

# The Gila River-Sky Island Bioregion: A Call for Bold Conservation Action

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**ABSTRACT:** Situated at the convergence of four biogeographic provinces, the Gila River-Sky Island region of southern Arizona and New Mexico ranks among the most ecologically diverse in North America. Seven biological "core areas," consisting of 84% public land, include full representation of the region's major biotic communities as well as habitat sufficient to support its most sensitive wildlife. Unfortunately, the ecological integrity of the region is severely threatened by rapid human population growth and unplanned urbanization. Many of 23 identified habitat corridors that interlink the core areas are in jeopardy. A broad coalition of environmental and rural interests is urgently needed to conserve this region as a premier natural area of the United States.

## INTRODUCTION

In Arizona, human numbers are growing at the same ecologically unsustainable rate as in Africa (2.7%). New Mexico's annual growth rate (2.2%) exceeds that of Brazil and India (1.9%) (Hoffman 1993, U.S. Bureau of Census 1994). In seven years, Arizona will likely add the population equivalent of nearly two new Tucsons, and New Mexico will grow by four to five times the current population of Santa Fe. This explosive growth, spreading from urban areas to the countryside, is now fragmenting what may be the richest ecological region of the American West.

## BIODIVERSITY EXTRAORDINAIRE

It is hard to imagine a better cradle for biodiversity. Located at the convergence of four major biogeographic provinces (Figure 1), the Gila River-Sky Island Region (GSR) of southeastern Arizona and southwestern New Mexico features:

- a broad band of disjunct mountain ranges ("sky islands") and desert valleys favorable to genetic isolation and evolutionary change;
- north-south orientation of highlands that could aid a latitudinal shifting of species in times of climate change;
- "vertical stacking" of diverse biotic communities, from desert scrub to spruce-fir forest, resulting from an impressive elevational range (4,000-11,000 feet);
- a large contiguous mountain system (San Francisco Mountains-Mogollon Mountains-Black Range) providing a "regional center" for wildlife of temperate and northern coniferous forests; and

- the largest number of species west of the Great Plains for major taxonomic groups such as vertebrates and butterflies (Pearson and Cassola 1992, Povilitis 1995).

## BIOLOGICAL CORES AND LINKAGES

### Core Areas

Seven biological core areas are evident for the GSR (Figure 2); these consist of 84% public lands (federal and state). The core areas avoid overlap with major population centers and largely exclude primary agricultural and land-development areas (Figure 3). Nearly 9% of their total acreage is congressionally designated wilderness.

The core areas include the major biotic communities and ecotones occurring in the GSR (Povilitis 1995). The Mogollon area contains five biotic communities and nine related ecotones not substantially represented elsewhere in the core area system. Playas and associated ecotones occur in the Peloncillo area. With respect to biotic community and ecotone richness, the Galiuro area stands out as the most ecologically diverse of core areas.

Included in GSR core areas are populations of nearly all of the 156 GSR species considered to be at risk of extinction (exceptions are localized species such as Parish's alkali grass, *Puccinellia parishii* Hitchcock, in Grant County, New Mexico). The Animas and Mogollon core areas contain the largest number of imperiled species (46 and 39 species, respectively). However, the smaller Altar (1 species/124km<sup>2</sup>) and Canelo (1 species/158 km<sup>2</sup>) areas have

Rocky Mountain  
(Upper Gila) Forest

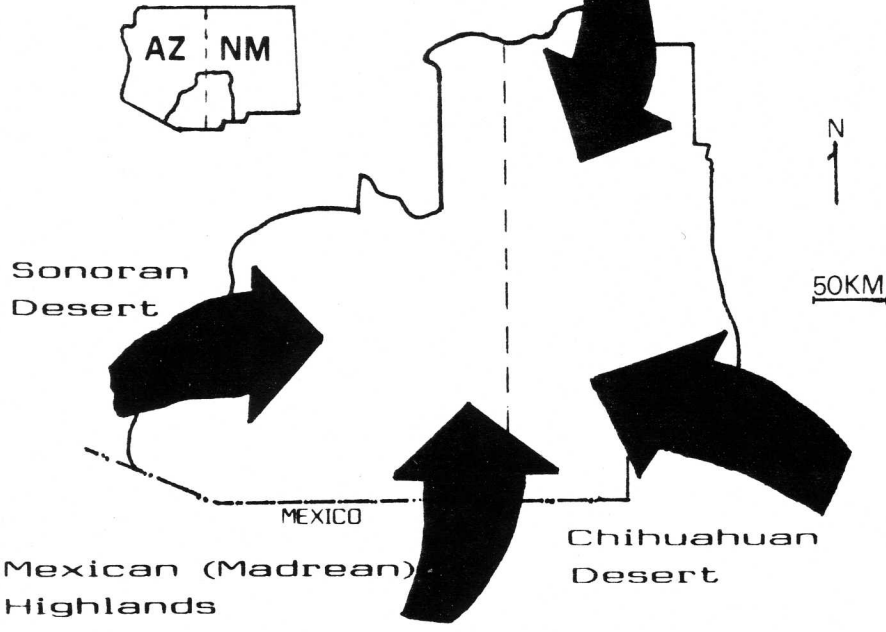


Figure 1. Convergence of biogeographic provinces, Gila River-Sky Island Area (based on Udvardy 1975, Bailey 1980, Brown and Lowe 1980).

two to four times the density of imperiled species as these areas.

Three mammalian carnivores, the desert bighorn, and the Mexican spotted owl (scientific names in Table 1) can serve as "indicator species" to test core area suitability for the region's most sensitive native wildlife. Important suitability criteria are described below.

*Habitat availability and population sizes*

The core areas total approximately 57,800 km<sup>2</sup>. This acreage falls within the 10,000–100,000 km<sup>2</sup> range believed necessary to support large wide-ranging mammals (Schonewald-Cox 1983, Newmark 1987). Available habitat within the core area system appears adequate to support significant populations of these indicator species (Table 1).

The Mogollon, Animas, and Galiuro areas provide the bulk of suitable habitat for grizzly bear (*Ursus arctos*) (85%) and wolf (*Canis lupus*) (80%). The Animas, Galiuro, and Dragoon areas are critical for jaguar (*Panthera onca*), providing approximately 70% of suitable core habitat. The Mogollon core area is essential to the spotted owl, with 85–90% of GSR spotted owl habitat located there. All core areas would help support the desert bighorn, whose viability depends on herd persistence in scattered areas of broken-terrain habitat.

*Human population density*

Population densities of greater than 2.3–4.6 persons/km<sup>2</sup> make large carnivore conservation improbable (based on criteria for the wolf: Henshaw 1979, Johnson et al. 1992). GSR core areas, with the exception of Altar, still fall within or below this range.

*Road density*

Road density should not exceed 0.58–.62 km/km<sup>2</sup> (Mech et al. 1988, for wolf; Povilitis 1993, for grizzly bear). High road densities significantly increase the rate of human-induced mortality and behavioral displacement of sensitive species. All GSR core areas fall below this threshold.

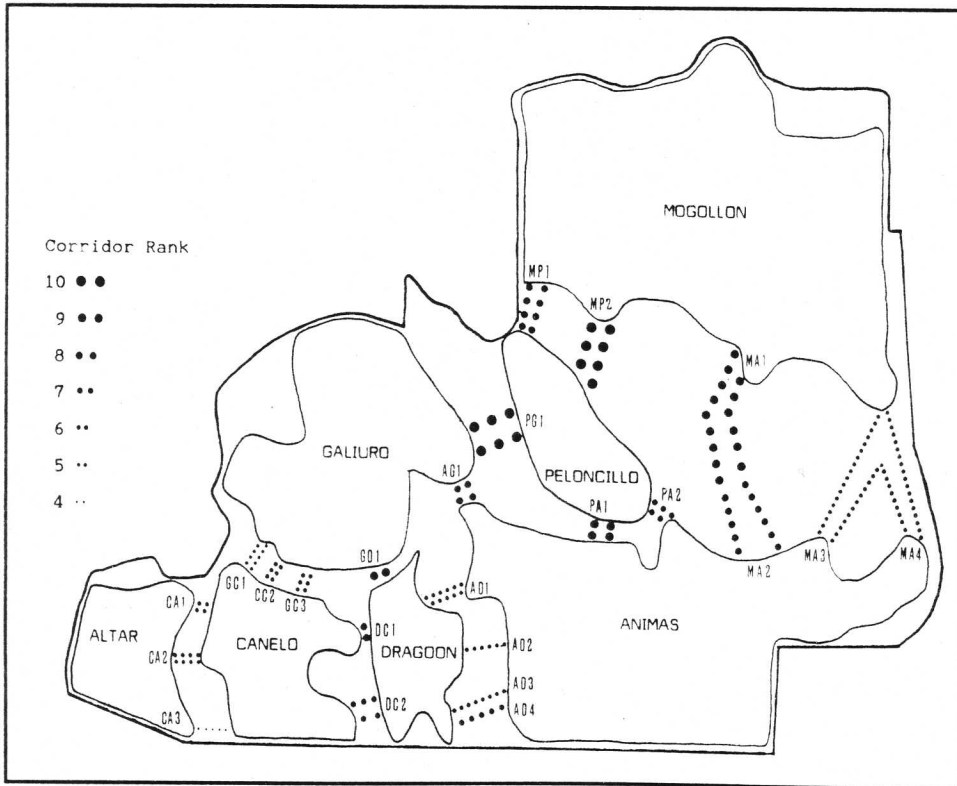


Figure 2. Biological core areas and corridors for the Gila River-Sky Island Region.

Ecological connectivity between the GSR and other regions is essential. For many species, the GSR alone cannot support population sizes (i.e., in the thousands, Soulé 1987) required for their long-term viability (on the order of centuries). The GSR alone cannot support migratory species that also depend on adjacent bioregions, nor can it provide sufficient land area for regional biotic conservation in response to future climate change resulting naturally or from the effects of anthropogenic "greenhouse" gases.

The Altar core area connects the GSR with the El Pinacate bioregion to the west, which includes the Tohono O'Odham tribal lands, Organ Pipe National Monument, Cabeza Prieta National Wildlife Refuge, and two Mexican biosphere reserves (Williams 1994). The Dragoon and Canelo areas link the biologically diverse Galiuro area directly with northern Mexico. The Animas area links the GSR with Mexico's northern Chihuahuan desert and the proposed Casas Grandes reserve (B. Miller, Universidad Nacional Autonoma de Mexico, pers. com.). The Peloncillo Mountains, which extend nearly 200 km north to south through the Peloncillo and Animas areas, provide a highland bridge to Mexico's Sierra Madre. Finally, the Mogollon and Galiuro areas connect the GSR northward with the Colorado Plateau region and central New Mexico and Arizona.

**PRIMARY THREATS TO THE BIOREGION**

Current land development, if unchecked, will destroy the GSR as a premier natural region. Development spreading east and south of Tucson along I-10 and I-19 is resulting in the closure of all major biological corridors connecting the Canelo area with the Galiuro and Altar areas. Agricultural and housing developments in the Sulfur Springs Valley threaten to sever ecological connectivity between the Animas area and other core areas to the west. Connectivity across the lower San Pedro Valley (linking the Canelo and Dragoon areas) is jeopardized by the proposed massive expansion of Fort Huachuca (U.S. Army 1992).

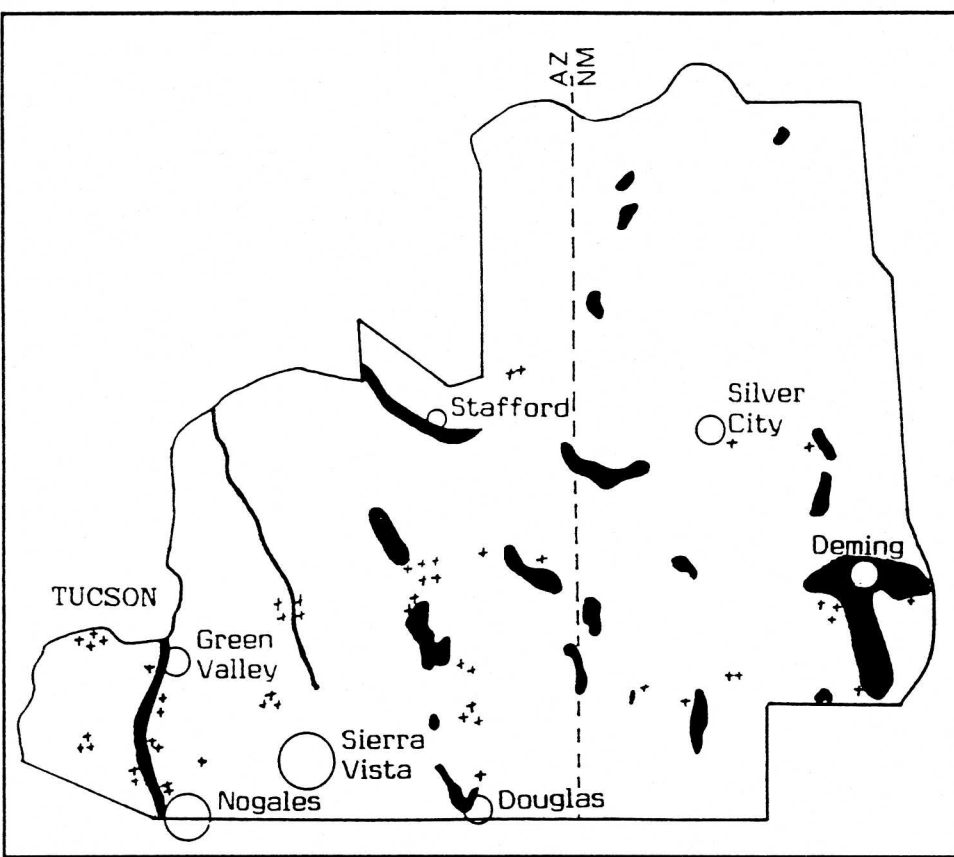


Figure 3. Primary agricultural areas (black), population centers (circles), and rural land development areas (crosses) in the Gila River-Sky Island Region (Hecht and Reeves 1981, Williams 1986, U.S. Bureau of Census 1990).

**Livestock**

Estimated livestock densities in GSR core areas range from 2.8 to 5.6 cattle/km<sup>2</sup> and 0.02 to 0.80 sheep/km<sup>2</sup> (Povilitis 1995). Livestock densities are generally lower than for the Yellowstone wolf reintroduction area (5.5 cattle/km<sup>2</sup> and 4.1 sheep/km<sup>2</sup>, peak values; U.S. Fish and Wildlife Service 1994).

**Corridors**

Twenty-three areas have been identified as primary biological corridors for the GSR (Povilitis 1994). These areas were ranked by combined numerical values for

- natural cover (i.e., land not converted for agriculture or other uses), where 3 = >90%, 2 = 50-90%, 1 = <50%;
- land development, where 3 = little or no housing development, 2 = scattered development, 1 = moderate development;

- interstate highway, where 1 = highway absent, 0 = highway present; and
- private land ownership, where 3 = <10%, 2 = 10-50%, 1 = >50%.

The Galiuro, Mogollon, and Animas areas are connected through the Peloncillo area by three "class 9 or 10" (highest ranked) corridors (PG-1, MP-2, PA-1 on Figure 2), consisting mostly of public lands. Corridors directly connecting the Animas area to other core areas rank lower, primarily because of private land development along Interstate highway 10 (I-10) and in Sulfur Springs Valley (between the Dragoon and Animas core areas).

A "class 9" corridor (GD-1) of mostly public land connects the Dragoon and Galiuro areas across I-10. Other corridors interlinking the Dragoon, Galiuro, Canelo, and Altar areas ranked lower largely because of private land development.

**Table 1. Estimated suitable habitat and potential population size for selected conservation indicator species for the Gila River-Sky Island Region.<sup>a</sup>**

Species	Suitable Habitat (km <sup>2</sup> )	Population Size
jaguar ( <i>Panthera onca</i> )	38,000	429
grizzly bear ( <i>Ursus arctos</i> )	42,200	587
Mexican wolf ( <i>Canis lupus</i> )	42,200	118–274
desert bighorn ( <i>Ovis canadensis Mexicana</i> )	12,200	610–5,002
Mexican spotted owl ( <i>Strix occidentalis lucida</i> )	4,100–5,800	313–446 adult pairs

<sup>a</sup> Potential population sizes were derived by applying animal density estimates to estimated suitable habitat in the GSR:

**Jaguar:** 1.4 animals/100 km<sup>2</sup> for madrean evergreen woodland and semi-desert grassland (probable primary jaguar habitat, Brown 1983) and 0.5 animals/100 km<sup>2</sup> for other habitats. Since density data are unavailable for jaguar in the Southwest, population density figures for mountain lion (*Felis concolor*) were substituted (Donaldson 1975, McBride 1976). The Mogollon area was excluded because of the absence of madrean evergreen woodland and semi-desert grassland.

**Grizzly bear:** 1.39 animals/100 km<sup>2</sup> (Povilitis 1993) for all habitat except desert basins and flats.

**Mexican wolf:** 0.28 animals/100 km<sup>2</sup> (Bednarz 1988) to 0.65/100 km<sup>2</sup> (U.S. Fish and Wildlife Service 1987) for all habitat except desert basins and flats.

**Desert bighorn sheep:** 5.0 animals/100 km<sup>2</sup> (San Andres Mountains, N.M.; A. Fisher, New Mexico Game and Fish Department, pers. com.) to 41.0 animals/100 km<sup>2</sup> (R. Schumacher, Refuge Manager, Cabeza Prieta National Wildlife Refuge, Arizona, pers. com.) for broken terrain habitats.

**Mexican spotted owl:** 8.28 adult animals/100 km<sup>2</sup> for national forest land and 6.4/100 km<sup>2</sup> for other suitable forest habitat (McDonald et al. 1991).

Throughout the GSR, the situation is much the same. Major linkage zones between biological core areas are imperiled because they are in large degree “developable” lands. If current land development trends continue, the GSR will be fragmented to the point where bioregional conservation will be impossible.

## CONSERVATION ACTION

Conservation on a grand scale for the GSR may seem an impossible undertaking. Indeed, human commitment, involvement, and cooperation on an unprecedented regional level will no doubt be needed. Yet there is a real basis for hope.

First, a plethora of home-bred organizations, already working in the GSR, could join together to address the land development crisis. These include the Border Ecology Project, Forest Guardians, Gila Watch,

the Greater Gila Biodiversity Project, the Sky Island Alliance, the Sonoran Institute, and the Southwest Center for Biodiversity. Second, there is a large, politically untapped public constituency for the rural Southwest. The ideal of a healthy, wholesome rural America is still powerful in our society. Third, the human population density of the GSR, for now, remains comparatively low (approximately 5 people/km<sup>2</sup>), and much of the land of the region (74%) is publically owned.

To preserve the ecological integrity of the GSR, a regional coalition of environmental groups, community leaders, landowners, businesses, local governments, and concerned citizens is needed. The fact that a broad range of land-based traditions, lifestyles, and interests are at stake should help unite citizens. Broad-based efforts at bioregional organizing for conservation

and sustainability are already underway for other areas of the United States, such as Yellowstone (Greater Yellowstone Coalition 1994), the Southern Appalachian Mountains (Council on Environmental Quality 1990), and the San Juan Mountains (Greater San Juan Partnership 1995).

At this critical time, a major coalition for conservation and rural sustainability is the best (and perhaps only) hope for an ecologically intact GSR. In the short run, such a coalition must at least slow down the pace of “rural sprawl.” Its primary aim should be to aggressively promote land conservation agreements and policies that can protect key ecological areas and, ultimately, bring the region’s explosive land development and population growth under control.

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