

***Scenario Analysis:
Evaluating Biodiversity Response
to Forecasted Land-use Change
in the San Pedro River Basin
(U.S.-Mexico)***

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A Community on Ecosystem Services

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Washington, D.C.



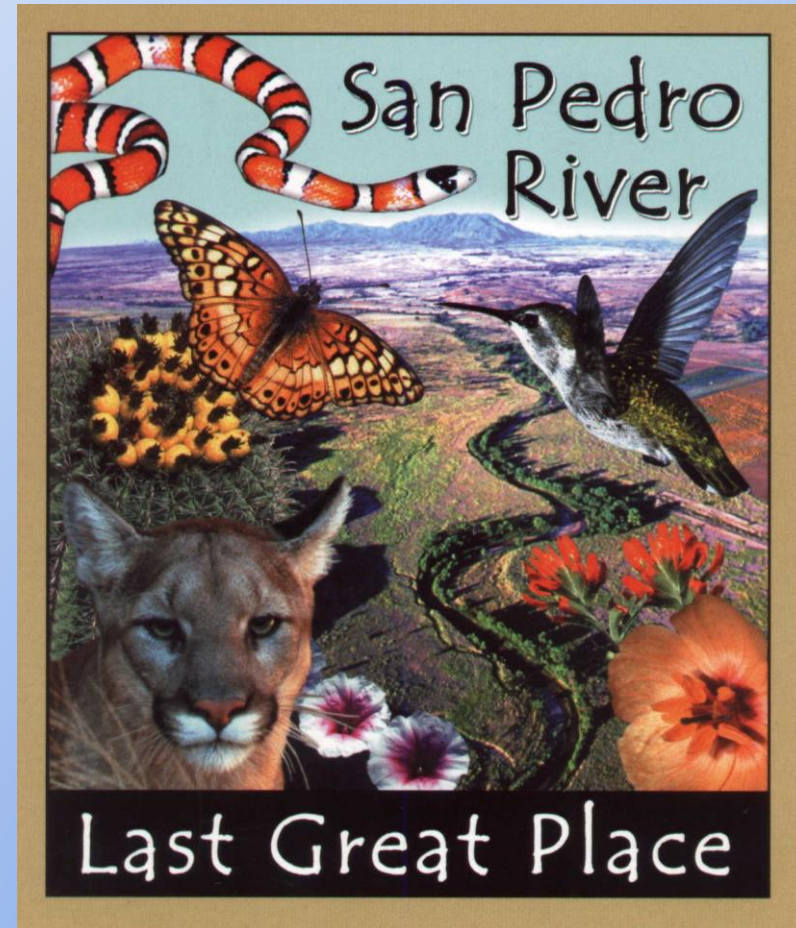
San Pedro River Basin

(U.S./Mexico, 9,800 km² and 1,800 km², respectively)

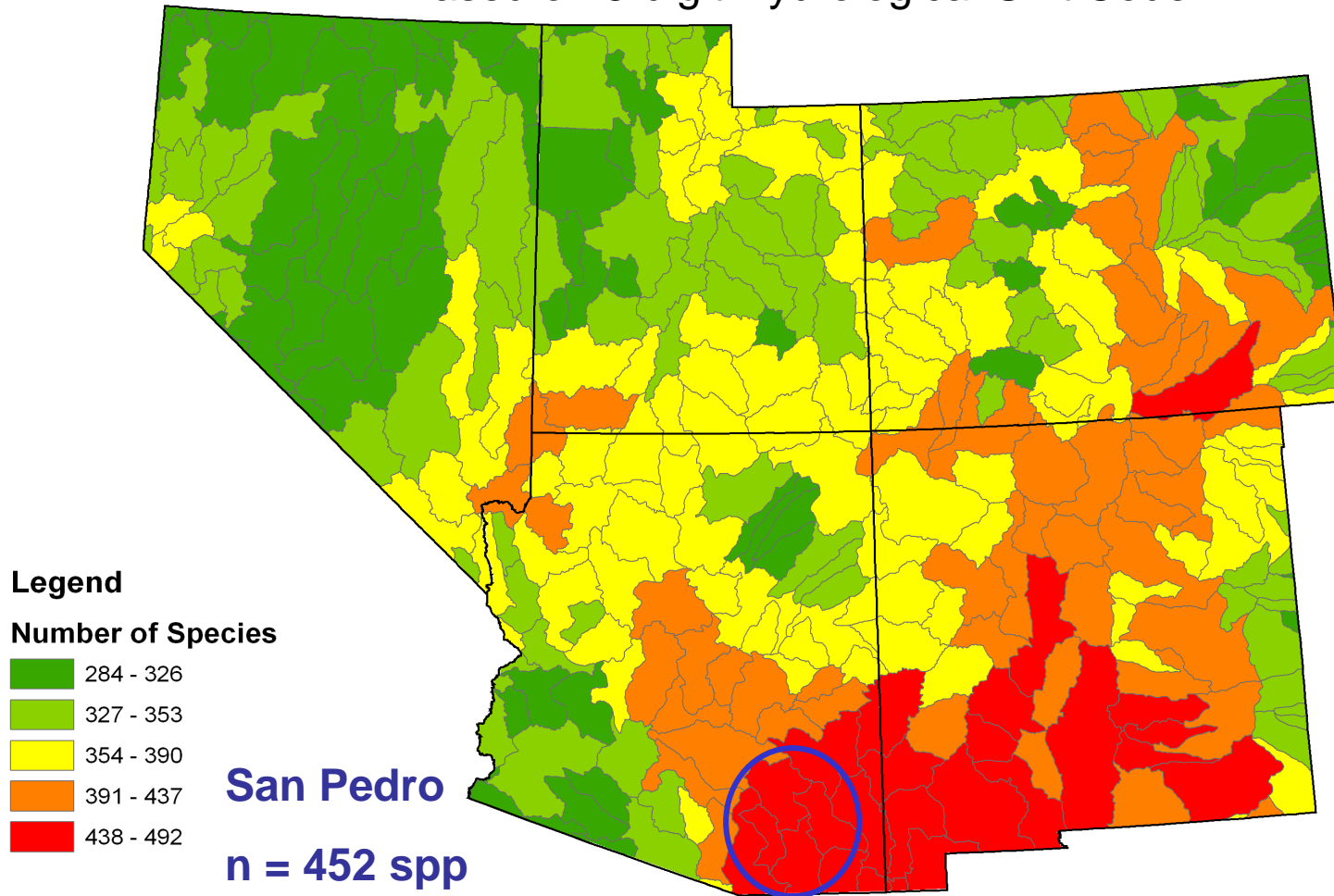


San Pedro River

- One of world's eight Last Great Places (TNC) – 6 preserves
- First designated National Riparian Conservation Area by Congress (1988)
- First designated Globally Important Bird Area in U.S. (American Bird Conservancy; 1996)
- Most Endangered River System (American Rivers)



Terrestrial Vertebrate Species Richness Based on 8-digit Hydrological Unit Code





Rocky Mountain Elk



Gambel's Quail



Mule Deer



**Arizona Watchable
Wildlife Guide**
Bonus: Camping in Arizona State Parks



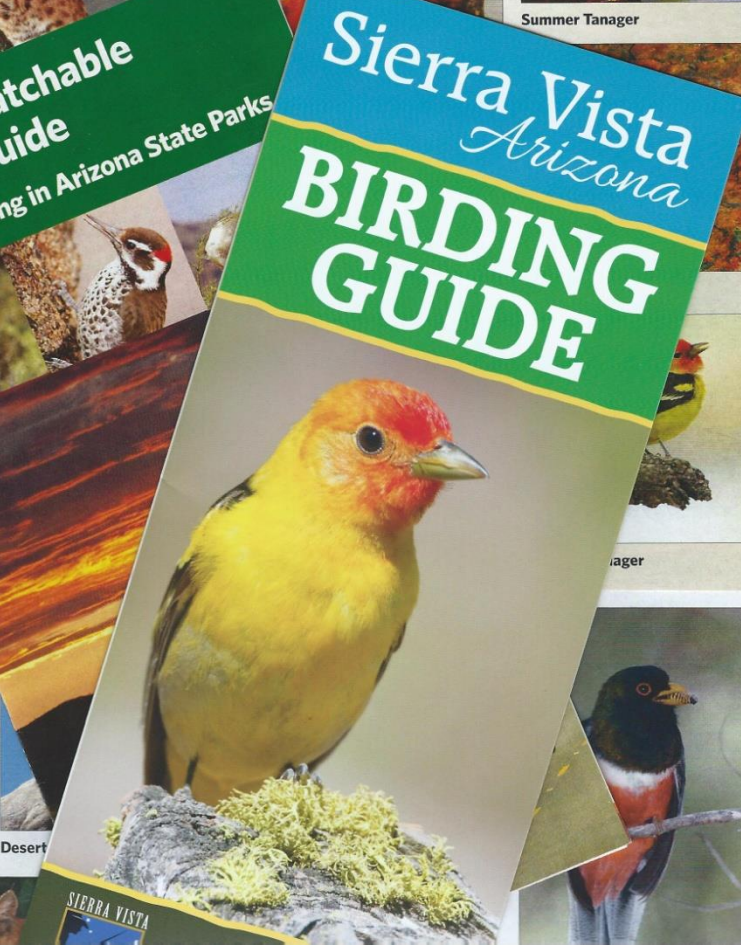
Coati



Bald Eagle



Summer Tanager



Total Species = 452

Bird Spp = 287

Mammal Spp = 88

Reptile Spp = 61

Amphibian Spp = 16

IMPORTANT BIRD AREA

THIS SITE HAS BEEN IDENTIFIED AS BEING SIGNIFICANT FOR WORLD BIRD CONSERVATION AND OFFICIALLY DESIGNATED A GLOBALLY IMPORTANT BIRD AREA

 AMERICAN BIRD CONSERVANCY

FOR MORE INFORMATION ABOUT THE IBA PROGRAM CONTACT AMERICAN BIRD CONSERVANCY: (888) 247-3624, www.abcbirds.org



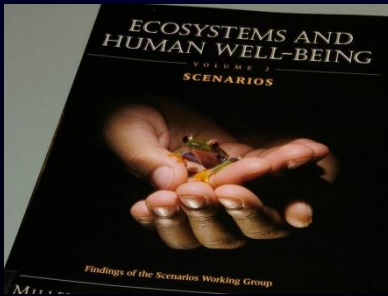


PROBLEM:

How do changes in land use, and any subsequent change to land cover, affect ecological conditions and what are the trade-offs between management decisions?

APPROACH:

- Systematically explore implications of wide range of *alternative futures* related to key environmental **stressors: climate variation and land use** or **endpoints: habitat**
- Invoke *Scenario Analysis* framework; apply deductive habitat models grouped as biodiversity metrics based on digital land cover derived from ICLUS at decadal intervals to 2100; spatially analyze response for each alternative future; quantify, visualize, and compare results for each scenario.



1. Climate



2. Land Use



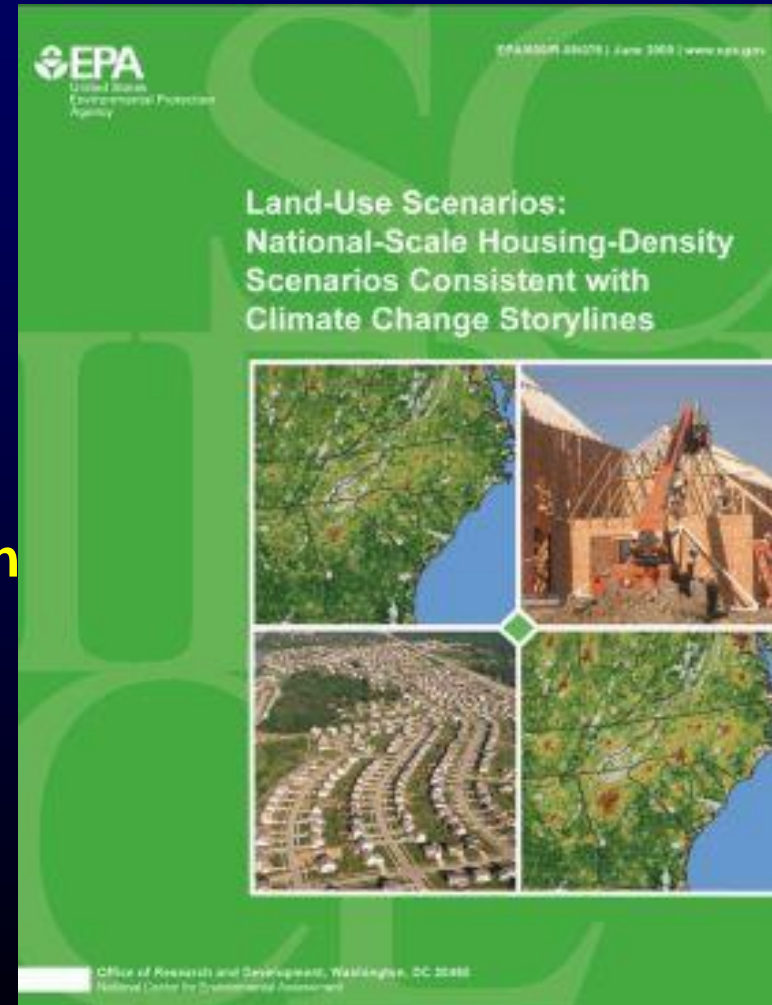
3. Socially Relevant Endpoints, e.g. habitat



ICLUS: Integrated Climate and Land-Use Scenarios

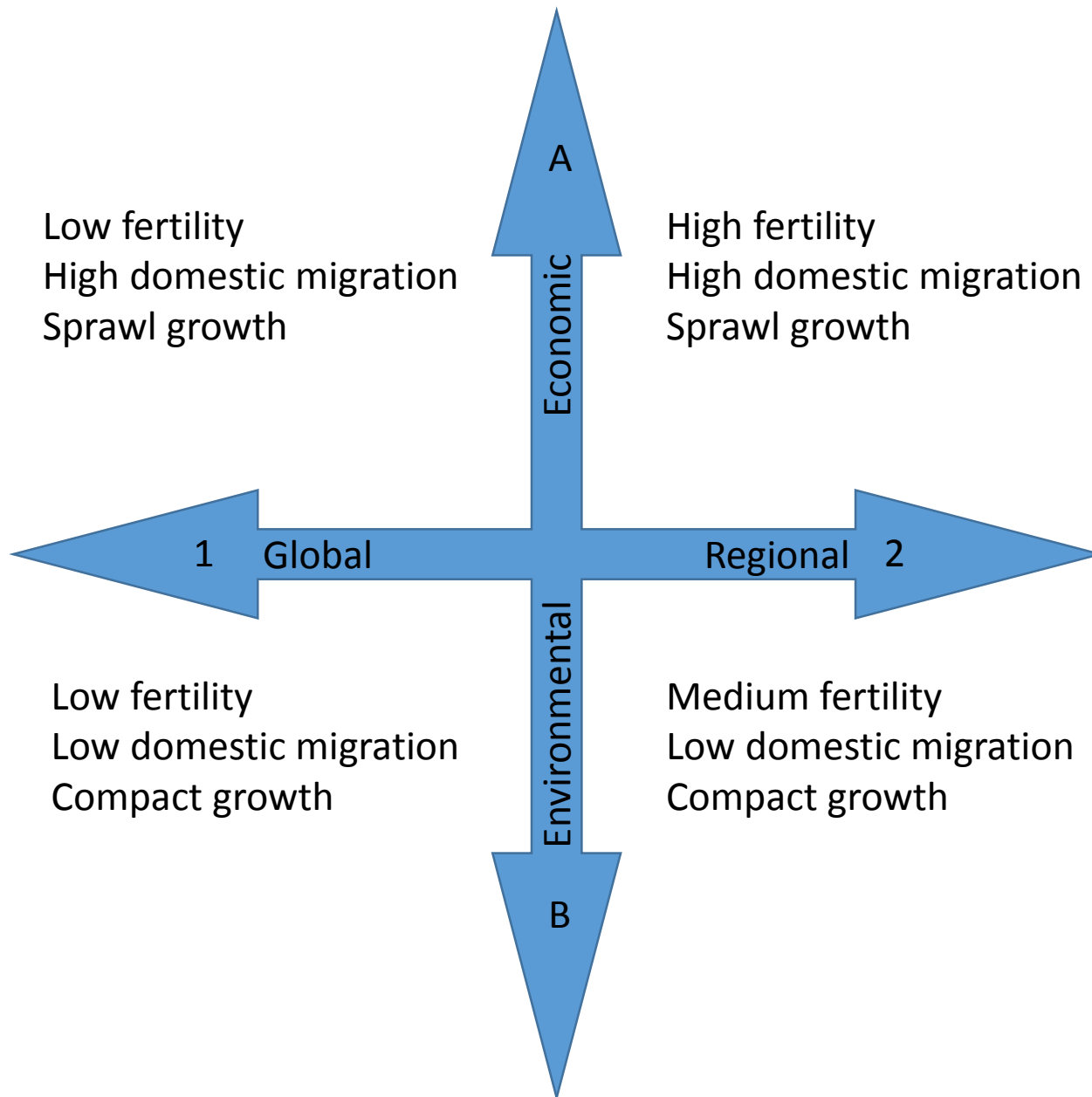
- Provides seamless land use scenarios for the **conterminous** United States consistent with IPCC emission storylines
- Demography and population at **county level**
- **Housing density allocated at 1 ha resolution**
- Estimated % impervious surface at **1 km² resolution**

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

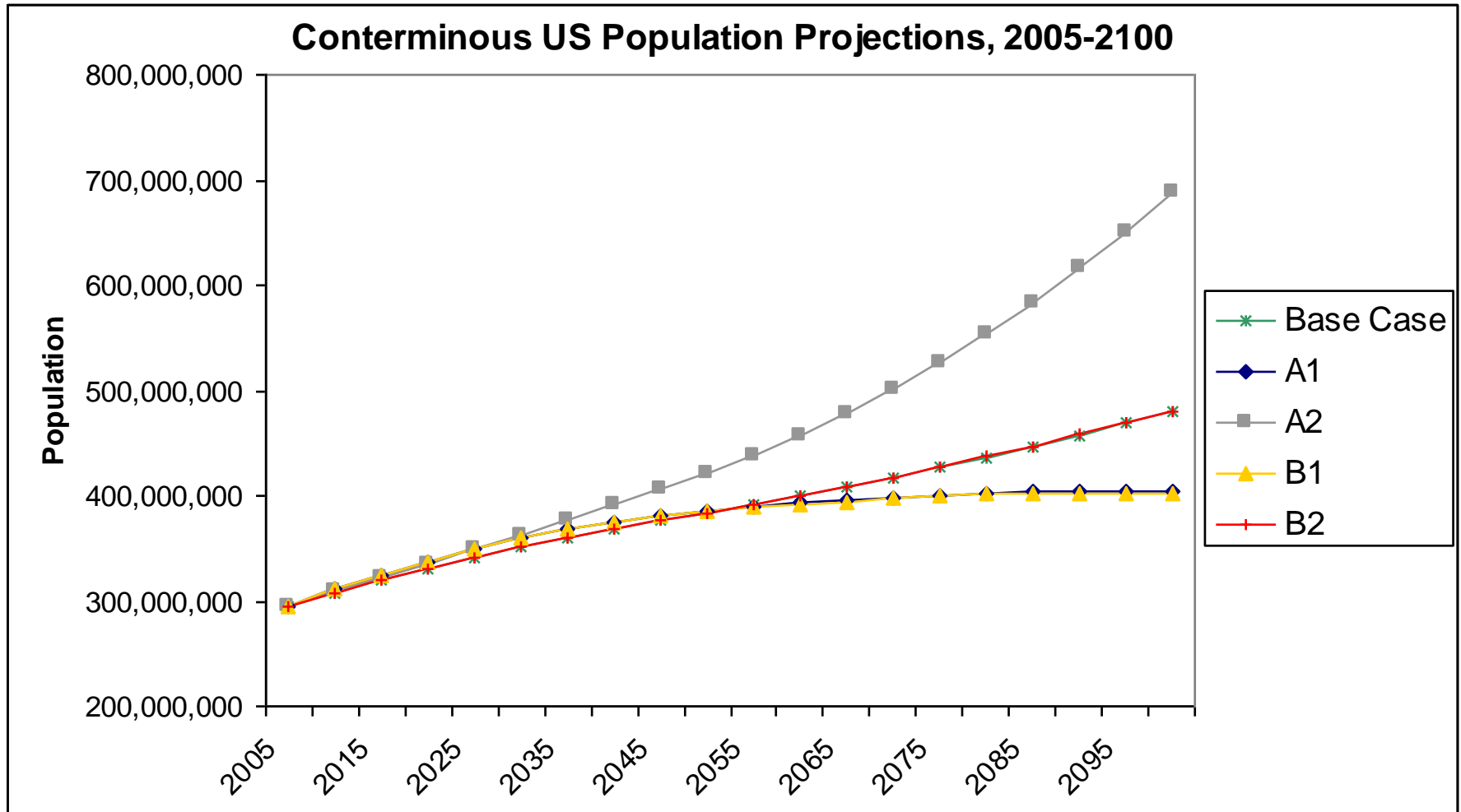


Interpretation of Base Condition and Scenario Families for US

Global Scenario	Demographic Model			Spatial Allocation Model	
	<i>Fertility</i>	<i>Domestic migration</i>	<i>Net int'l migration</i>	<i>Household size</i>	<i>Urban Form</i>
A1: fast econ. dev.; med. pop growth; high global integration	Low	High	High	Smaller (-15%)	No change
B1: medium pop. growth rate; low dom. migration resulting in compact urban dev.	Low	Low	High	Smaller (-15%)	Slight compact
A2: high pop. growth rate, greatest land conversion, high dispersal (dom. migration) resulting in new pop. centers	High	High	Low	Larger (+15%)	No change
B2: moderate econ. dev.; med. pop growth; med int'l migr.	Medium	Low	Low	No change	Slight compact
Baseline (2000): US Census medium scenario	Medium	Medium	Medium	No change	No change



Population Projections for ICLUS Scenarios



Gap Analysis Products and Data Sources

(Southwest Region: AZ, NM, CO, UT, & NV)

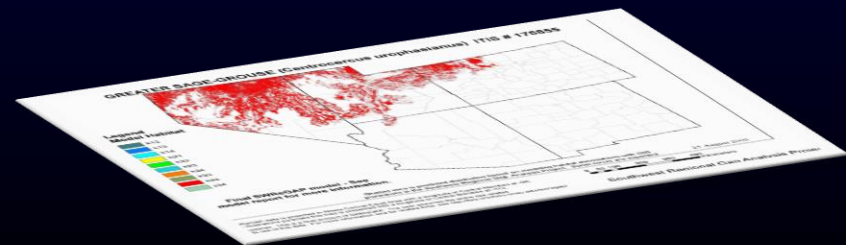
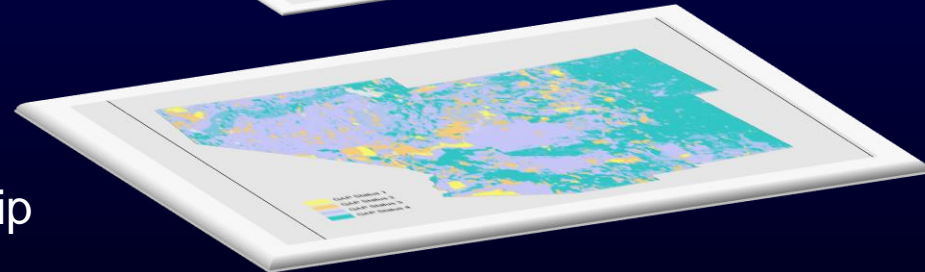
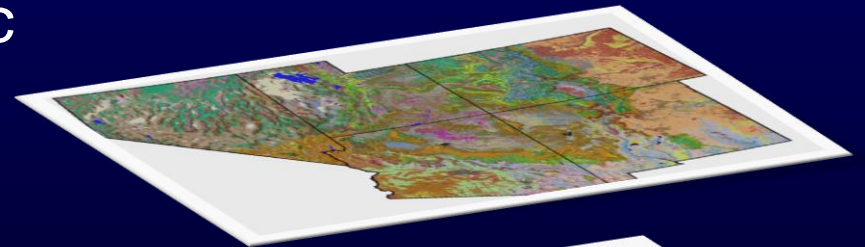
Deductive Habitat Models (817 spp)

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

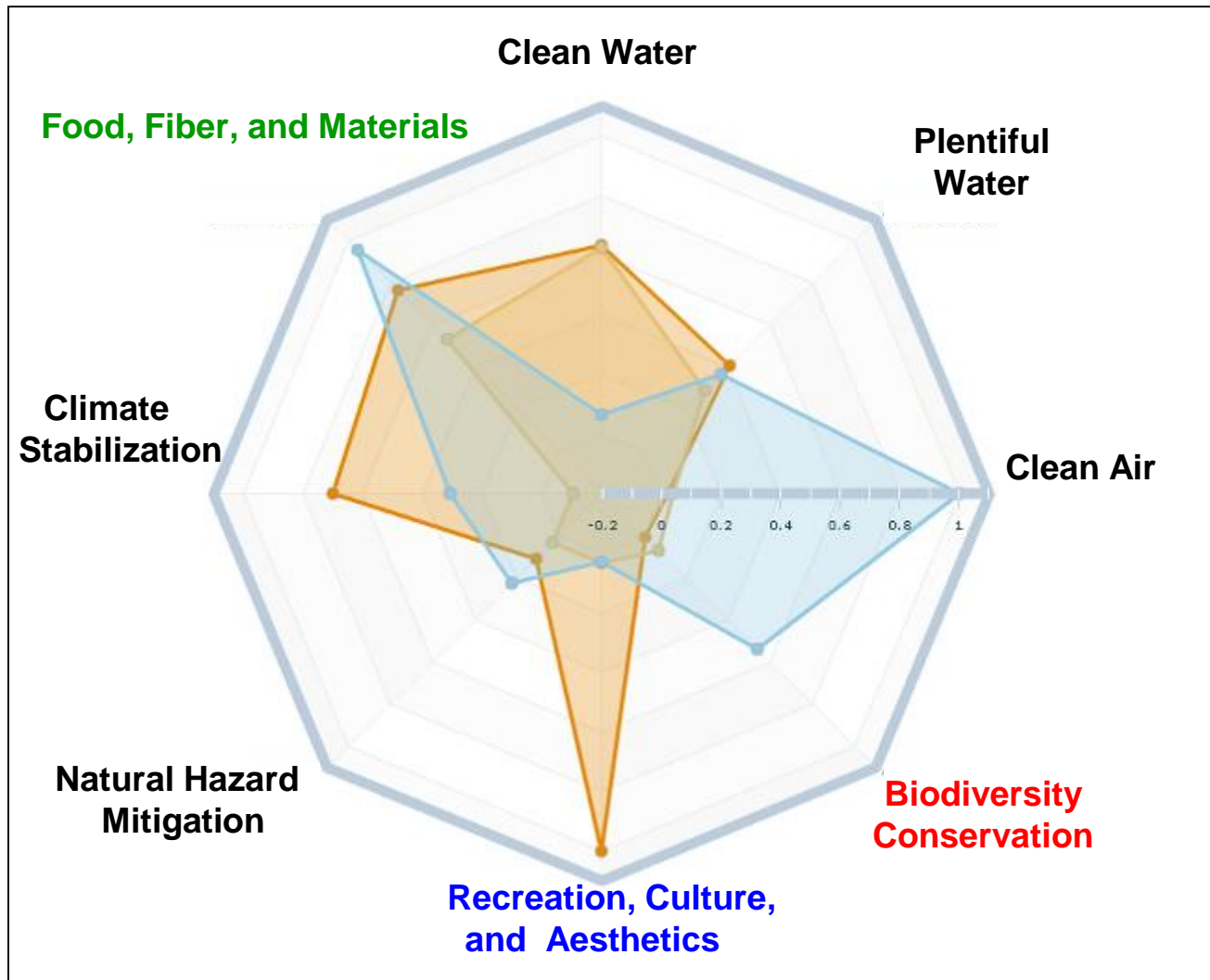
Land Cover (125 classes;
Group 5 & 7 NVCS)

Land Ownership/Stewardship

Habitat Models



EnviroAtlas: Linking Ecosystems, People, and Well-being



* **Total Species Richness**

* **Audubon Climate Threatened Species**

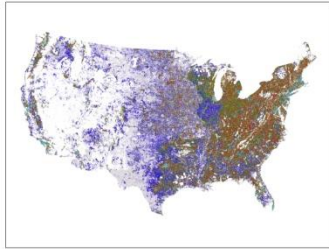
* **Total Harvestable Species**

* **Total Bird Species**

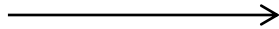
Total Economic Effect =
\$24,130,389/annum

Fish & Wildlife Economics
and Statistics, Southwick
Associates, 2013

National ICLUS Data Set

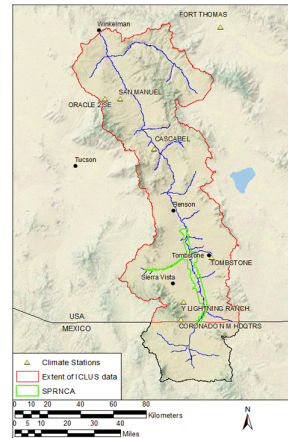


Extract

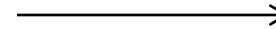


Approach

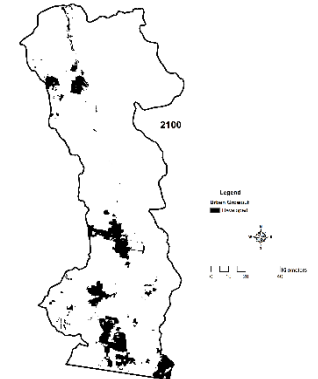
San Pedro River Study Area



Reclassify

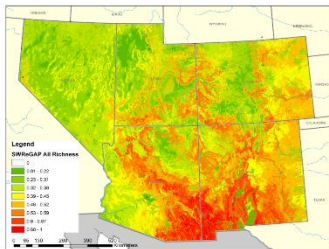


Urban Area (1)
Non Urban
Area(0)



BC 2000- All 5
Scenarios 2100
@ 10-yr increments

SWReGAP Data Set

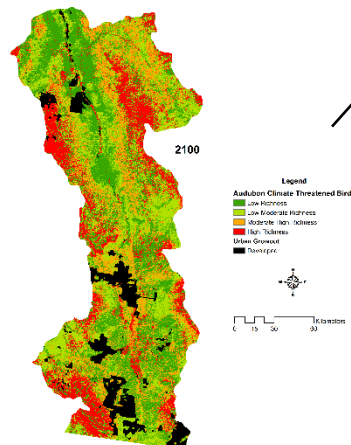


Extract



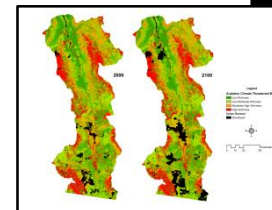
Biodiversity Metrics
derived from 452
GAP Deductive
Habitat Models

Selected Metrics

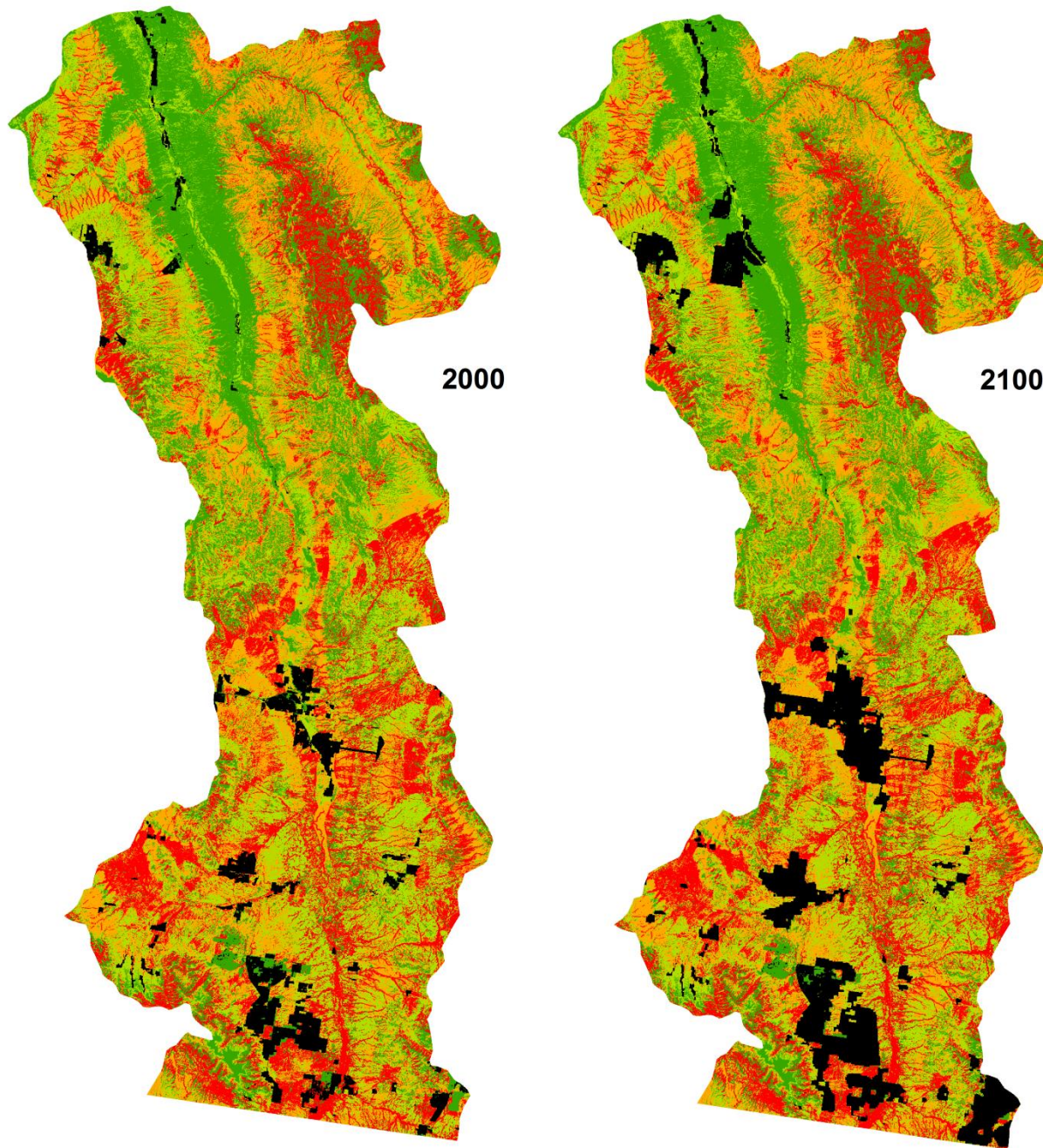


Analyze-
areas of each class of each biodiversity
metric by Non Urban areas using the
five ICLUS future development
scenarios.

Compare-
Change in square km and
percent change in area of
each metric was
compared between
baseline and all 5 ICLUS
Scenarios to year 2100



All Vertebrate Species Richness as Impacted by Scenario A2



Legend

Vertebrate Species

- Low Richness
- Low-Moderate Richness
- Moderate-High Richness
- High Richness

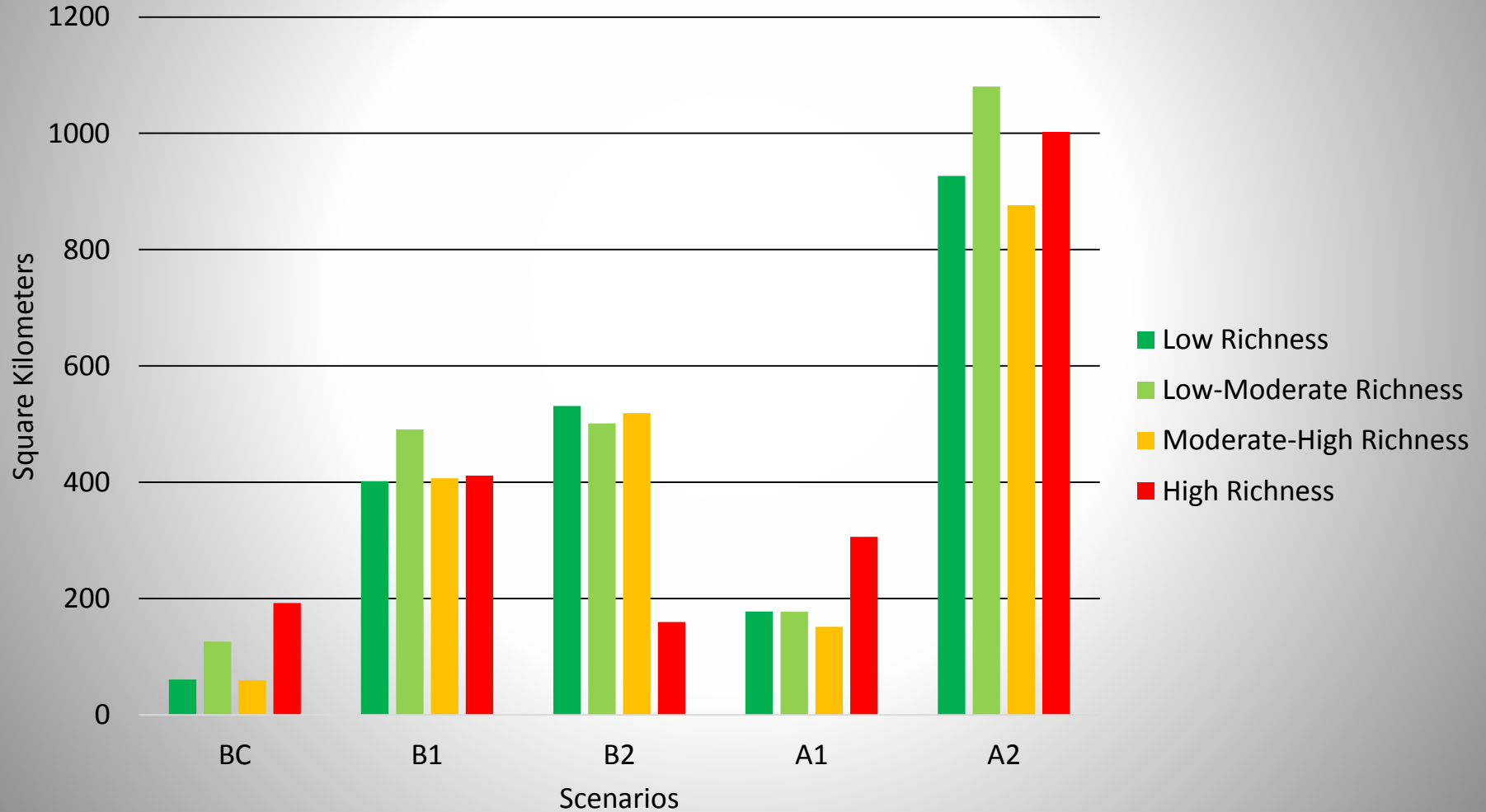
Urban Growout

- Developed

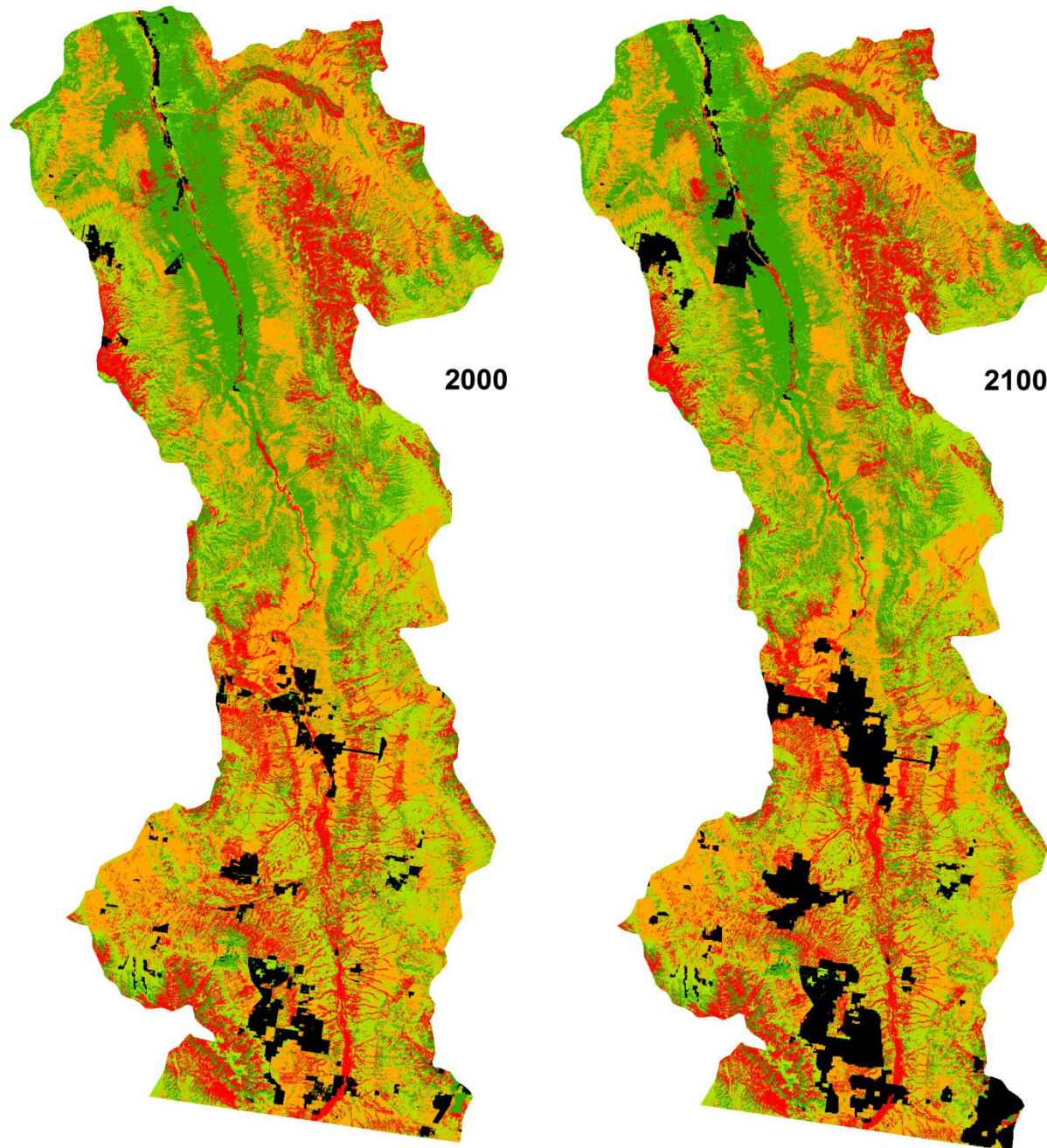


0 15 30 60 Kilometers

All Vertebrate Species



Bird Species Richness as Impacted by Scenario A2



Legend

Bird Species

- Low Richness
- Low-Moderate Richness
- Moderate-High Richness
- High Richness

Urban Growout

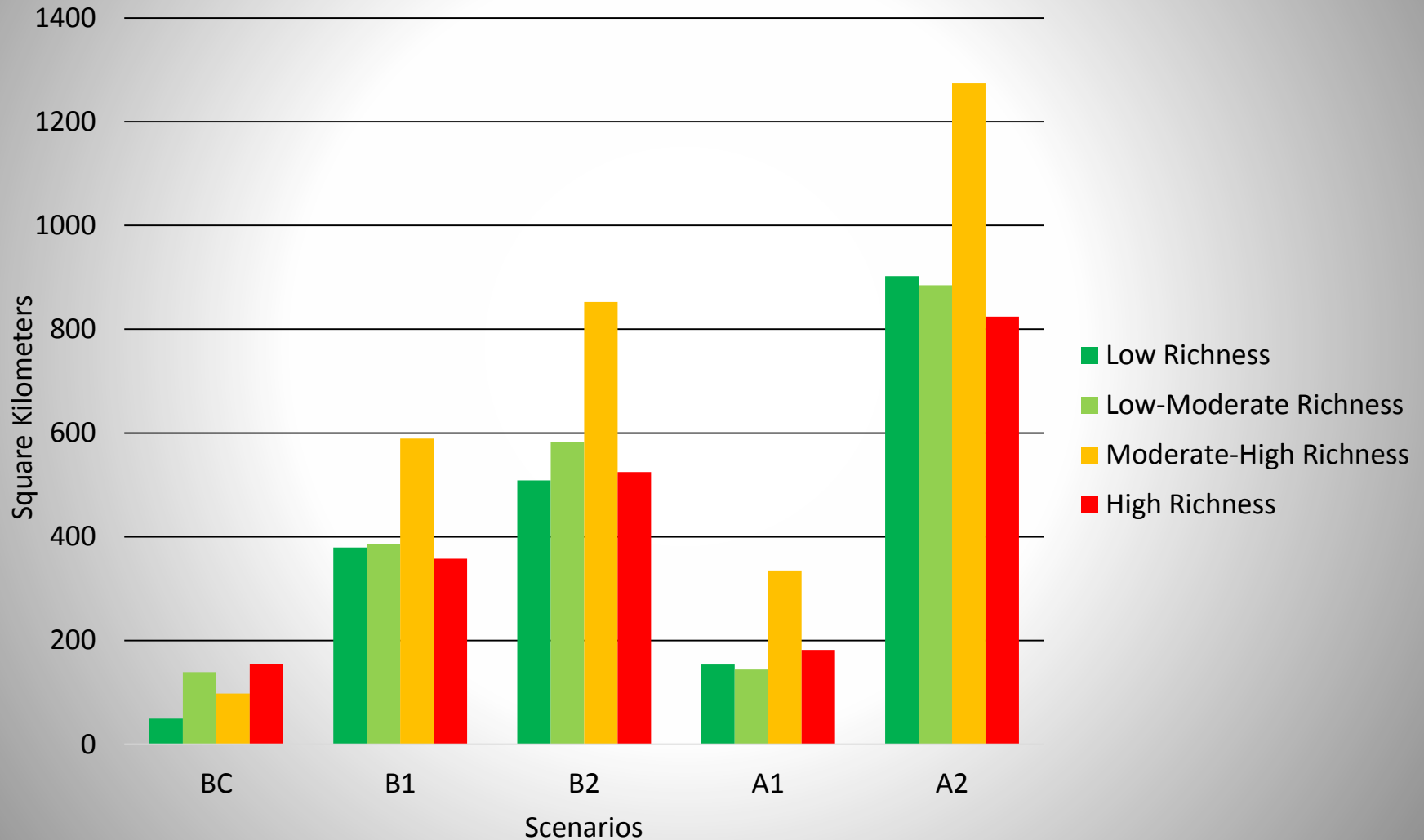
- Developed



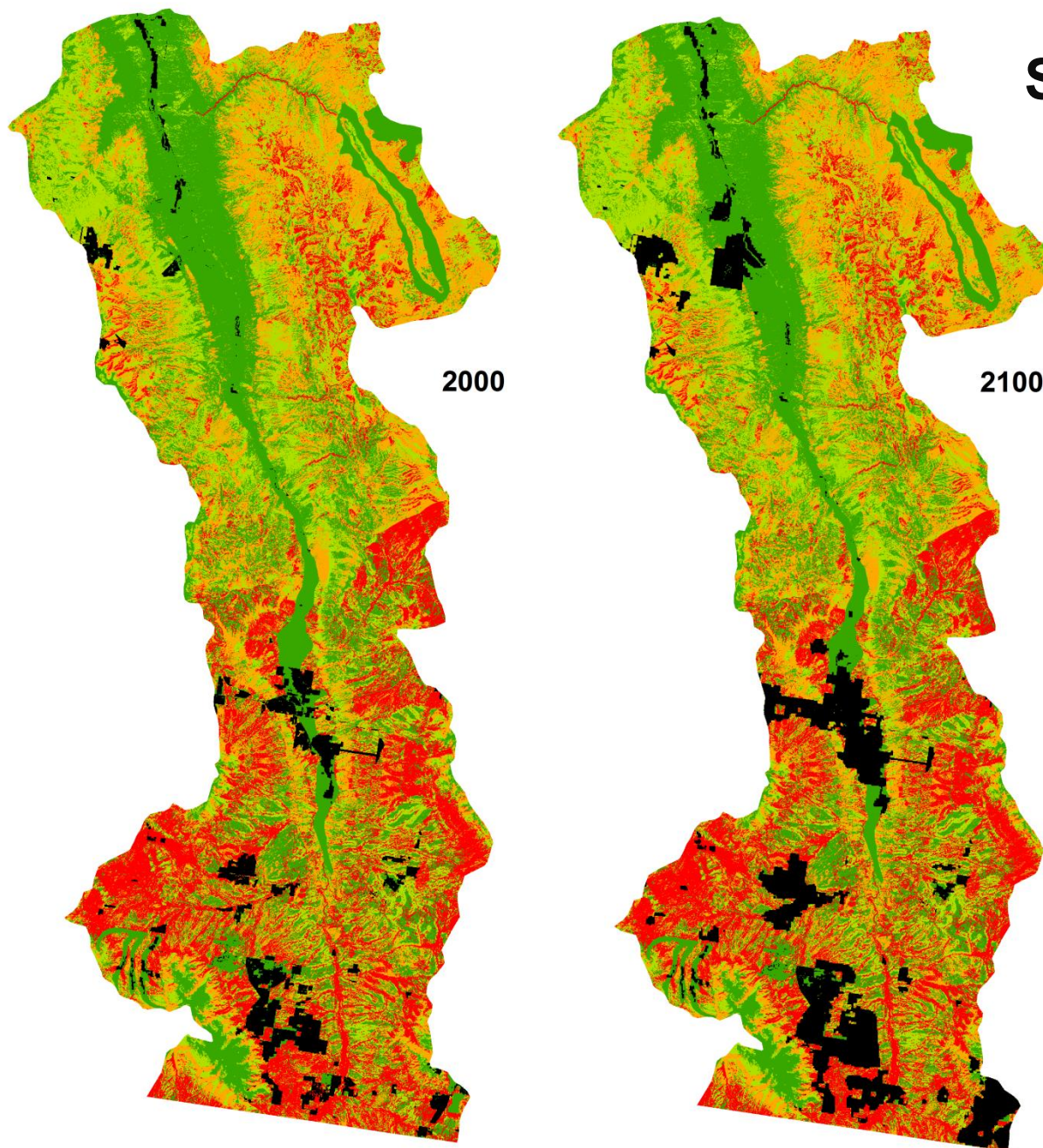
0 15 30 60 Kilometers

Total Bird Species

Change in Area for 4 Species Richness Categories



Harvestable Species Richness as Impacted by Scenario A2



Legend

Harvestable Species

- Low Richness
- Low-Moderate Richness
- Moderate-High Richness
- High Richness

Urban Growout

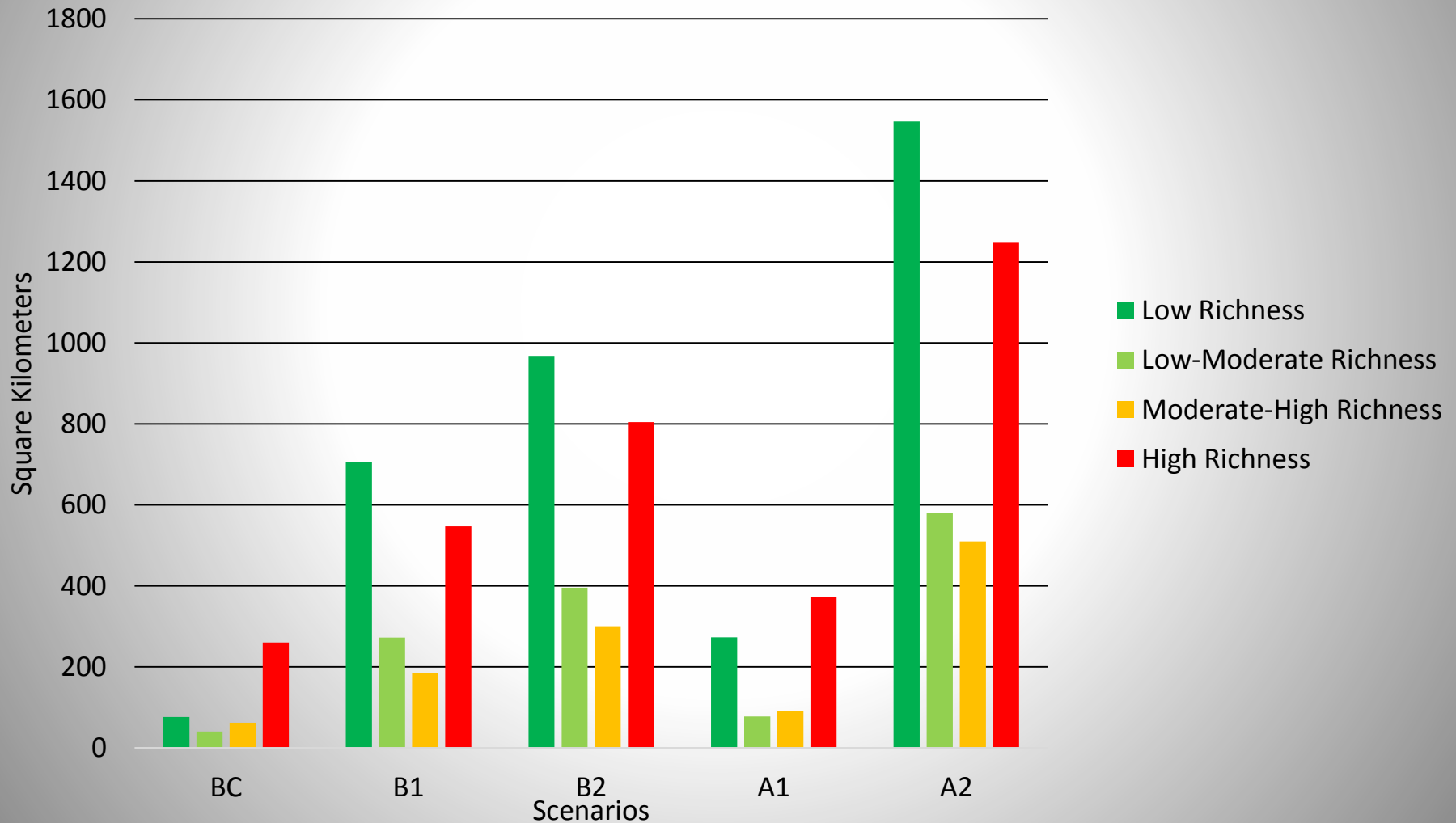
- Developed



0 15 30 60 Kilometers

Total Harvestable Species

Change in Area for 4 in Species Richness



General Conclusions



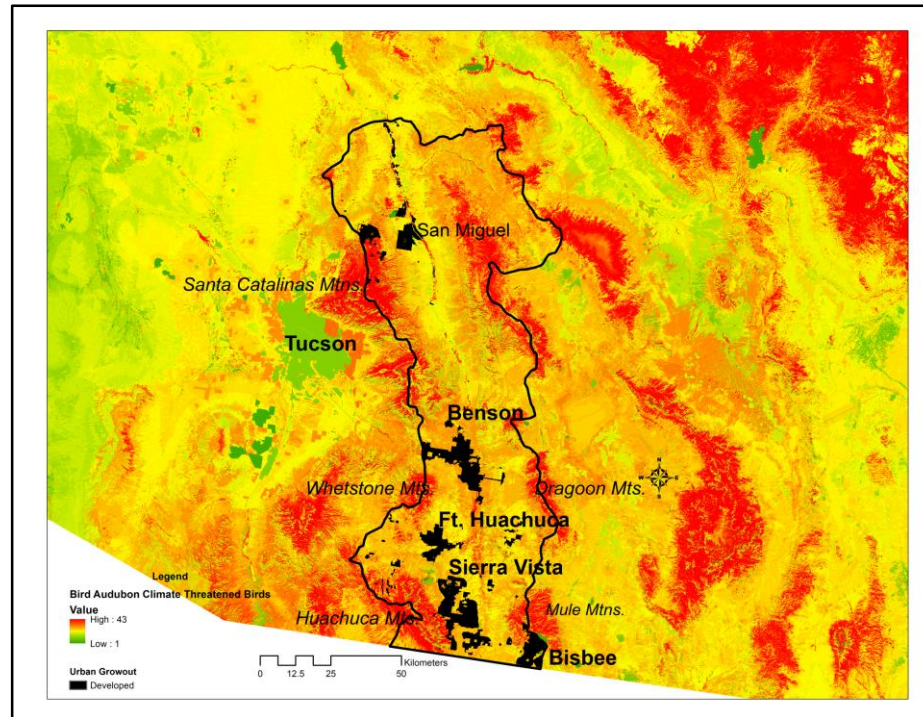
- 1) Deductive modeling provides a common sense approach for mapping and quantifying metrics of habitat provisioning, a surrogate for biodiversity, at watershed to national scales;
- 2) It provides reference condition and comparative analysis for future scenario analysis related to climate change and urbanization stressors;
- 3) Decreases in extent of area are projected for all species richness categories for the 4 metrics (of 22 tested) in the San Pedro over the next century;
- 4) Among the 5 scenarios examined, A2 (highest population growth, high fertility and domestic dispersal, and greatest land conversion to new population centers) presented the greatest increase in urban growth both in percent change & total area, and subsequently the greatest change in species richness for the 4 metrics;

<u>Biome Type</u>	<u>Total</u>	<u>Amphibians</u>	<u>Birds</u>	<u>Mammals</u>	<u>Reptiles</u>
Barren Lands	107	3	35	43	26
Evergreen Forest	263	3	146	74	40
Deciduous Forest	104	0	68	32	4
Shrub/Scrub	206	6	96	76	45
Grassland	232	5	102	80	45
Woody Wetland	301	6	202	61	36
Emergent Wetland	149	3	108	35	3
Urban/Agriculture	170	1	131	33	7
Water	94	2	79	12	1

Evergreen Forest	18.2 % Areal Extent	263 spp.
Desert Scrub	49.4 % Areal Extent	206 spp.
Grassland	27.8 % Areal Extent	232 spp.
Woody Wetland (Riparian)	1.3 % Areal Extent	301 spp.

General Conclusions cont'd

- 5) Evergreen Forest, Desertscrub, Grassland, and Woody Wetland (riparian) appear to be the most specious Biome types;
- 6) Riparian woodland and Evergreen Forest are the least extant Biome types and the most specious and thus likely most vulnerable to changes in management practice or climate variation which could affect land cover extent (and species occurrence).



- 7) Initial testing with biodiversity/habitat metrics and ICLUS scenarios appears promising and transferable to other geographies and may prove to be an important decision-making tool for impact assessment.

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<http://case.nmsu.edu/CASE/ES/>

<http://enviroatlas.epa.gov/enviroatlas/atlas.html>

