

# SPECTACLED BEAR CONSERVATION AND DISPERSAL CORRIDORS IN VENEZUELA

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**Abstract:** The spectacled bear (*Tremarctos ornatus*), depends on the mountain forests along the Andes Cordillera. This means that in Venezuela this species has 2 distinct ranges. Perijá, with 8,052 km<sup>2</sup> of continuous forest, is the most important for bear conservation, with low human interference and 33.5% of its area protected as national park. Cordillera de Mérida, with 13,348 km<sup>2</sup> of total forest area, is fragmented into 4 blocks where bear populations are threatened and likely to lose the potential for genetic exchange. Its largest block has 10,072 km<sup>2</sup> of forest, still keeping habitat continuity over a 310-km mountain axis, and has 5 national parks protecting 40% of the total area. To preserve the remaining unprotected habitats and dispersal corridors is a major policy of the National Park Service. Venezuelan Andes bear conservation depends on such a policy and on the effective management of protected areas in Colombia, where wilderness continuity still exists along both ranges.

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Spectacled bear in Venezuela depend mainly on humid mountain forests along the Andes Cordillera (Yerena 1988, Goldstein 1990). This comprises 2 distinct and isolated ranges extending from the Colombian Cordillera Oriental. The first area running north is the Perijá Sierra with 8,052 km<sup>2</sup> of forested slopes. This is perhaps the most important for bear conservation in Venezuela, containing low human interference habitats. One-third of this area is national park habitat, and continuity exists in adjacent Colombia, where a new national park exists (Fig. 2).

The second range is the Mérida Cordillera, with 13,348 km<sup>2</sup> of forested slopes potentially suitable for bears, but the bear populations are more threatened there (Goldstein 1990). This Cordillera is almost

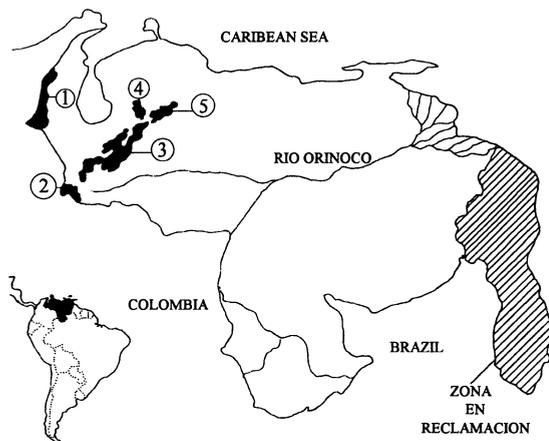
entirely fragmented into 4 wilderness blocks (Fig. 1), the most important being the central one. On this block there are 5 national parks comprising 3 conservation units (Fig. 2), that have 3,499 km<sup>2</sup> of forested bear habitat.

Fragmentation and isolation between populations is probably the most important long-term threat to bear conservation in this region. Among these 3 conservation units habitat continuity is not definitely lost yet. We address the need for maintaining habitat continuity among these units through dispersal corridors interconnection, along a 310-km mountain axis. The purpose of this study is to design an interconnected and functional natural protected areas system for the Central block of the Mérida Cordillera, which will allow long-term survival of the spectacled bear.

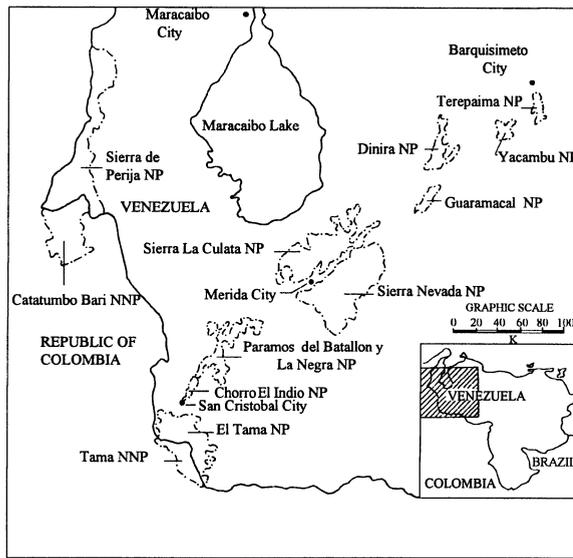
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## METHODS

The central block was surveyed through remote sensing Thematic Mapper Landsat images (path row 6-54 and 7-54, 11 Jan 1988). They were specifically processed to discriminate wilderness areas at a general scale of 1:250,000 and also at a scale of 1:50,000 for potential corridors areas. Extensive ground checking, recognition flights, and conventional air photographs allowed for a good image interpretation. Types of recognized ground cover were: nondisturbed forest and shrubs, páramo (high altitude grasslands), desert páramo, early secondary growth forests and secondary growth shrubs, cultivations, and pasture grounds.



**Fig. 1. Major wilderness blocks of the Andes Cordillera in Venezuela, where spectacled bear populations are located: 1. Perijá, 2. Tama, 3. Central, 4. Dinira, 5. Portuguesa. Source: E. Yerena and I. Goldstein.**



**Fig. 2.** Venezuelan National Parks (NP) of the Andes Cordillera and transboundary Columbian Natural National Parks (NNP). Source: Inparques, Inderena, E. Yerna, V. Vera.

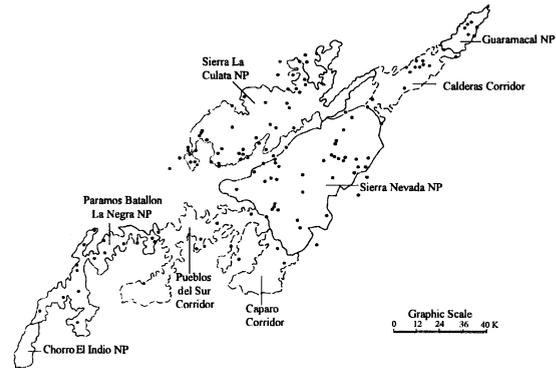
Extensive field trips were conducted to gather evidence of bear presence, with special reference to locality exactitude, date periodicity, and confidence of the evidences.

Field evaluations also included social aspects in order to perceive tendencies and conflicts in land use and environmental issues. All fieldwork was accomplished between 1986 and 1991. Superimposing wilderness cover information on bear localities and knowing land-use tendencies allowed us to identify the most suitable areas for bear conservation. Interconnection corridors alternatives were drawn on topographic maps (Scale 1:50,000) with lines or boundaries following relief forms, contour lines, streams, and ridges. A main criteria used for corridors was to include as wide an area as possible, within the conservation-suitable areas.

The final result was an integrated wilderness-cover and bear-location map, with closed boundaries encompassing existing conservation units and proposed linking corridors (Fig. 3) with correspondent areas calculated (Table 1).

**RESULTS**

Within the central block of Mérida Cordillera, 7 wilderness area subunits were identified, 4 of these almost completely protected as national parks. The 3 remaining subunits could well serve as lines between the others (Fig. 3 and Table 1). Among these subunits



**Fig. 3.** Proposed interconnection of existing national parks through dispersal corridors in the central Andes Cordillera of Venezuela. Dots show confirmed spectacled bear localities. Source: E. Yerna.

there are not significant disruptions, except for the contact zone between the Sierra Nevada and Calderas subunits, where the continuity had been broken because of a 2-lane motor road, surrounded by agriculture-derived secondary growth vegetation. The core area of the system comprises the Sierra Nevada-Sierra La Culata National Parks, linked by a contiguous páramo "bridge." From this conservation unit, 2 large corridors could extend to the northeast and to the southwest, along the continuous forested areas and the páramo highlands of the cordillera. Within these corridors we have identified evidences of regular bear presence. Therefore, if these habitats are preserved and illegal hunting is stopped, these corridors should be effective for long-term dispersal and/or used as residence areas by the bears. Adequate legal status for corridors is national park or natural monument, which are proved and successful management categories.

The best quality habitat for Andean bear is the mountain forests, humid to seasonal types. Páramo ecosystems are only used seasonally for feeding purposes, even though they can play an important role in bear dispersal. Among the different páramo types, the desert páramo (Monasterio 1980) is the least suitable for bear-feeding needs. From our studies we have identified the following habitats as being unsuitable for bear conservation (Table 1): desert páramo, cultivations, and pasture grounds. Certain habitat types have not yet been fully evaluated, and among these we include (Table 1): early secondary growth forests or secondary growth shrubs and areas under cloud cover. As a consequence we estimate that nondisturbed forest shrubs provide up to 4,598.72 km<sup>2</sup>

**Table 1. Total area (ha), habitat cover (ha), and altitudinal range (m) of conservation units and proposed corridors, located on wilderness subunits, for a spectacled bear conservation system in the central block of the Mérida Cordillera.**

Wilderness subunit	Conservation unit total	Bear habitat cover				Altitudinal range
		Forest	Páramo	Not suitable	Not evaluated	
Guaramacal NP <sup>a</sup>	21,466	20,535	800	131	---	1,500-3,100
Calderas Corr. <sup>b</sup>	60,169	22,563	13,450	950	23,206	
Sierra Nevada NP	276,500	172,437	77,813	8,594	17,656	300-5,007
Sierra La Culata NP	200,400	89,931	100,469	10,000	---	800-4,700
Caparo Corr.	49,842	32,968	0	312	16,562	
Pueblos del sur Corr.	94,993	54,368	12,813	1,875	25,937	
Batallón-El Indo NP	98,500	67,070	12,218	4,838	14,374	1,200-3,900
Total	801,870	459,872	217,563	26,700	97,735	

<sup>a</sup> National Park.

<sup>b</sup> Proposed Corridor.

of relatively continuous bear habitat. This area shall be used as a base for our estimations of potential effectiveness of the proposed bear conservation system.

As no spectacled bear fieldwork-based density has ever been estimated, we follow Peyton's (1984) comparisons to American black bear. We use a low-density estimate of 0.11 black bear/km<sup>2</sup> (Erickson and Petrides 1964 *in* Peyton 1984). In reality, *T. ornatus* densities could be higher, because, theoretically, any given mammal should have a smaller home range if moved from a low productivity (available energy) habitat (i.e., temperate coniferous forest) to a high productivity habitat (i.e., a tropical mountain moist forest) (Harestad and Bunnell 1979); this could imply a higher population density if food resources are relatively evenly distributed. Nevertheless, if we take the 0.11 black bear/km<sup>2</sup> density estimate, we can extrapolate an Andean bear population of 505 individuals, which could be protected under this linked conservation area system.

If we follow a home-range approach interpolating the spectacled bear mean body mass (100 k) (Suárez 1985) into the body-weight home-range statistical relationship (Harestad and Bunnell 1979), we get a theoretic home range of 48.57 km<sup>2</sup>. If we also assume no home-range overlapping (probably far from reality) among bears we get an estimate of 94 individuals, according to habitat availability.

Our field evidence, based on skilled hunters' interviews and direct physical signs, indicate the presence of at least 3 bears (breeding pair and cub, over 18 months) in a semi-isolated forest tract of 70.75

km<sup>2</sup>. This evidence also tells us about 10 possible different individuals in another 227.35 km<sup>2</sup> forest. This evidence suggests a possible density of 0.04 bears/km<sup>2</sup> in both cases. Extrapolating to the total forest amount we get an estimate of 183 individuals.

## DISCUSSION

A reasonably optimistic estimate of the total number of bears living in the proposed conservation system is 505 individuals. Assuming this is true, is this population large enough to assure long-term survival? It has been suggested that to keep enough genetic variability for genetic adaptation, any population should be at least 500 individuals (Frankel 1983). Rockwell and Foote (1988) applied a minimum viable population (MVP) analysis on the world captive spectacled bear population, resulting in an effective population ( $N_e$ ) estimation of 482 individuals, to retain 90% genetic diversity over 200 years. According to the global population ( $N$ ) to  $N_e$  relationship ( $N/N_e = 0.5$ ),  $N$  should be 964 individuals.

It is probable that the population structure of such a captive population has no similarity to that of our wild population, although we can expect the latter to have a healthier functioning and structure. This means  $N_e$  could be smaller. However we can suggest that: (1) there is no optimistic certainty about the long-term survival probability of our bear population under the proposed linked system; (2) such a system should offer improved probabilities for population long-term viability than the existing isolated conservation units, and; (3) to

raise to even more confident levels of viability certainty, it should be necessary to link the whole proposed system (central block) to the rest of the conservation units located in the adjacent wilderness blocks (Tamá, Dinira y Portuguesa, see Fig. 2).

The need for coordinated field and captive spectacled bear research (Rockwell and Foose 1988) is even more urgent today, to get real field data on density, home range, population structure, and genetic variability, in order to significantly adjust this interconnected strategy. We also think it is time to start actions to establish a coordinated captive propagation and wild population management program, searching for reintroduction, relocation, or managed migration goals. This technology must be rapidly acquired and adapted to South American institutions.

Real and political viability for these proposed corridors has been evaluated positively. Venezuela has laws, policies, and schemes of understanding of the need to match economic development and natural landscape limitations. The areas proposed as corridors are the same as those needed for watershed protection for hydroelectric and agriculture dams. Preserving natural vegetation cover is a necessity for these developments. Also, historic and agroecologic limitations for agriculture frontier expansion, as well as modern tourism needs, favor the protection of lands included within the proposed corridors.

## MANAGEMENT IMPLICATIONS

The linking of conservation units using a corridor system approach must be extended on a continental scale. Its social and ecological benefits can be easily promoted and accepted in Andean countries. Restricting this approach to subregional or national levels will not provide long-term conservation benefits. In Venezuela the 2 starting points of the Andes Cordillera have conservation units with their respective counterparts across the Colombian political boundary (Fig. 2). This can be the starting point for the setting up of other similarly linked systems, farther into Colombian territory.

The spectacled bear is an optimal species to be used as a design criteria for a whole Andean conservation system. Any comprehensive action plan devised for the conservation of the spectacled bear will serve as a

conservation plan (Yerena and Suárez 1989) for tropical Andean biodiversity if such a linked conservation unit approach is adopted.

Andean bear conservation in Venezuela depends on the success of keeping or restoring continuity between various populations, including the Colombian populations across the political divide.

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