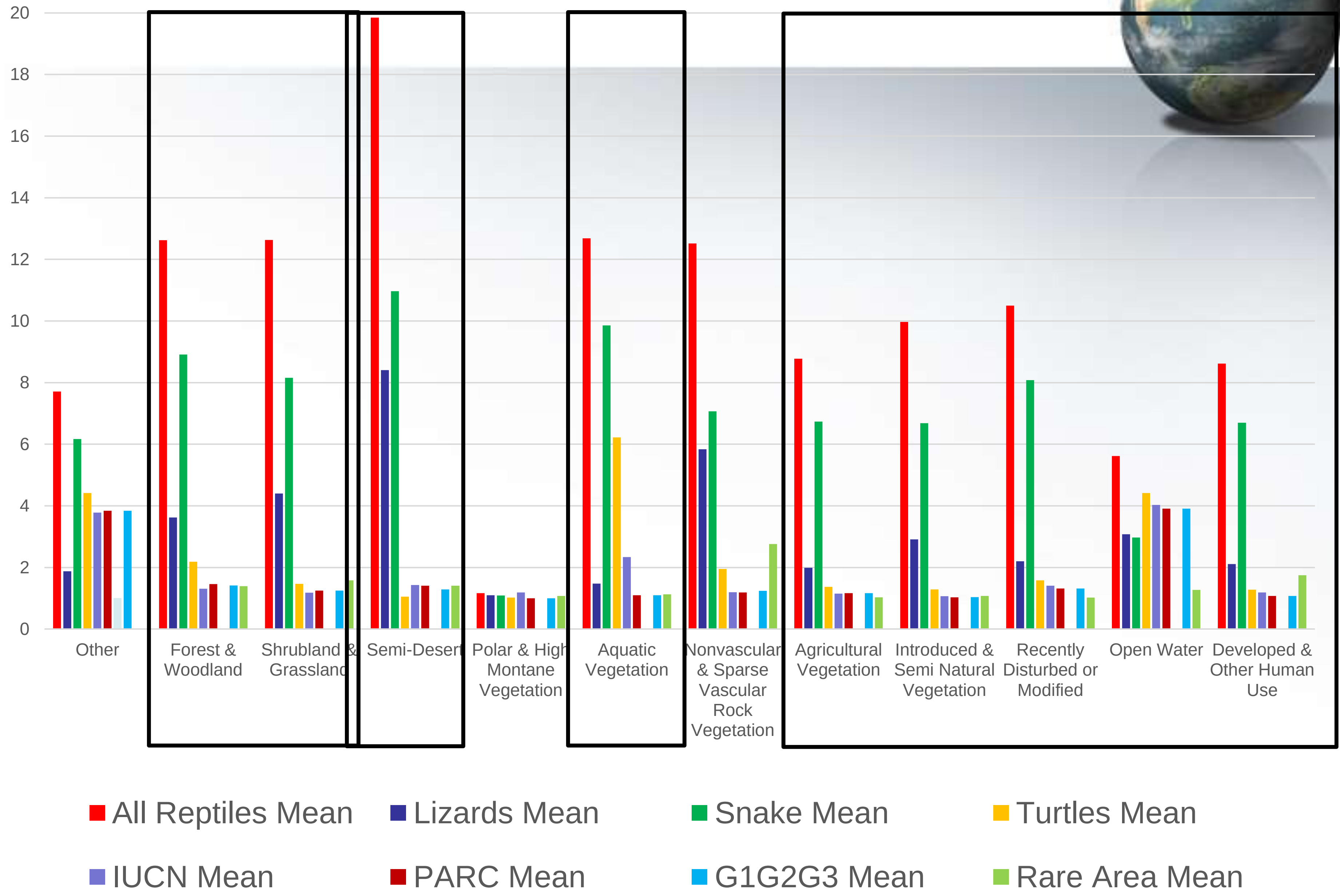
# Richness by Land Cover



# Reptile Richness per NLCD Category



# Conclusions

- Metrics suggest current Protected Lands system are not sufficient;
    - For all metrics
- Metrics suggest current Status 1-3 Lands are sufficient
    - All Reptiles, Lizards, Snakes, G1G2G3 and PARC
    - Marginally Turtles and IUCN
- Other Lands (not Status 1,2, and 3) are sufficient

# Conclusions

- Semi-Desert has the most richness
- Forest/Woodlands and Shrubs/Grasslands next
- Turtles are high in aquatics
- Relatively high richness is modified lands
  - Snakes
- Reptiles are an interesting ES model because:
  - Understudied
  - General fear and loathing

•Ecosystem Services can play an important part in Conservation

# Reptile Ecosystem Services

| Benefit Category EnviroAtlas | Function, Service, Goods | Description |
|---|---|---|
| Food, fuel and materials | Food | Turtles and tortoises are eaten across the world.  Alligators. Snakes and lizards in some degree |
| | Medicine | Anti-venom and blood thinning drugs.  melanoma (Gila monster; Hailey et al. 2012), blood thinning (snakes), cardiovascular disease (snakes), pain (snakes), diabetes (Gila monster), and Alzheimer's disease (Gila monster (Lewis and Garcia 2003) |
| | Medicine | Traditional medicinal ingredients in Brazil from Alves et al 2009 |
| | Clothing | Boots, belts, hats |
| Recreation, culture, aesthetics | Pet Trade | Reptile collectors and breeders |
| Natural hazard mitigation | Disease transmission | Regulating disease carrying rodents.  Ostfield and Holt (2004) suggest the complexities of this are "largely untested" |
| | Pest outbreaks | Regulating rodent populations |
| Recreation, culture, aesthetics | Awareness | Poison/venomous Snake hunting in OK |
| | Art | Art/books/mythology, music - |
| | Regulatory | Federally and state listed species are of concern to agencies and organizations. |
| | Religious | Used in various religious ceremonies |
| Biodiversity Conservation | Food web | Community structure and effect on trophic cascade |
| | Altering physical habitats | Ecosystem engineering such as tortoise burrows |
| | Cycling nutrients | Decomposition and primary production |

# Acknowledgements


Southwest Stakeholders

Southeast Stakeholders

National Stakeholders

Other stakeholders representing:

- BLM
- NRCS
- NMDGF
- DoD
- NGOs

USGS SWReGAP Project

(http://fws-nmcfwru.nmsu.edu/swregap/)

USGS SEGAP Project (http://www.basic.ncsu.edu/segap/)

*Steve Williams, Matt Rubino, Nathan Tarr*

EPA EnviroAtlas Team (https://www.epa.gov/enviroatlas/)

*Megan Mehaffey, Megan Culler, Jessica Daniels*

National Gap Analysis Program (http://gapanalysis.usgs.gov/)

*Jocelyn Aycrigg, Jeff Lonneker, Thomas Laxon*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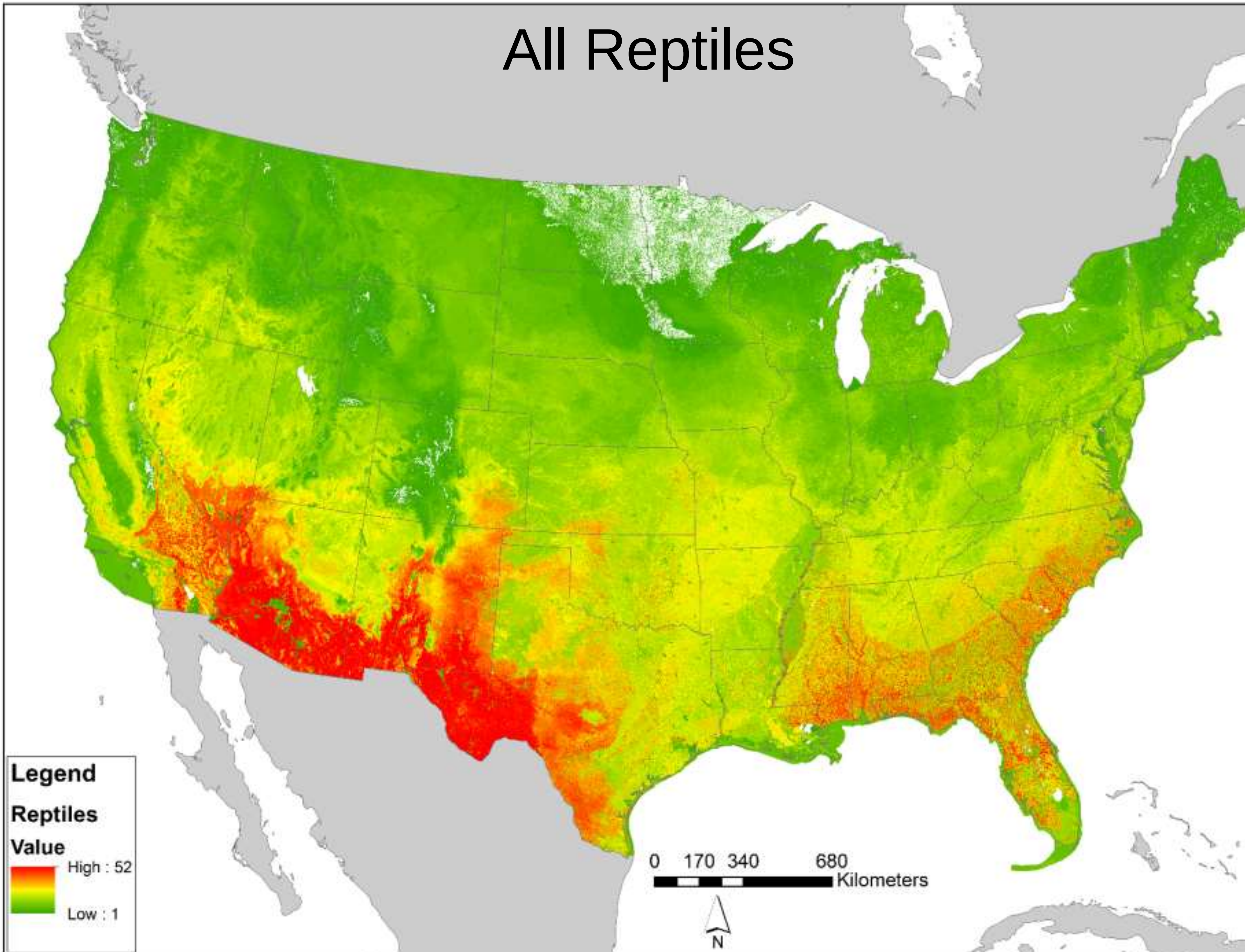
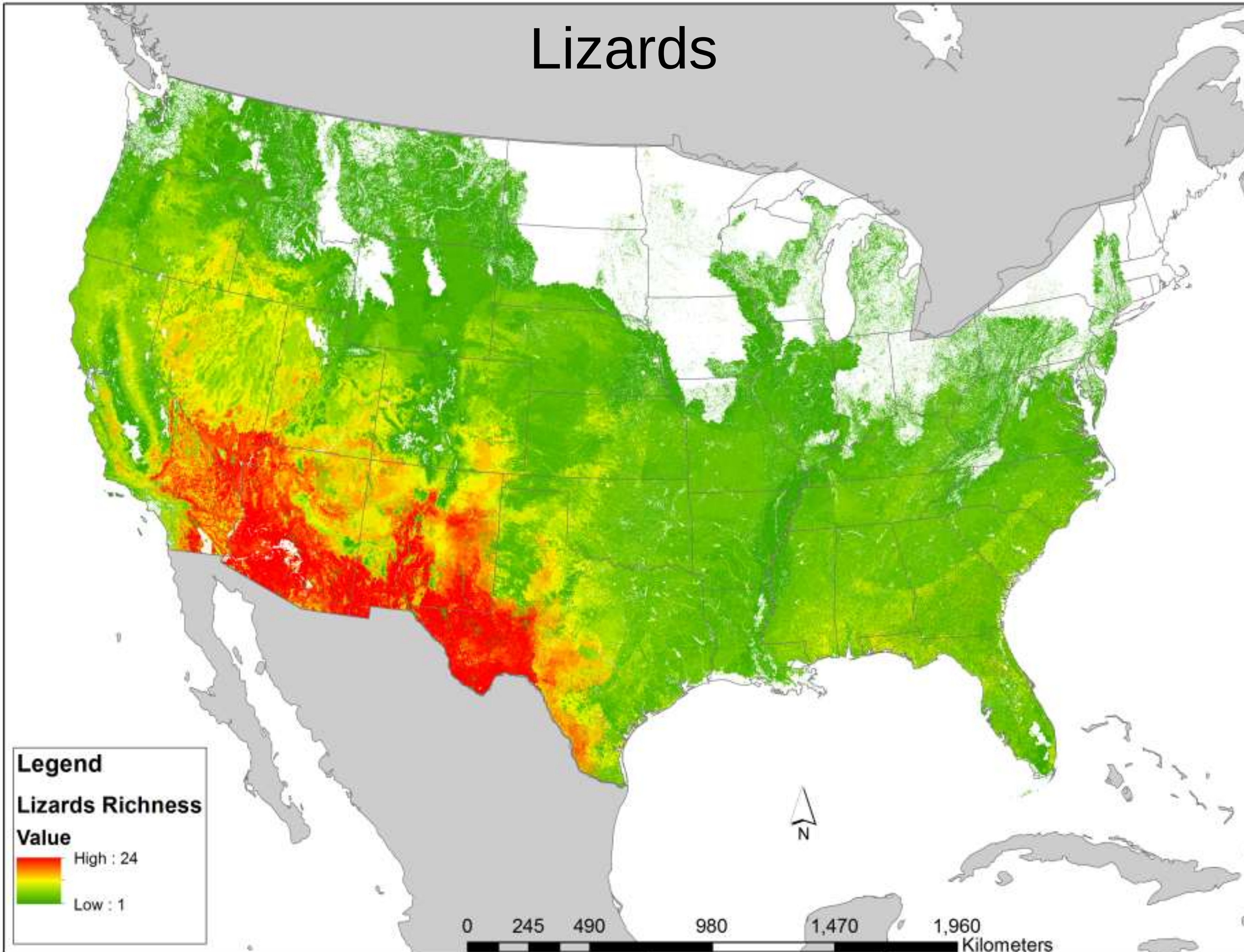
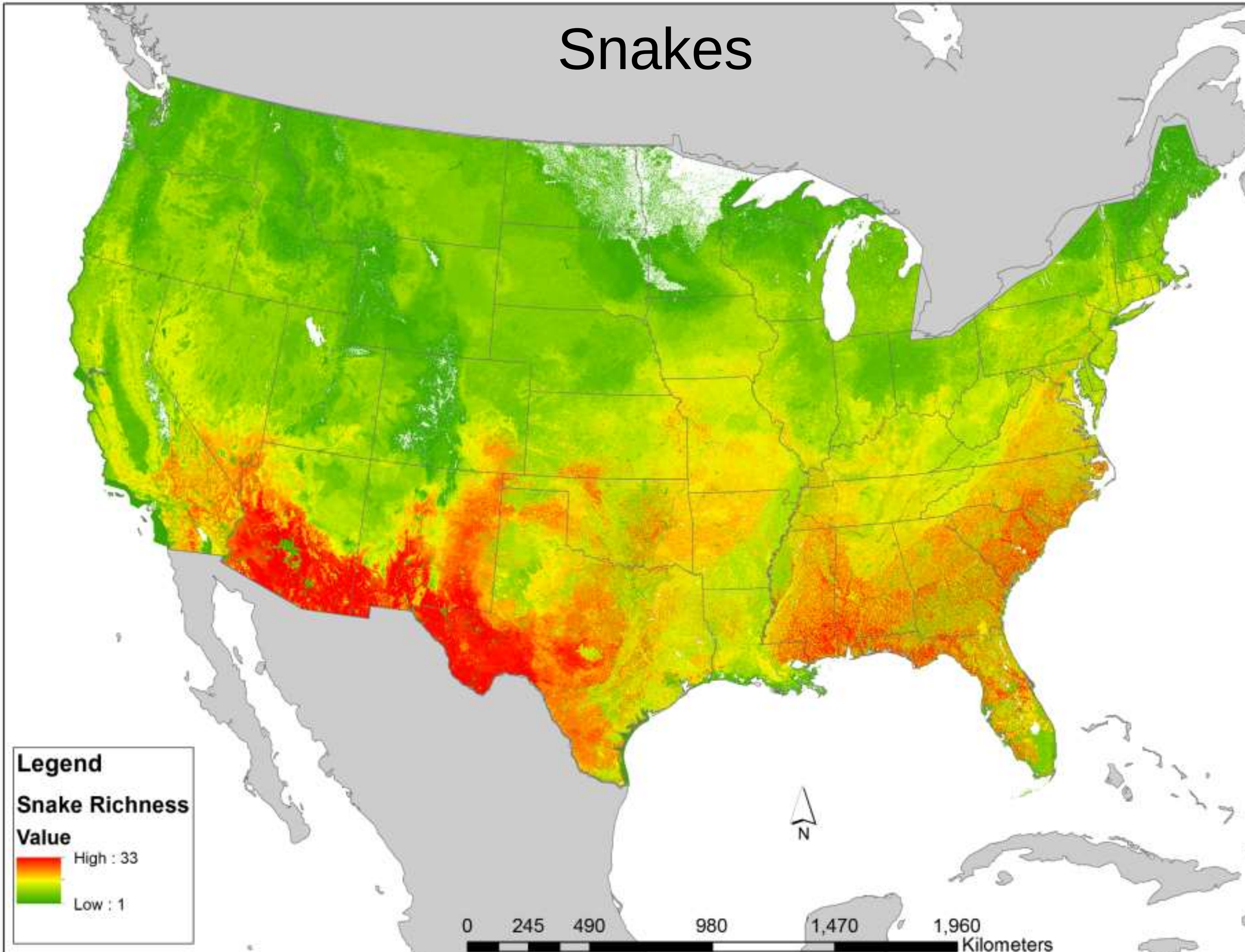
***Alexa McKerrow, Raleigh, NC***
***Kevin J. Gergely, Boise ID***
***USGS National Gap Analysis Program***


***http://case.nmsu.edu/***
***https://www.epa.gov/enviroatlas/***
***http://gapanalysis.usgs.gov/***

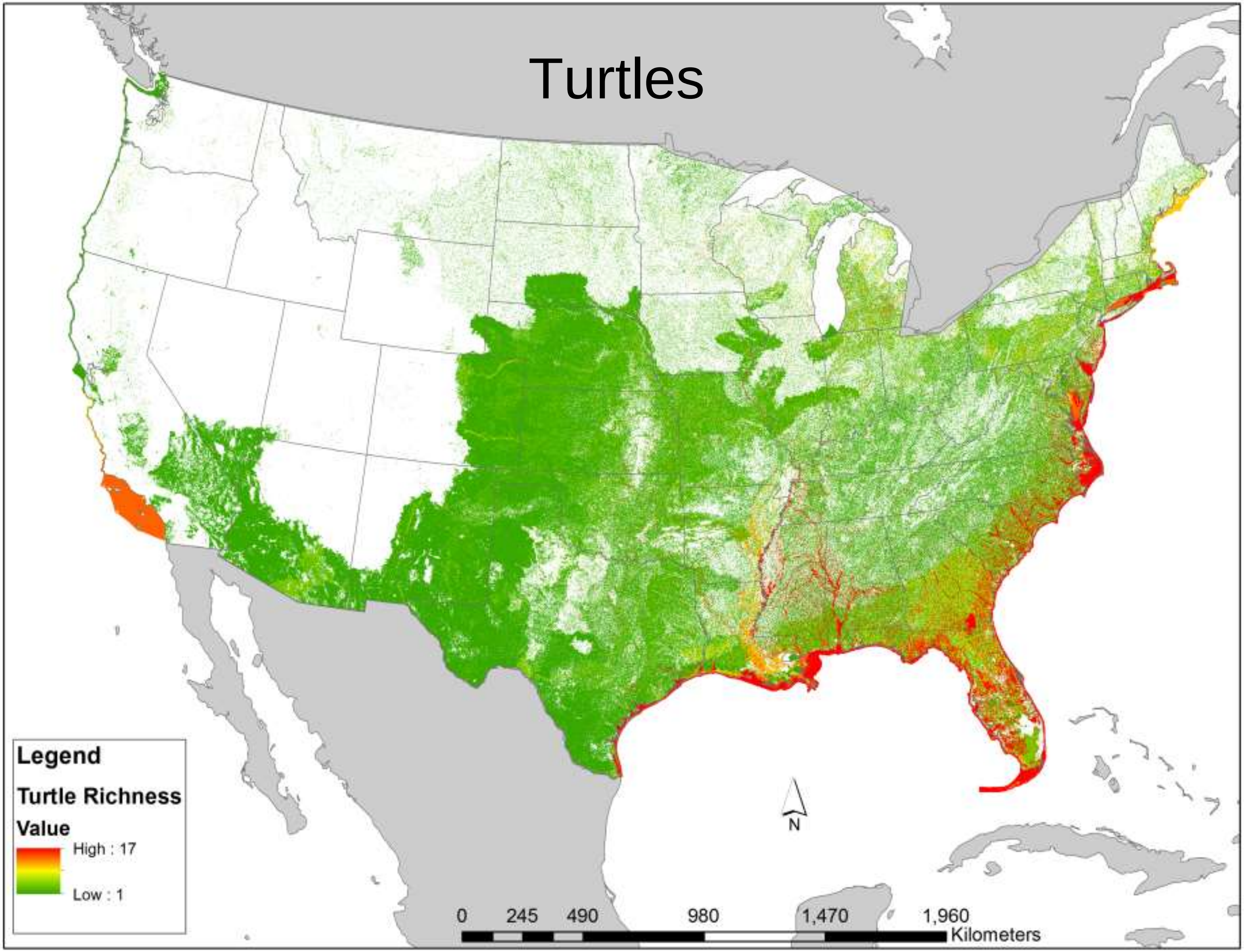

All Reptiles
Legend
Reptiles
Value
High : 52
Low : 1
0 170 340 680
Kilometers
N



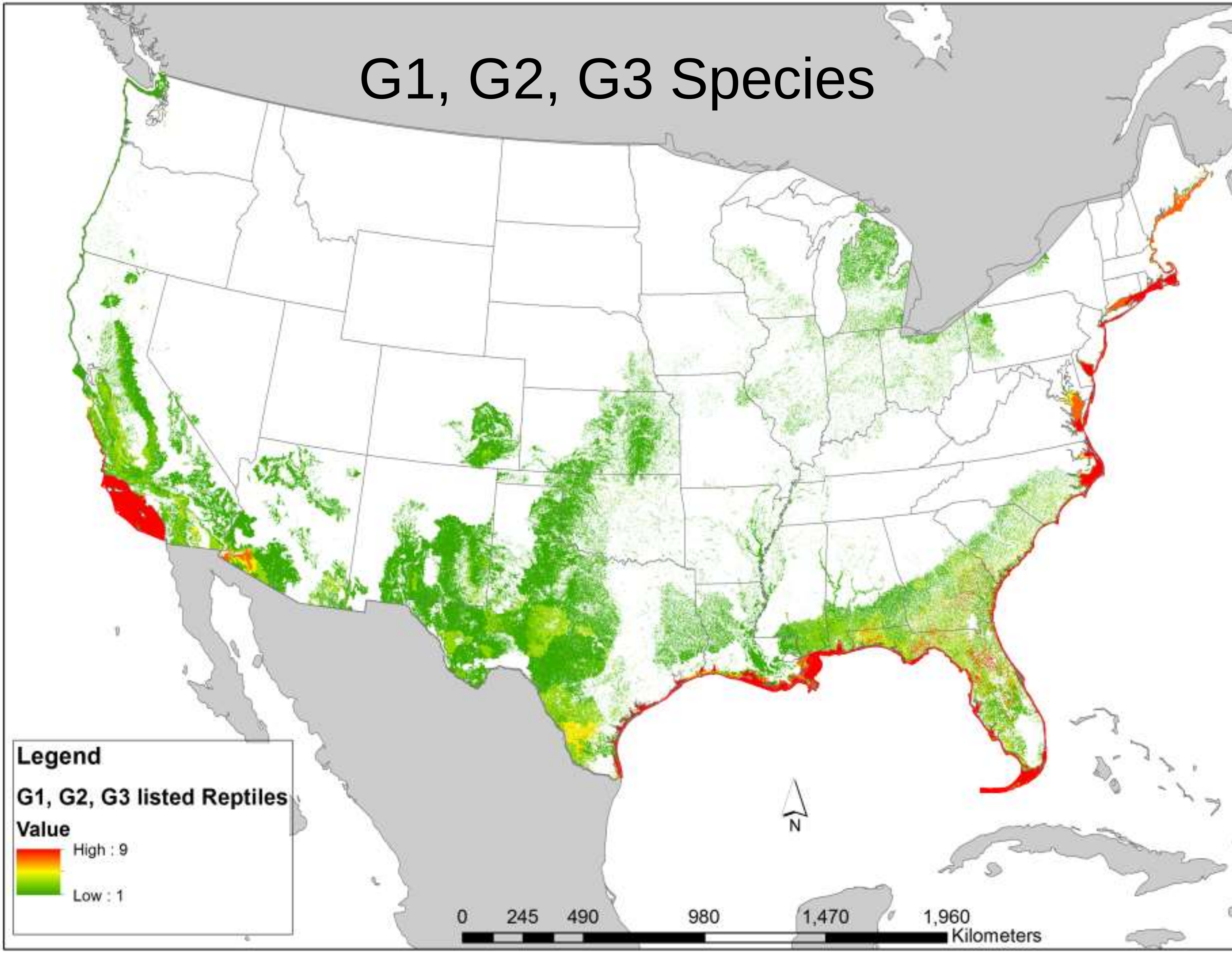
Lizards
Legend
Lizards Richness
Value
High : 24
Low : 1
N
0
245
490
980
1,470
1,960
Kilometers

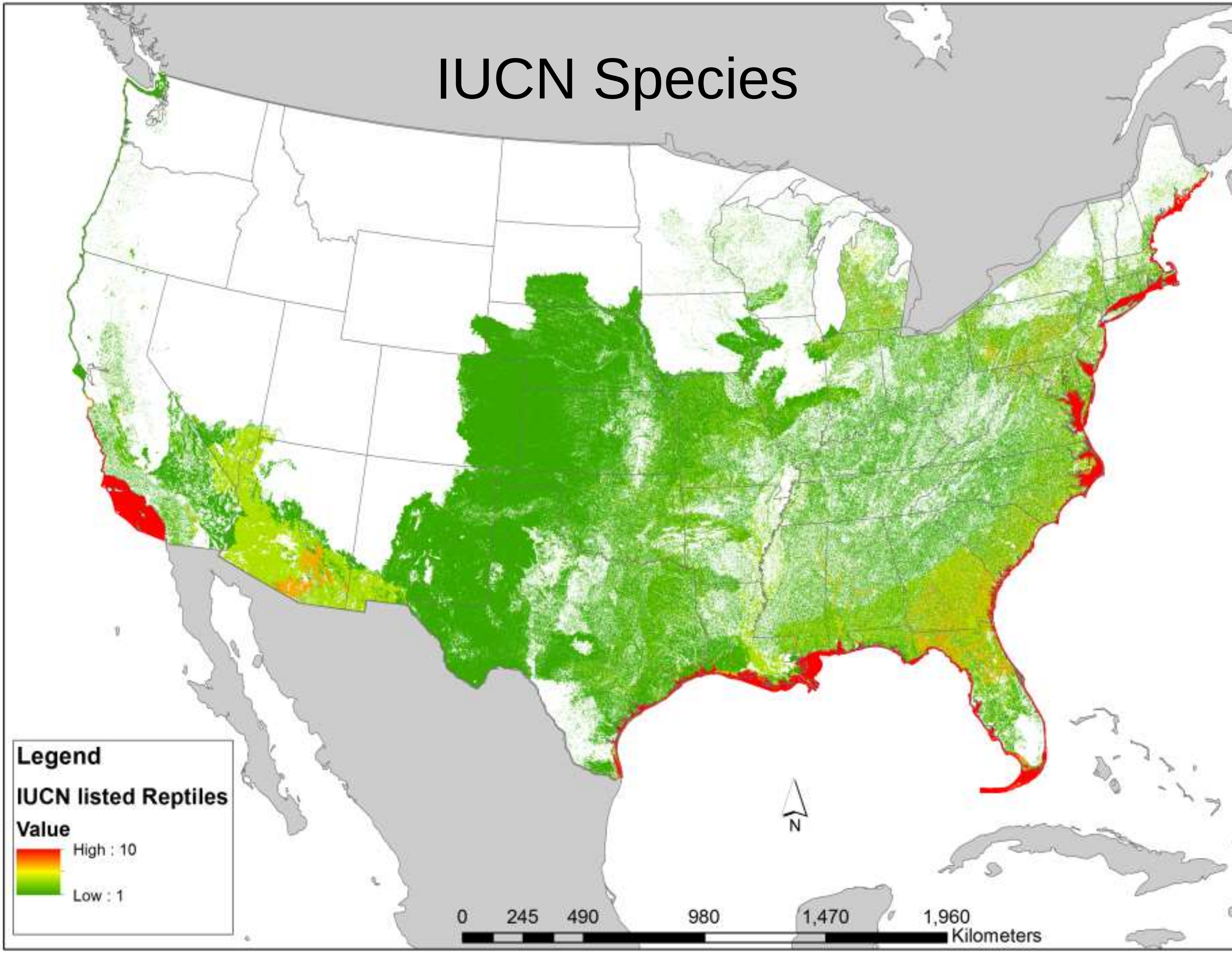


Snakes
Legend
Snake Richness
Value
High : 33
Low : 1
N
0
245
490
980
1,470
1,960
Kilometers

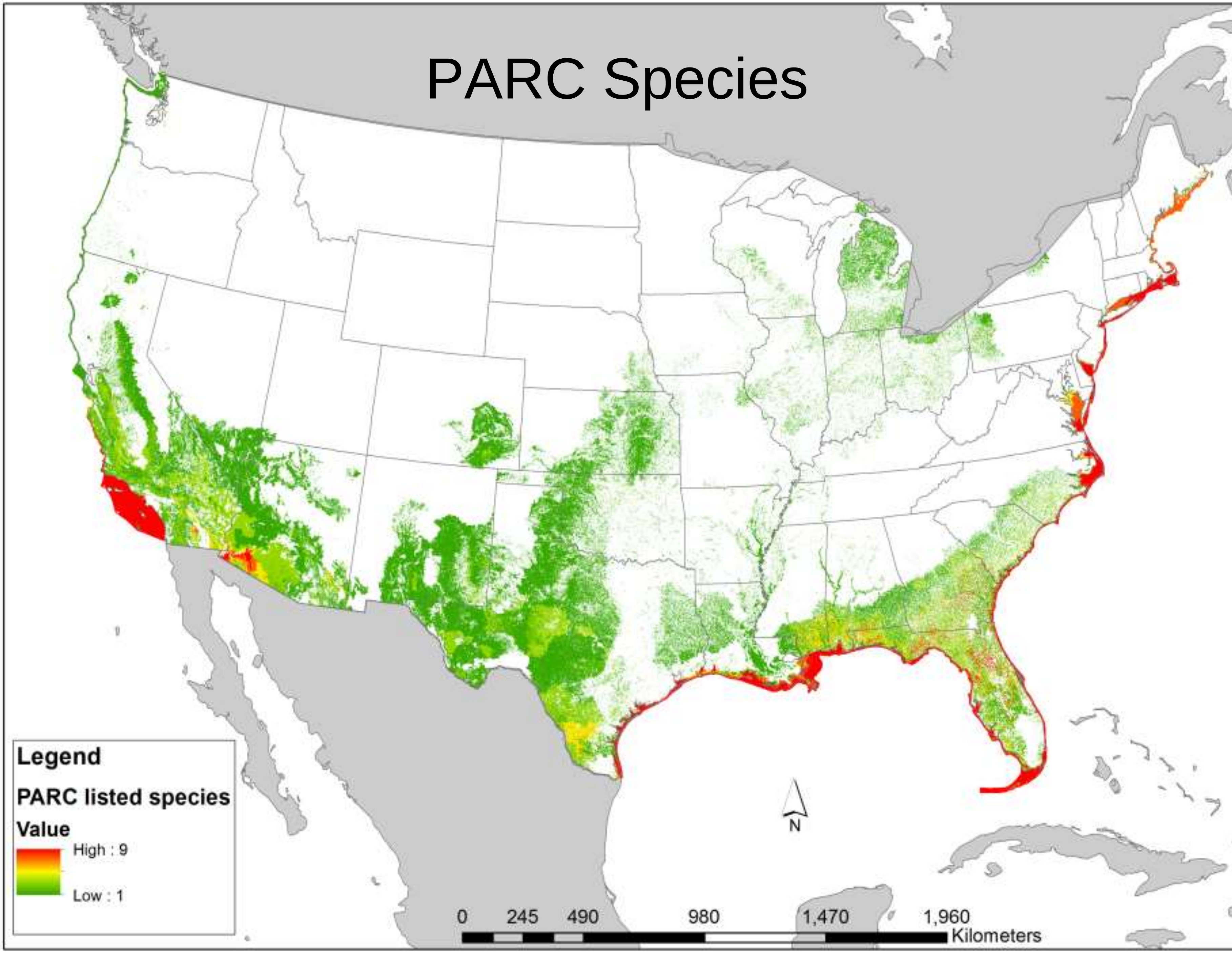


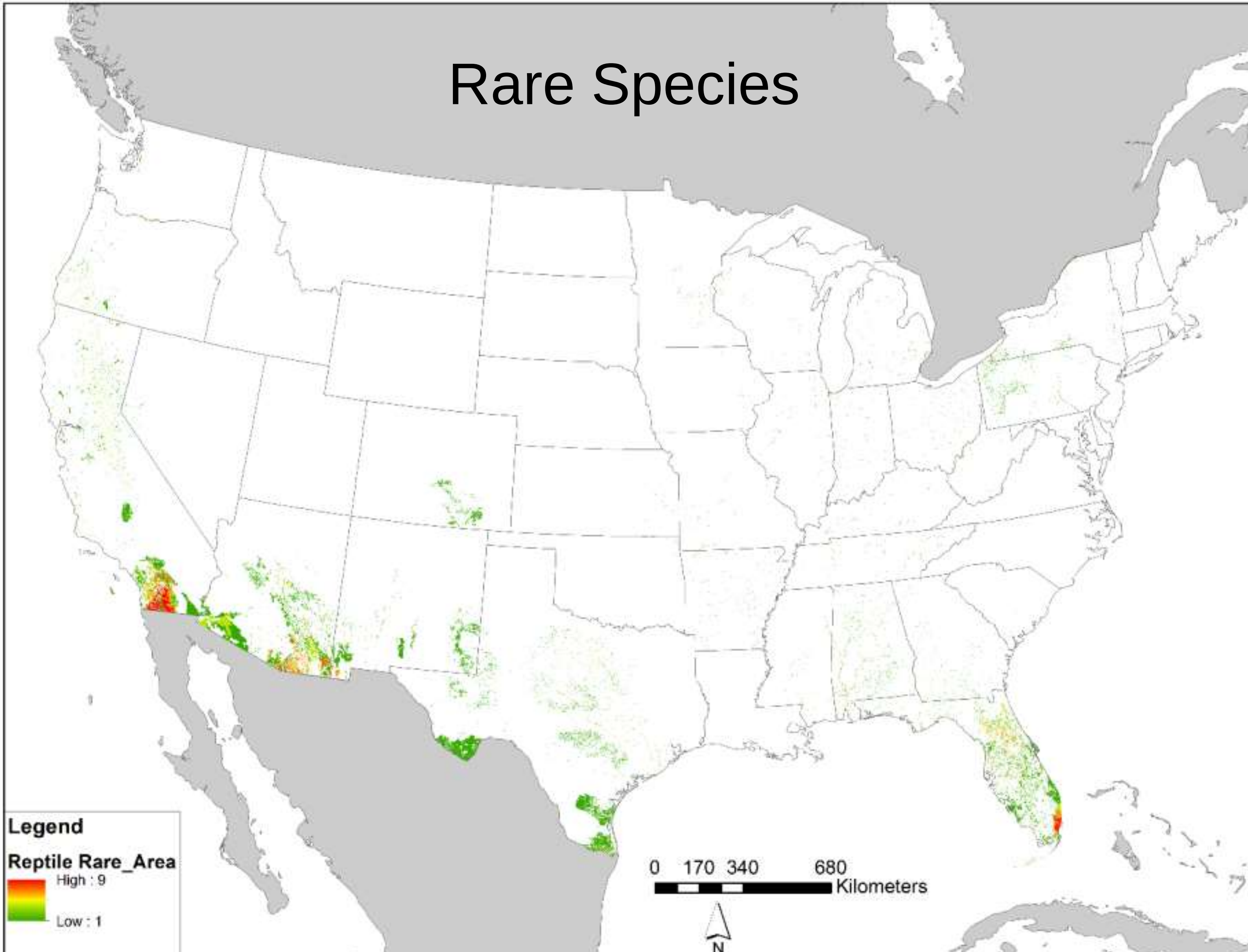
Turtles
Legend
Turtle Richness
Value
High : 17
Low : 1
N
0
245
490
980
1,470
1,960
Kilometers


G1, G2, G3 Species
Legend
G1, G2, G3 listed Reptiles
Value
High : 9
Low : 1
N
0
245
490
980
1,470
1,960
Kilometers

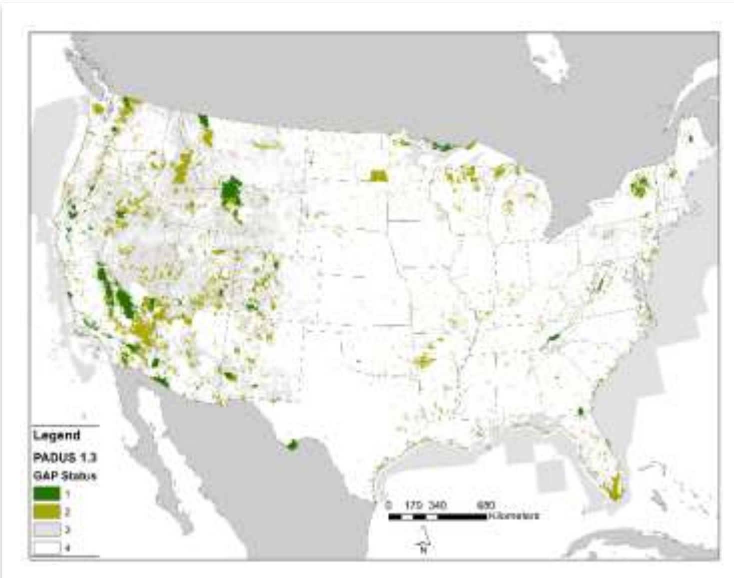


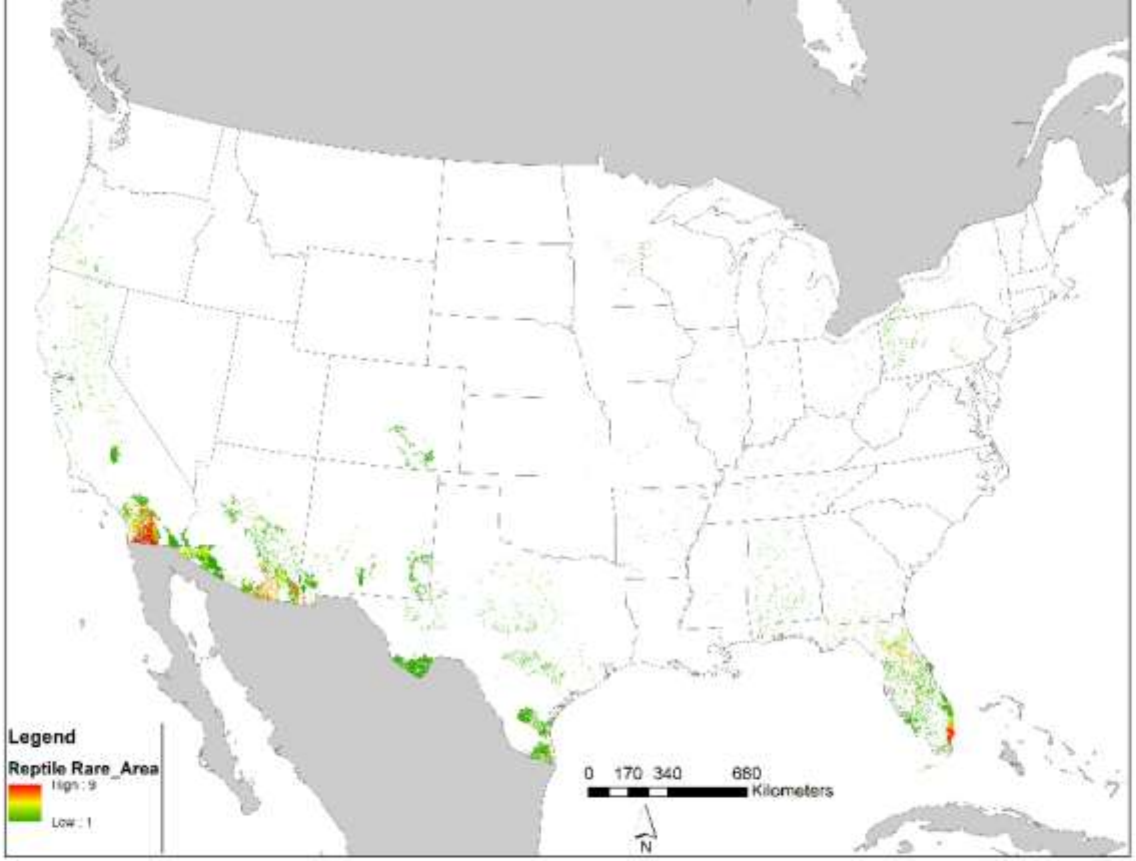
IUCN Species
Legend
IUCN listed Reptiles
Value
High : 10
Low : 1
N
0
245
490
980
1,470
1,960
Kilometers


PARC Species
Legend
PARC listed species
Value
High : 9
Low : 1
0 245 490 980 1,470 1,960
Kilometers
N

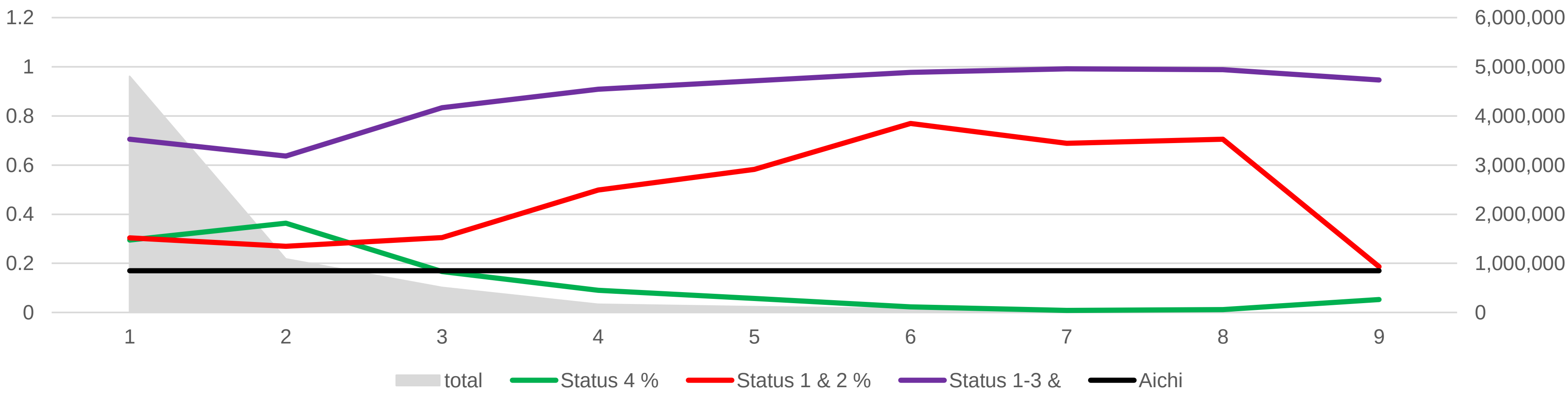

Rare Species
Legend
Reptile Rare_Area
High : 9
Low : 1
0 170 340 680
Kilometers
N

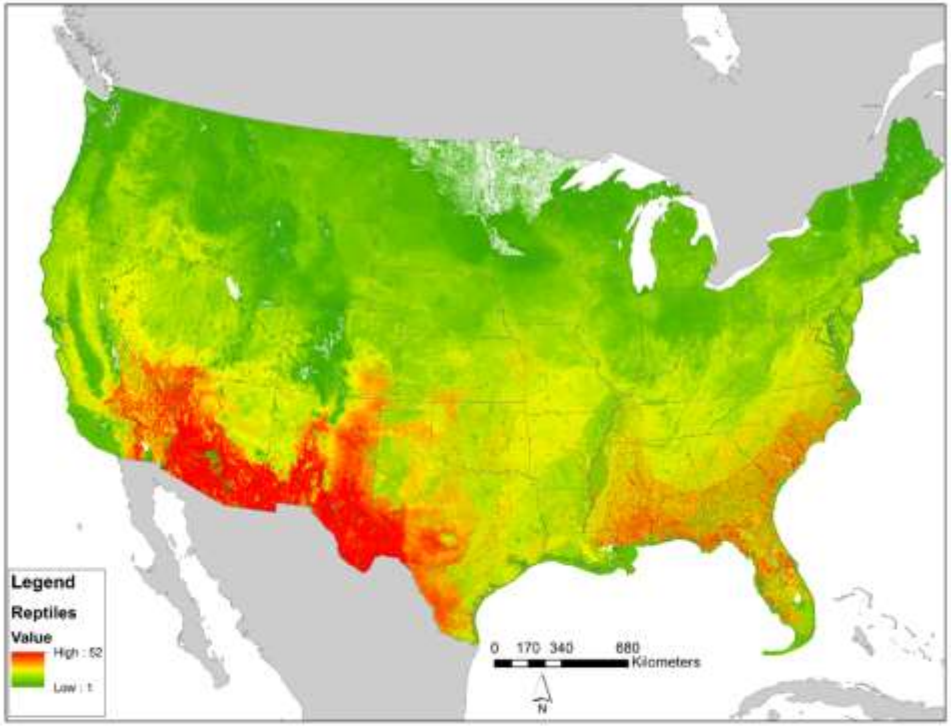
# Rare Species



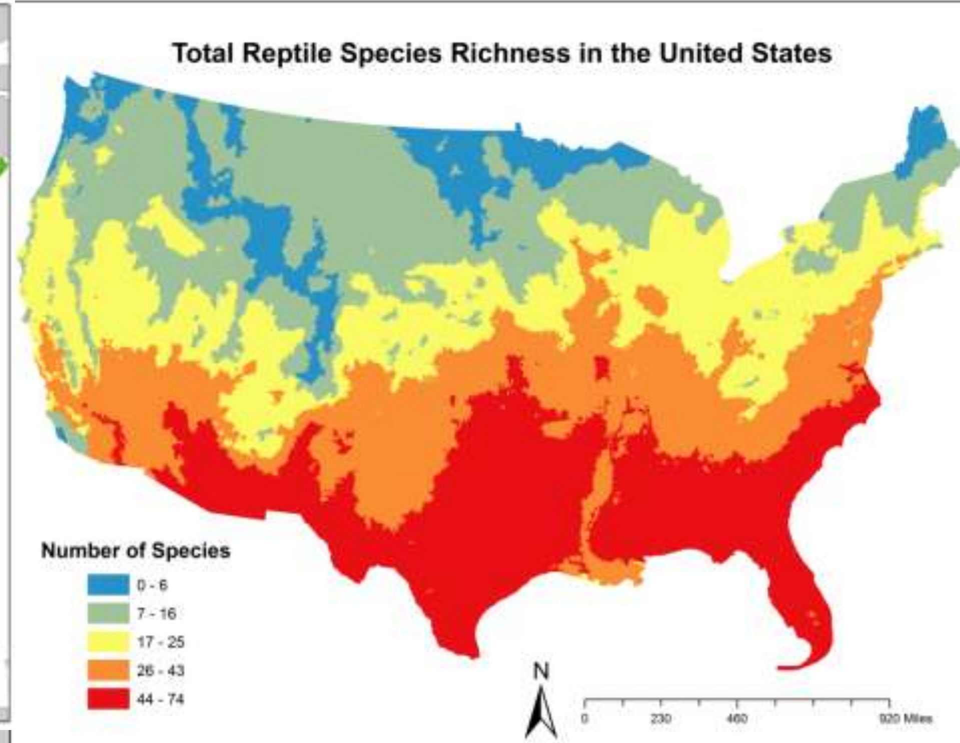




Rare (modeled habitat based) Species Richness by GAP Protection Status

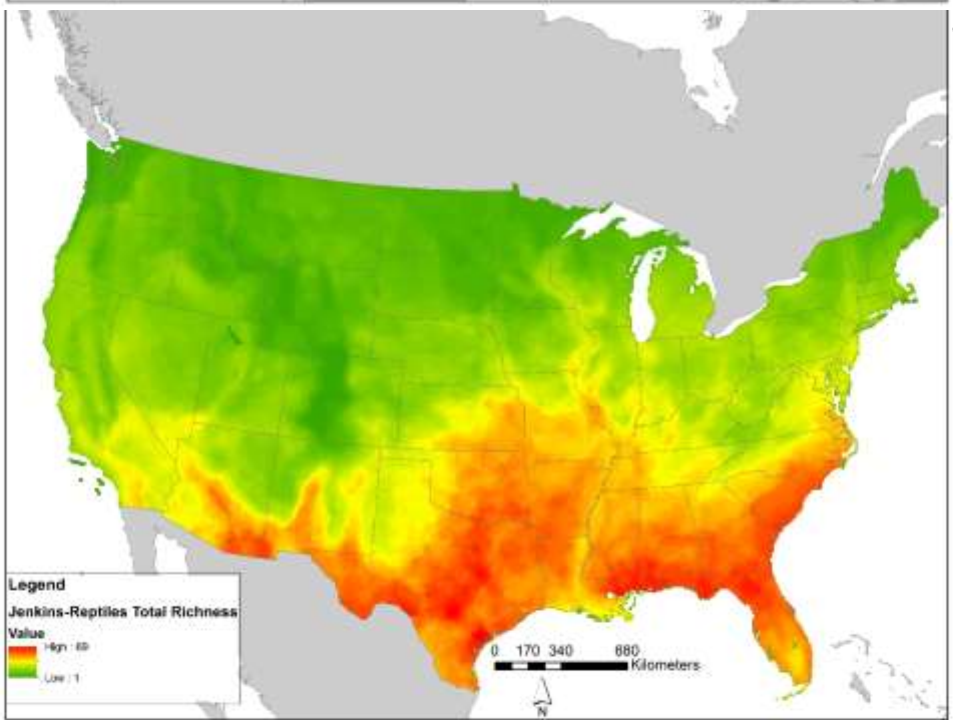




Legend
Reptiles
Value
High : 52
Low : 1
0 170 340 680
Kilometers
N

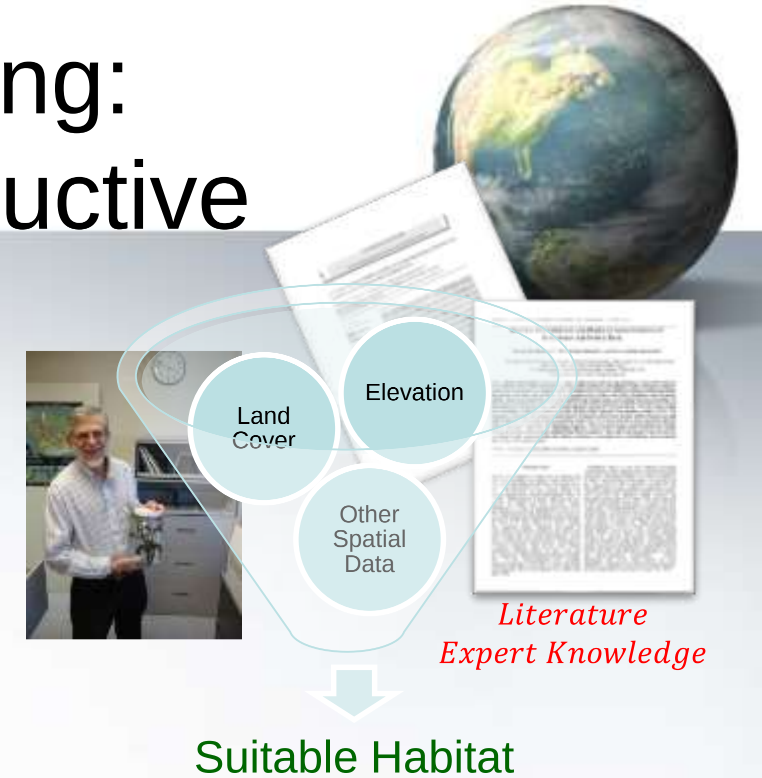
Total Reptile Species Richness in the United States
Number of Species
0 - 6
7 - 16
17 - 25
26 - 43
44 - 74
N
0 230 460 920 Miles

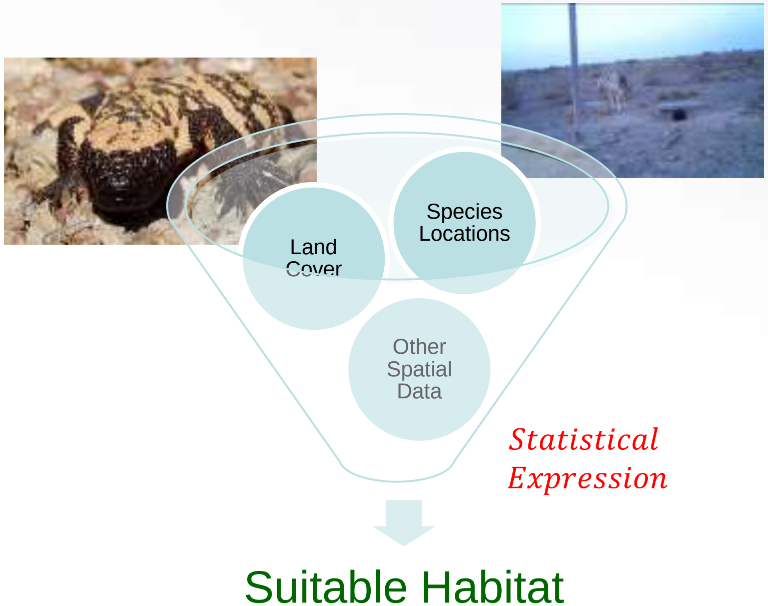
Legend
Jenkins-Reptiles Total Richness
Value
High
Low : 1
0 170 340 680
Kilometers
N

# Habitat Modeling:
# Deductive vs. Inductive

- Deductive (GAP Standard)
  - Knowledge based/expert based
  - Habitat based
  - Top down- general to specific



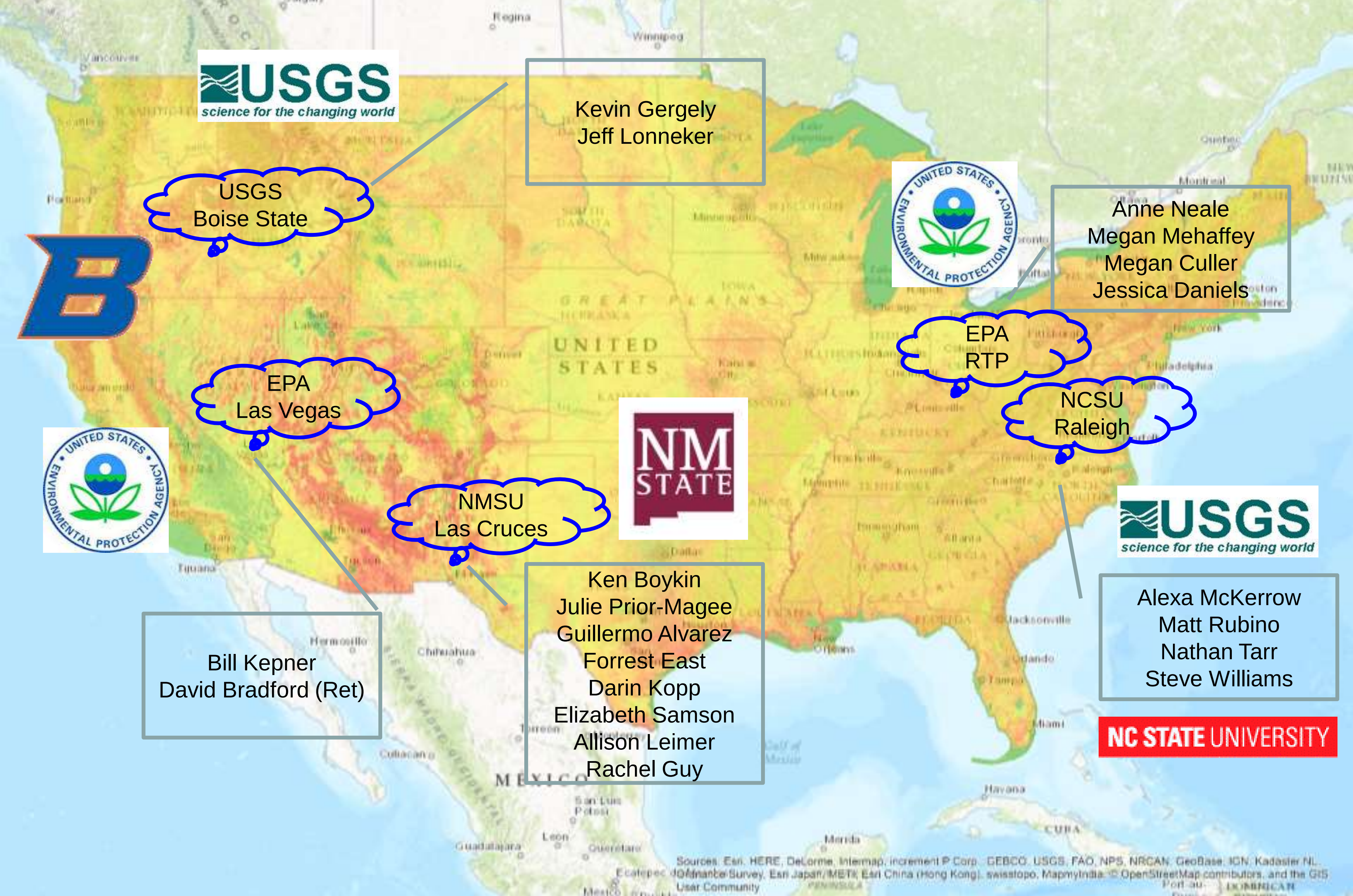

- Inductive (Maximum Entropy)
  - Species occurrence based
  - Bottom up- specific to general
- Merge the two types
- Ensemble models



# General Conclusions

- Process allows many perspectives;
- Responsive to needs of users;
- National level with moderate scale;
- Establish common sense *indicators of ES* for end-user and decision maker needs, e.g.
    - Landscape Conservation Cooperatives
    - State Wildlife Action Plans
    - Potentially also for IPBES, TEEB, GEO BON, DIVERSITAS, etc.

# Project Related Personnel



# Modeling Process

Model Variables

- Land cover
- Patch Size
- Edge
- Forest Interior
- Canopy Cover
- Hydrography
  - Flowing water
  - Open/Standing Water
  - Wet Vegetation
- Soils
- Human Impacts/Road Density
- Elevation
- Land Forms