

Andean bear management needs and interactions with humans in Colombia

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Abstract: Andean bears (*Tremarctos ornatus*) in Colombia face serious threats, including hunting, habitat loss, and bear–human interactions. Interactions are increasing, but data about these encounters are not consistently compiled. Likewise, bear management needs have not been evaluated. Solutions to these threats and needs are complex and will depend upon biological as well as cultural and political considerations. The objectives of this paper are to (1) quantify and characterize recent bear–human interactions in Colombia with respect to type and geographic distribution, and (2) identify conservation threats within the context of a general management program for Andean bears in Colombia. The study area is the entire range of the Andes Mountains in Colombia. The study is based on 43 written responses to surveys distributed during the early part of 1997 to local government officials that summarized 257 bear–human interactions at 94 localities (138 observations, 66 attacks or depredation, 34 hunting kills of bears, and 19 live captures or sale of parts). Interactions were reported most frequently in the Eastern Cordillera (108). This was explained by recent increases in the level of human activities in that region. We recommend (1) that the survey be continued to estimate bear–human interaction trends, and (2) that Colombian officials focus their bear conservation and management activities on the Western and Eastern Cordilleras, in areas where human density is lowest and the amount of natural forest is greatest, but where deforestation as a result of human colonization is increasing.

Key words: Andean bear, bear–human interactions, Colombia, crop depredation, hunting, interviews, livestock depredation, management, *Tremarctos ornatus*

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Andean bears in Colombia face serious threats (Orejuela and Jorgenson 1999, Jorgenson in press). Bears occupy mid-level elevations in areas undergoing development. As a result, bears are especially vulnerable to local hunters—despite the fact that hunting of the species is outlawed in Colombia—as they move about seeking refuge (Jorgenson and Rodríguez 1986, Lozada 1989). Bear habitat also is declining in quantity and quality as the agricultural and timber harvest frontier expands into areas used by the species (Posada et al. 1997). Many bears occupy national parks, but even parks and other natural habitats face severe threats (Andrade 1993, Etter 1993, Dávalos 2001, United Nations Office

on Drugs and Crime 2004a:32,80). Other taxa such as mountain tapir (*Tapirus pinchaque*; Lizcano et al. 2002) and birds (Álvarez 2002) are also threatened. Given these critical circumstances, an evaluation of the status and general management needs for Andean bears in Colombia is urgent.

A thorough evaluation requires basic information about the biology, ecology, and behavior of the species (Rodríguez and Lozada 1989). More specifically, it should estimate or monitor abundance, distribution, habitat, population trends and threats, and human activities in bear areas. While basic biological studies are important, they also are costly and require years to complete (Rodríguez 1991). Monitoring, on the other hand, often can provide much of the necessary information at reduced costs, but this information may not be as precise as that obtained through intensive studies.

In 1997, we surveyed local government officials to obtain baseline information about Andean bear distribution and abundance in Colombia. The goal of the survey

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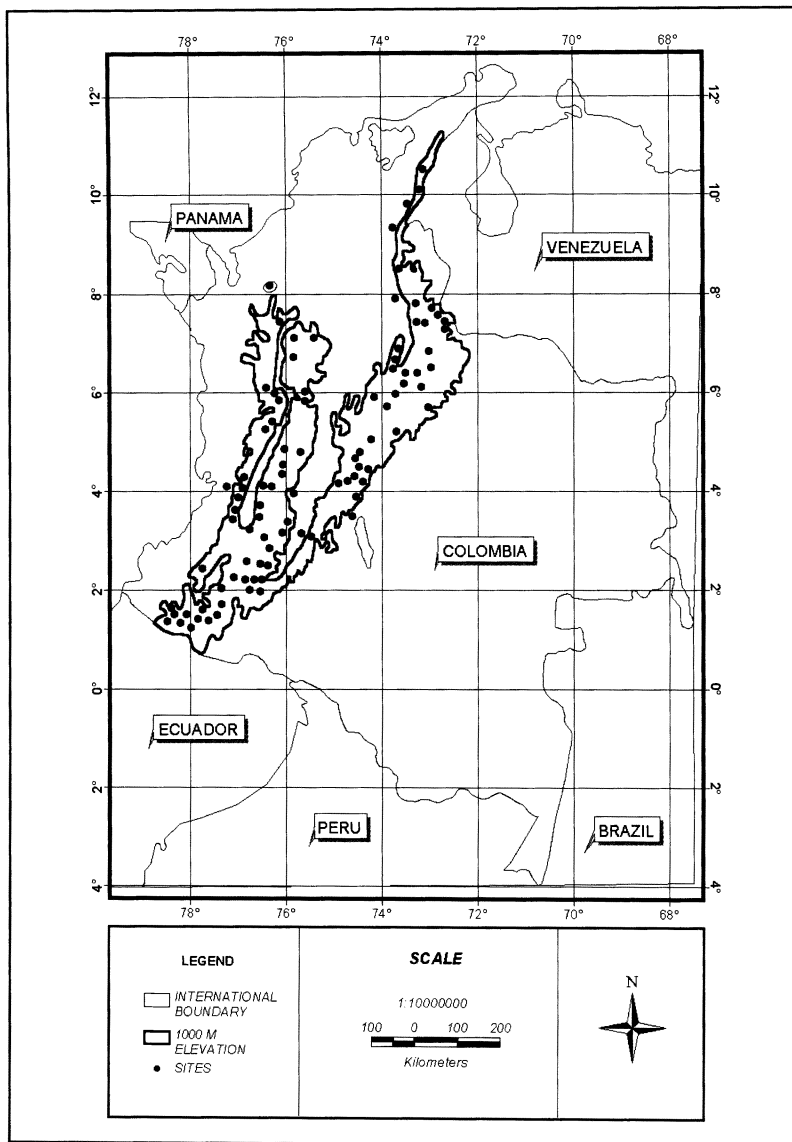


Fig. 1. Distribution of bear–human interactions ($n = 257$ interactions at 94 sites) in Colombia, 1992–97. Multiple interactions at same or adjacent sites were combined (each point represents on average 2 or 3 interactions). Area circumscribed by the thick line represents the region $\geq 1,000$ m elevation (prime bear habitat). In areas with reduced levels of human activities, however, Andean bears occupy much lower elevations.

was two-fold: to obtain general information about bear distribution and to obtain specific information about bear–human interactions. In Colombia, bear–human interactions between Andean bears and local residents are increasing (Rodríguez et al. 1986). Colombian residents report instances of crop and livestock depredation by bears as well as illegal hunting of adults for skins

and meat and the capture of young bears for use as pets (C. Lora, Chingaza National Park/Ministerio del Medio Ambiente, Bogotá, Colombia, personal communication, 1997), but these data are not compiled in a consistent manner. Colombian natural resource management officials are unable to quantify accurately the extent of problems or to propose a meaningful management program for the species. Consequently, although a national bear program has been developed (Ministerio del Medio Ambiente 2001), it has yet to be implemented fully, and local residents continue to kill problem bears or degrade bear habitat. Hunter-induced mortality, as well as the cumulative effects of deforestation, agriculture, livestock grazing, and other human activities, probably stress the population of Andean bears in Colombia, but little supporting evidence is available.

The objectives of this paper are to (1) quantify and characterize recent bear–human interactions in Colombia with respect to type and geographic distribution, and (2) identify conservation threats within the context of a general management program for Andean bears in Colombia. Ultimately, this information will be used to prioritize actions to reduce conflict and to assist Colombian officials in implementing the recently developed national management plan for the species to identify areas where bear–human interactions are occurring.

Study area

The study area is the entire range of 3 cordilleras of the Andes Mountains in Colombia ($352,150 \text{ km}^2$ or about 23% of Colombia; Instituto Geográfico Agustín Codazzi [IGAC] 1996; Fig. 1). The Western Cordillera has the smallest surface area and lowest average maximum elevation (about $76,000 \text{ km}^2$ and 2,000 m, respectively),

whereas the Eastern Cordillera has the largest surface area and highest average maximum elevation (about 130,000 km² and 3,000–3,500 m, respectively). Numerous mountain peaks in each of the cordilleras exceed 4,000 m in elevation. Human population density is greatest in the Western (56.8 people/km²) and the Central Cordillera (61.4 people/km²) and least in the Eastern Cordillera (32.5 people/km²). Only about 26% of the original forests of the 3 cordilleras remains (Ministerio del Medio Ambiente 1996:3).

Methods

We surveyed national park officials, extension agents (known locally as UMATAS [Unidad Municipal de Asistencia Técnica; Municipal Technical Assistance Unit]), and officials of regional natural resource management agencies asking for information on bear–human interactions and a description of the official’s jurisdiction. We received 43 responses. Although sampling effort was not equal, essentially all appropriate offices in each of the 3 cordilleras received a survey form. The survey form asked for the following information: date and place of the bear–human interaction, type of interaction (observation, hunting kill, bear sign, or bear tracks), type of depredation (cattle, sheep, goats, horses, corn or crop, or other), details on captures of live bears or sale of bear parts, products, or derivatives (for example, claws, teeth, hides, processed meat, and oil), name and address of the person who took part in the interaction, and names of other collaborators potentially able to provide information about bears. Data were summarized for 1992–97, but about 91% of the interactions occurred during 1994–96.

Survey forms were distributed only to officials in the 3 cordilleras of the Andes because bears do not frequently occur in lowland areas in Colombia (<1,000 m) due to high levels of human activities there (D. Rodríguez, Ministry of the Environment, Bogotá, Colombia, personal communication, 1997). In most cases, respondents were not personally involved in the interaction; rather, they reported information provided by local residents. Results were summarized by cordillera to account for regional differences in the habitat and in the nature and extent of human activities. Given the voluntary nature of the survey, the reported levels of bear–human interactions may not reflect actual levels. However, we assumed similar reporting rates for each cordillera.

Many of the respondents reported several independent interactions at the same location, as well as interactions at adjacent sites. These interactions were treated separately in the data compilation.

Table 1. Summary of bear–human interactions by type of interaction and geographic distribution (cordillera) in Colombia, 1992–97.

Interaction	Cordillera (Number of observations)			Total observations	
	Western	Central	Eastern	Number	%
Observations ^a	40	42	56	138	53.7
Attacks or depredation ^b	29	10	27	66	25.7
Hunting kills of bears	15	1	18	34	13.2
Capture or sale ^c	6	5	8	19	7.4
Total (observations)	90	58	109	257	
Total (%)	35.0	22.6	42.4		100.0

^aIncludes visual sightings, bear sign, and tracks.

^bIncludes depredation of crops and domestic animals and 2 instances of aggressive behavior by bears toward humans.

^cIncludes live captures and sale of parts, products, or derivatives (claws, teeth, hides, processed meat, and oil).

Results

Four types of bear–human interactions were reported in the survey: 138 observations, 66 attacks or depredations, 34 hunting kills of bears, and 19 live captures or sales of bears or bear parts (Table 1, $n = 257$ interactions).

Most attacks or depredation were on crops (36 of the 66 interactions [54.5%]; primarily corn) and domestic animals (39.4%; primarily cattle; Table 1). There were no reports of injuries or unprovoked bear attacks on humans. However, there were 2 accounts of bear aggression toward humans. In one case, young children observed a bear at close range without incident, but were subsequently pursued for a short distance when the bear became aggressive. In the second case, a farmer had an aggressive encounter with a bear while defending his pigs from the bear, but neither farmer nor pigs were injured.

Bear–human interactions were most frequent in the Eastern Cordillera (108 interactions; Table 1; Fig. 1). Observations (56 of 138), hunting kills (18 of 34 interactions), and live captures or sale of parts, products, or derivatives (8 of 19 observations) were all more frequently reported in the Eastern Cordillera; only interactions categorized as attacks or depredation were more frequent in the Western Cordillera (29 of 66; Table 1).

Based on personal contacts with respondents, we estimated that as many as 50% of bear–human interactions were not reported to us for this survey. Reasons for not reporting interactions included a lack of interest by the officials who received the survey and the non-mandatory survey response. We did not detect any reporting bias by type of interaction or geographic

distribution. Hunting kills of bears were likely under-reported due to the illegal nature of the activity.

Discussion

The results of this survey suggest 2 important points. First, written surveys sent to local officials can be used to characterize bear-human interactions. The 43 responses provided information on 257 interactions during 1992-97 throughout the geographic range of the species in Colombia. Although coverage was not as complete or detailed as we would desire, the responses provided an excellent starting point from which to plan additional surveys and Andean bear conservation programs.

The second important point relates to the nature of the interactions. Interactions categorized as observations were relatively common (54% of total). Although conflicts with bears were less commonly reported, the frequency of conflicts (46%) is important to conservation. Each case of crop or livestock depredation, for example, could result in the death of the offending bear by the affected farmer or rancher. Interactions were reported most frequently in the Eastern (108) and Western (90) Cordilleras, areas experiencing increased colonization and infrastructure development. These results followed trends in Canada and the US, where increased human activity in bear areas resulted in increased bear-human interactions (Herrero 1985).

The results of this study were based on voluntary responses to written surveys. As such, there is great potential for bias or error with respect to the frequency of reporting and the type of interaction reported (Bernard 1988). Potential respondents, for example, might report an attack against a person or a case of livestock depredation but not report a seemingly less important interaction categorized here as an observation. Likewise, officials from one entity, such as the national park service, might be more likely to report a bear-human interaction than might officials from another entity. We tried to limit bias and error (a) by keeping the survey short and simple and (b) by surveying only officials most likely to provide a correct and complete response due to their professional training and agency affiliation. Information provided informally by several respondents suggested that our greatest bias or error was under-reporting and that the level of this problem was similar in each of the 3 cordilleras. Despite these deficiencies, we believe that the results generally reflect the type and geographic distribution of interactions.

The survey results presented here should be interpreted with great care. First, the number of interactions may not necessarily reflect bear abundance. An especially active bear reported numerous times or an especially diligent respondent could easily inflate perceived Andean bear abundance in an area. Second, the sampling effort was too sparse to measure accurately Andean bear abundance or population trends. Further, factors such as differences in fruit availability associated with weather conditions also affect Andean bear populations (B. Peyton, University of California, Berkeley, California, USA, personal communication, 1986). Third, most of the reports were based on second-hand information. Bear researchers in other areas have noticed that such reports may be biased (D. Garshelis, Minnesota Department of Natural Resources, Grand Rapids, Minnesota, USA, personal communication, 1995). Despite these limitations, this survey represents the most comprehensive data set available to date on Andean bear distribution and bear-human interactions in Colombia. To improve reliability of surveys, they should be intensified, standardized, and complemented with data on habitat availability and human use of bear areas within the context of a national bear monitoring program.

The future existence of wild Andean bears depends on limiting human effects on the species and its habitat (Poveda 1986, Peyton et al. 1998, Pérez-Torres 2001). This is especially true for Colombia, where socio-economic concerns lead poor farmers increasingly to colonize bear areas, especially in the upper regions of the Andes Mountains, after having populated the lower and middle elevations for centuries (Etter and van Wyngaarden 2000). Four socio-economic factors are of special concern in Colombia in the development of a general management plan for the species: human population increase, deforestation, illicit drugs, and guerrillas and civil violence.

Human population increase

Perhaps the greatest threat to Andean bear survival in Colombia is the increase in the human population. During 1973-93, the population increased 57% from 22.9 million to 35.9 million inhabitants (IGAC 1996). Although the population increase in the Central Cordillera was lower than this (37%), increases in the Western Cordillera (70%) and Eastern Cordillera (60%) were greater than the national average. As a result of this national increase, deforestation, the cultivation of illicit drugs, and other human activities are degrading both the quantity and quality of Andean bear habitat (Etter and Villa 2000).

Deforestation

The most recent available data estimate the size of Andean forest at about 92,000 km² (17% of Colombia; Ojeda et al. 2001). Annually, about 2,000 km² (>2%) are deforested. Although some of the deforestation is caused by direct uses of wood such as timber and firewood, most of the deforestation is caused by indirect uses, such as infrastructure development and expansion of the agricultural frontier (Ministerio del Medio Ambiente 1996, 1997).

The remaining tracts of Andean forest are distributed primarily on the western slope of the Western Cordillera, the eastern slope of the Eastern Cordillera, and the southern one-third of the 3 cordilleras (Ministerio del Medio Ambiente 1996, 1997). Of the 16 areas at high risk of deforestation in Colombia, 13 occur in the Andean cordilleras (8 in the Western Cordillera, 2 in the Central Cordillera, 3 in the Eastern Cordillera). Nine other areas have been identified as having a critical deforestation risk, including 7 in the Andean Region: the Panamanian frontier, Patia River Valley, and Paramillo Knot (Western Cordillera); San Lucas Range and the Upper Patia River Valley (Central Cordillera); and Caucana Boot and the La Macarena Range (Eastern Cordillera). Based on the criteria developed by Peyton (1980, 1986), the 7 Andean areas categorized as having a critical deforestation risk in Colombia are prime Andean bear habitat.

Illicit drugs

The impact of illegal drugs has been especially great in the Eastern Cordillera, as large expanses of natural habitat have been converted to disturbed areas (Bureau of International Information Programs 2004), but coca, poppy (amapola), and marijuana are cultivated throughout the country (González 2000). Recent studies have documented coca cultivation at about 86,000 ha (down from 163,300 ha in 2000), poppy cultivation at 4,100 ha (down from 7,350 in 1998), and marijuana production at 4,000 metric tons (about 12.5% of global production; United Nations Office on Drugs and Crime 2004*a,b*). Whereas poppy cultivation occurs mainly in the warmer regions of the Amazon Basin, coca and marijuana are cultivated in prime bear habitat in the cooler montane areas (Cavelier and Etter 1995).

Guerillas and civil violence

During the past 50 years, several guerrilla groups have fought against the national government (Leech 1999). The attacks initially were minor. Recently, however, the attacks have become more frequent and more violent (Kelly 1998). During 2003, for example, there were 596

terrorist attacks (e.g., car or letter bombs) and 46 villages that were attacked (Departamento Nacional de Planeación 2003). These attacks were undertaken primarily by the FARC (Fuerzas Armadas Revolucionarias de Colombia) and ELN (Ejército de Liberación Nacional) groups, and occurred mainly in 8 of the 32 Colombian states. Based on press reports, these attacks were widespread and occurred mostly in sparsely-populated, rural areas (Leech 2004). Upper montane forests inhabited by bears frequently are used by guerrillas as camps or travel areas. As a result, bear habitat in these areas is deteriorating, and some bears have been injured or killed in the conflict. In 1994, for example, a young bear lost a foot (to a trap or land mine) in an area controlled by guerrillas in Chingaza National Park. The bear was treated and released in the park, and in 1998 observed by local residents (I. Rubiano, National University of Colombia, Bogotá, Colombia, personal communication, 1998). Until this unrest is resolved, bear research and conservation will be difficult throughout most of the country.

Management implications

We recommend that Colombian officials focus their bear conservation and management activities on the Western (western slope) and Eastern Cordilleras (eastern slope), in areas where human density is lowest and the amount of natural forest is greatest, but where deforestation and other threats to the conservation status of Andean bears as a result of human colonization are increasing. This survey documented relatively high levels (77%) of bear-human interactions in these areas, including several of the 15 national parks in these 2 cordilleras. Wildlife and natural resource management officials also should improve efforts to enforce wildlife protection laws nationally and to implement policies that limit logging, colonization, agriculture, and livestock grazing in parks.

At this time it is neither possible nor appropriate to identify specific national parks or protected areas in which to focus management efforts. While some might argue that a triage approach to bear management is necessary—immediately, given the critical nature of the situation—to select research sites and set management priorities (Paddock and Paddock 1967), the current political and economic situation is extremely fluid and may take several years to stabilize (Padgett 1998, The Economist 1999). Officials of the Ministry of the Environment are concerned about the conservation status of the Andean bear, however, and are promoting

its conservation. As a first step, the Ministry of the Environment established the “National Program for the Conservation of the Andean Bear” (Ministerio del Medio Ambiente 2001). The program document, unfortunately, did not indicate specific conservation actions or priorities. Andean bear conservation efforts in Colombia, however, have been swept up in a regional effort under the leadership of 5 conservation NGOs (non-government organizations): World Wildlife Fund Colombia, EcoCiencia, Fundación Wii, Wildlife Conservation Society, and Red Tremarctos. Through meetings and workshops during 2000–02 of about 50 regional bear biologists, natural resources managers, and decision makers from conservation NGOs and government agencies, representatives of these organizations developed a program document titled “Regional strategy for the conservation of the Andean bear in the Northern Andes” (Rodríguez et al. 2003). This document suggests specific sites, actions, and conservation priorities for Andean bear research in the region and a time frame for those activities. These actions will apply the triage approach, but from a regional perspective. Bear biologists promoting Andean bear conservation and management at the international level from outside Colombia will have to be patient as these actions are implemented.

We also recommend that wildlife and natural resource officials develop or continue the following 5 activities.

Develop bear population monitoring programs

To estimate bear population trends, survey efforts should be intensified and standardized, taking into account the limitations mentioned earlier (such as voluntary reporting and reports based on second-hand information). A survey should be conducted on a regular basis (1–2 times/yr). In addition, the various agencies involved should establish cooperative agreements that require the reporting of bear–human interactions by their local officials. This reporting requirement should allow a response of “no bear–human interactions” during the reporting period, if appropriate; a measure of survey effort (number of people or households interviewed); and a measure of data reliability (first-hand versus second-hand information; level of technical knowledge about bears by the informant). Given that precise time or distance measures might not be possible for bear censuses, information obtained via field surveys could be related generally (for example, “half or full day”) or specifically to the number of hours spent walking in the forest (for example, “5 feeding sites observed during 2–3 hr of steady walking”). It would be

critically important for local officials to report the occurrence of Andean bears in areas where they had not been known to occur previously. Expanding ranges, as noted during preliminary surveys in Peru during the early 1980s, often reflect local population increases of Andean bears (B. Peyton, personal communication, 1995). These data should be stored electronically in a central location, be updated on a regular basis, and generally be available to appropriate individuals and entities. This metadata approach has been used successfully in Nepal and India to map the distribution and abundance of sloth bears (*Melursus ursinus*; Joshi et al. 1996).

In addition to collecting data on bear–human interactions, it is important to monitor habitat availability and human use of bear areas in the 3 cordilleras. In the previous section we discussed the effects of colonization and deforestation on the quantity and quality of bear habitat. These threats need to be monitored locally and regionally. Specific attention should be given to sites where these activities occur within or adjacent to national parks and other protected areas.

Increase protected areas

Despite the large number of parks and sanctuaries in Colombia that include Andean bears, many of these sites are primarily *páramo* (open high altitude Andean grasslands) and Andean forest ($\geq 2,300$ m elevation), and include only a portion of the habitat necessary for bears. Peyton (1980) emphasized the importance of lower ($< 2,000$ m) elevations to ensure year-round sources of food, water, and shelter for bears. To provide a wide range of habitat, the eastern boundary of Chingaza National Park recently was extended to include the lower montane area used by Andean bears (park area expanded from 50,300 to 76,000 ha; C. Lora, personal communication, 1997). Although annual home range sizes and dispersal distances have not been determined for Andean bears, data from the US for the ecologically similar American black bear (*Ursus americanus*) suggest that male bears have individual home ranges of 21–318 km² and dispersal distances up to 56 km (Wooding and Hardisky 1994). If Andean bears have similar spatial requirements and movement patterns, it might explain in part the high level of bear–human interactions in sparsely populated areas in Colombia. While field studies are necessary, these requirements and patterns also may indicate that a metapopulation approach (Harrison 1991) might be appropriate, rather than individual management of bear populations.

Develop protected corridors between forest patches

Colombian forests increasingly are becoming fragmented. Fragmentation can reduce the total population of a species via a reduction in available habitat, as well as reduce its genetic variation through isolation of small populations (Rockwell and Foose 1989). On a macroscopic scale in Colombia, the 3 cordilleras are isolated from each other through most of their extent by infrastructure development along the Cauca and Magdalena Rivers. On a more limited scale, each of the 3 cordilleras is traversed by several major highways running east–west between major cities (for example, Buenaventura–Cali [Western], Manizales–Pereira–Armenia–Ibague [Central], and Honda–Bogotá–Villavicencio [Eastern]). On a still more limited scale, Los Nevados National Park in the Central Cordillera—and the associated bear population—effectively is isolated from all surrounding forest due to agricultural activities. This level of habitat fragmentation and the isolation of bear populations presents a severe conservation threat to the taxa.

The use of biological corridors—or interconnections—has been especially successful in Venezuela to link bear populations in fragmented areas, as well as to increase the total amount of land designated as protected areas (Yerena 1994). Between Yacambú and Terepaima National Parks in northwest Venezuela, for example, a 21-km strip of primary montane forest with little human intervention in the upper reaches of the Sierra de Portuguesa Range links the 2 protected areas where small bear populations occur (about 5 individuals/site; Yerena et al. 2003). Support for the 11,447 ha tract among local farmers is especially strong as they seek to reduce deforestation around important water sources. Three other corridors with documented Andean bear use link national parks in the Mérida Cordillera, extending about 350 km to the southwest (Yerena and Torres 1994).

Colombian officials should consider using biological corridors to counteract the negative effects of fragmentation and forest isolation. In this regard, it would be especially important to use existing, high-quality montane forest or to restore natural bear habitat and link small patches of forest that presently are not part of the national protected area system. While formal legal protection of corridors by the Ministry of the Environment would be the best mechanism to secure the conservation status of the tract, informal agreements between farmers and community representatives can also be effective at interconnecting bear areas until high-level political decisions are made (Yerena et al. 2003). In other parts of the

Northern Andean Ecoregion, forests outside of formal protected areas comprise as much as 95% of the range of Andean bears (Peyton et al. 1998). We specifically recommend that appropriate areas in Colombia held privately by groups such as Asociación Red Nacional de Reservas Naturales de la Sociedad Civil (National Association of Private Nature Reserves) be incorporated into a larger set of protected areas to benefit bears.

Environmental education

Given the tremendous local interest in Andean bears, efforts to strengthen existing environmental education programs by conservation NGOs in Colombia based in part on this species (for example, Manaba, Herencia Verde, and Fundación Natura Colombia) likely would be very successful at convincing local residents to conserve the remaining montane forest. Fundación para la Educación Superior (FES), for example, took advantage of this interest by school children and sponsored a program in coordination with a national book publisher in which photographs of bears under FES care at La Planada Nature Reserve appeared on the covers of notebooks. The royalties earned by Fundación FES allowed that organization to continue their bear conservation program (P. Moreno, La Planada Nature Reserve, Cali, Colombia, personal communication, 1997).

Damage compensation

We recommend at this time that farmers and ranchers who suffer crop or livestock depredation due to bears not be compensated economically by the state. Although compensation programs have been successful for the brown bear (*Ursus arctos*) in many parts of Europe (farmers and ranchers accept cash payments or tax credits from the state to compensate for livestock losses in lieu of killing problem bears; Servheen et al. 1999), they probably would not work in Colombia. At Chingaza National Park, for example, Andean bears are known to scavenge on cattle that have died due to accidents or illnesses (Poveda 1999). Given the difficulty of establishing cause in depredation cases, any system of payment likely would be abused by farmers and ranchers. However, this is a difficult matter that merits further thought (I. Goldstein, Wildlife Conservation Society, Caracas, Venezuela, personal communication, 2002).

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