PROGRESS REPORT I

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Establishing distribution, habitat and landscape-use of the Andean bear (*Tremarctos ornatus*) population inhabiting Sierra de Portuguesa, northeast end of the Venezuelan Andes: Analysis Stage.

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SUMMARY

Andean bear (*Tremarctos ornatus*) populations are becoming isolated across the Venezuelan Andes due to habitat destruction, and poaching has caused important drops on population numbers. The smallest population within the country is found in Sierra de Portuguesa, restricted to small patches of primary forest at mountain-tops, continuously reduced by agricultural expansion. Three national parks have been established within the species range, but they are partially-isolated from each other and surrounded by a matrix of human disturbance. Immediate action is required to reduce the risk of local extinction.

This research seeks to identify factors that modulate Andean bear distribution, habitat and landscape-use in Sierra de Portuguesa, through the generated of a habitat model. The information collected will fulfil key requirements on the species Action Plan, and allow the establishment of guidelines for future management strategies on the study area.

Following four years of continuous effort, the project's fieldwork stage is now completed. The use of bear-sign censuses across truncated-distance sampling transects allowed the establishment of the species current distribution in Sierra de Portuguesa, the evaluation of use of an "Ecological Corridor" between two protected areas, and the characterization of bear habitat-use patterns across primary and secondary forest, forest edges, agriculture and dirt roads.

For the coming year, the analysis and final stage of the project will be undertaken at the Wildlife Research Group, University of Cambridge. Landscape ecology concepts supported by a GIS (geographical information systems) database will be used as principal framework for the generation of the habitat model, and the establishment of conservation guidelines. **This report represents a thorough review of the activities undertaken since the beginning of the project in September 2002.**

INTRODUCTION

The Andean bear, also known as spectacled bear, is the only species of the family Ursidae that inhabits South America, and the largest carnivore in this region[2, 3]. Its distribution extends from Venezuela to Argentina, inhabiting the three main mountain ranges that constitute the Andean region[2-4]. Its altitudinal range goes from 250m to 4,750m asl, where the species uses an important variety of ecosystems such as dry, evergreen and humid forests, moors, páramos and puna prairies[2, 3, 5-8]. This characteristics together with its charisma, has allowed the selection of the Andean bear as a "flagship species" for the promotion and design of conservation strategies within the Andes, a highly threatened *Biodiversity Hotspot* [2, 3, 9, 10].

In Venezuela, the Andean bear is considered an “Endangered” species. Its distribution is discontinuous and involves two divergent and isolated mountain ranges: Sierra de Perijá and Cordillera de Mérida (Figure 1). La Sierra de Portuguesa (4,300Km^2) (northeast end of the Cordillera de Mérida) is considered a high-priority area for conservation given its unique geographical location and the fragmentation of its remnants forests due to an intensive and well-spread agricultural activity (Figure 2)[11, 12]. The range embraces three National Parks (NPs): Yacambú (254Km^2), Terepaima (187Km^2), El Guache (160Km^2) partially isolated from each other, and surrounded by a landscape mosaic of different economic activities (Figure 2)[11, 12]. The presence of the Andean bear has been recorded within the entire range[5, 11-16]. Unfortunately, population numbers are dropping rapidly due to poaching and habitat destruction, and thus, immediate action is required to ensure its long-term conservation[2, 3, 17, 18].

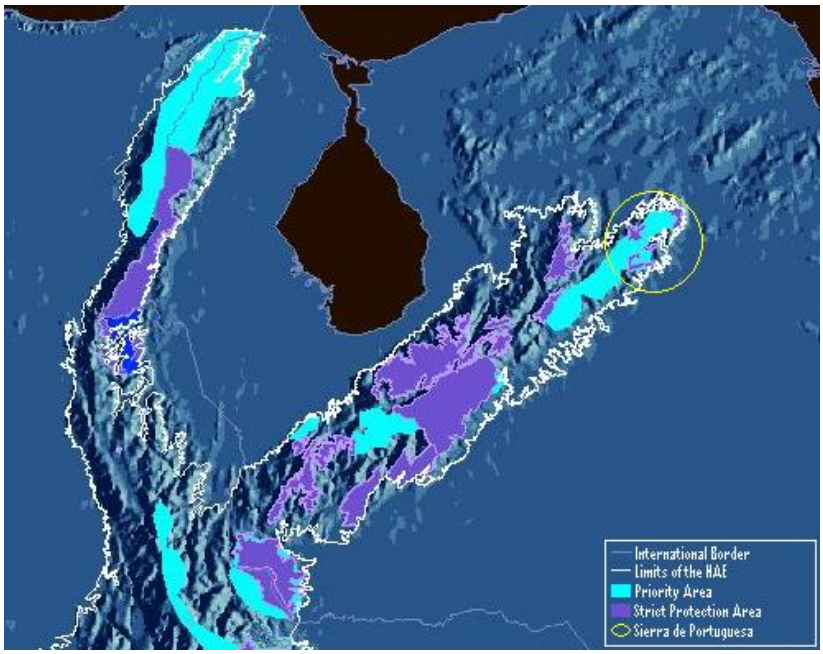


Figure 1.- Venezuelan Andes highlighting Sierra de Portuguesa [1].

This project was designed to generate a habitat model for the Andean bear population in Sierra de Portuguesa, capable to identify those environmental and anthropogenic factors that modulate its distribution, habitat and landscape-use[19]. This information will allow the establishment of guidelines for the design of a management strategy, and will fill in some of the gaps related to the species ecology on fragmented landscapes[19]. A landscape ecology approach is being followed using GIS as spatial databases, and non-intrusive monitoring techniques are employed for field-data collection[19].

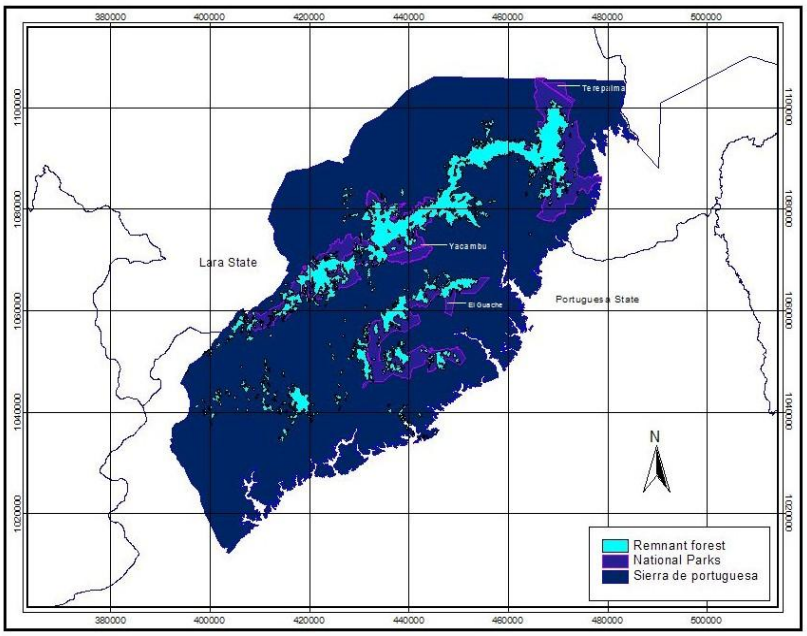


Figure 2.- Sierra de Portuguesa, Nacional parks and remnant forested areas.

Project Goal

To generate a habitat model for the Andean Bear (*Tremarctos ornatus*) population inhabiting Sierra de Portuguesa, northeast end of the Venezuelan Andes.

Specific objectives

- To establish Andean bear distribution, habitat and landscape-use patterns in Sierra de Portuguesa.
- To determine environmental and anthropogenic factors that modulate Andean bear distribution, habitat and landscape-use patterns in Sierra de Portuguesa.
- To generate guidelines for the design of a management strategy.

ACTIVITIES UNDERTAKEN

Project Design

Period: October 2002 – August 2003.

Site: Wildlife Research Group - University of Cambridge, UK.

Objective

- To design a project to define Andean bear distribution, habitat and landscape-use in Sierra de Portuguesa, Venezuelan Andes.

Procedure

- Bibliographic review of sampling methods to define distribution and characterize habitat and landscape-use of large mammals[19].
- Bibliographic review of methods for botanical surveys, interviewing and questionnaire application, landscape modelling and GIS[19].
- Selection of methods to be used during fieldwork to define distribution and characterize habitat and landscape-use for the Andean bear population under study[19].
- Writing a report (First Year Report of Progress) containing all the procedures to be followed during fieldwork, including Pilot Study, Large Scale Survey and analysis stages [19].
- Approval of the First Year Report of Progress by the Wildlife Research Group, University of Cambridge.

Exploratory Stage

Period: September 2003 – March 2004.

Site: Sierra de Portuguesa, Venezuela.

Objectives

- To undertake the first study site by the Principal Investigator (PI).
- To train the PI on bear-signs recognition.
- To undertake a logistics evaluation for future fieldwork activities.
- To select the group of field-assistants to be hire fieldwork.

Procedure

- Project presentation to the Parque Zoológico y Botánico Bararida. This institution is in charge of the Andean Bear conservation plan for Sierra de Portuguesa and the project was included as part of its research division.
- Excursions to sites known to be part of the species distribution in Sierra de Portuguesa according to previous records, and to other sites with no previous information on the species presence[5, 10, 12, 16, 20]. Presence/absence information was collected based on bear-signs, and interviews were undertaken at local communities.

- Data Analysis. (MSc Edgard Yerena and Prof Isabel Llatas. Universidad Simón Bolívar).

Results

Andean bear distribution

Andean bear historic distribution in Sierra de Portuguesa was established compiling in a GIS database, records of sightings, sign surveys and poaching events obtained from: a) Unpublished data collected by Yerena, Vera and García-Rangel (1986 to 2004); and b) that reported on scientific and technical publications: Goldstein (1990), Mondolfi (1971, 1983, 1989), Padrón (2002), Todd (2000) Vera (2001), Yerena (1997). This information was presented at the 15th IBA Conference as a poster. Manuscript is on preparation[21].

Sites explored

4 main sites were visited in Sierra de Portuguesa: The three national parks (Yacambú, Terepaima and Guache NPs) and the remnant forest connecting Yacambú and Terepaima NPs, known as the "Ecological Corridor" of Sierra de Portuguesa (See Table 1).

Table 1.- List of localities visited specifying the activities undertaken.

Sites	Localities Visited	Date
Yacambú NP		October
	Santo Domingo	10-11
	El Salvaje	12-13
	Pena Blanca	14
	Trampa del Tigre	15
	Chorro Azul	16
	Chamiza	23
	Cerro de Cupido	25
	Bojó	26
	La Bucarita	27-28
	La Pastora	29
	Finca San Rafael	30
		November
	Tumaque	18
	Sabana Grande	19
	Montana de la Paz	20
	La Parrilla	21
	El Banqueo	24-26
Terepaima NP		December
	Sabana Alta	8
	Fila Los Potros	9
	Rio Claro	12
	Cocodrilo-Guamasire	13
	Paujisal	14
Ecological Corridor	Las Virtudes	16-17
	Palenque	18
	Bombóm	20-21
Guache NP		February
	Ospino	25
	La Estación/La Laguna	26

	La Bujía	27
	Santa Rosa/La Bucarita	28
	El Veral	29
		March
	Acarigua	01

Bear-sign census

A total of 12 expeditions (1 day or more) and 6 short excursions (3 hours approx.) were undertaken in search for bear-signs. Over 400 signs were found and two bears (female and cub) were sighted (See Figure 3)[5-8, 10, 15, 16, 22-32]. Andean bear presence was determined at Guache NP were previously records were non-existent. Sign-encounter rate was high enough to achieve the objectives on this research.

Figure 3.- Bear signs found in Sierra de Portuguesa: A) Claw mark. B) eaten bromeliads. D) feaces. D) eaten palms.

Types of signs

A total of 8 different types of signs were found during this stage of the project (See Figure 3). The types found correspond to those reported on previous studies[5-8, 10, 15, 16, 22-32]. Encounter frequency differed significantly between them, being the feeding signs the most abundant group (See Figure 4). Faeces encounter rate was smaller compare to those reported, probably because surveys included high-elevation shrublands with low faces decay rates that are lacking in Sierra de Portuguesa[5-8, 10, 15, 16, 23-32]. Low encounter frequency of tree nests was probably a consequence of its reduced visibility in close forest cover; this represents a drawback of the sampling method[5-8, 10, 15, 16, 23-32].

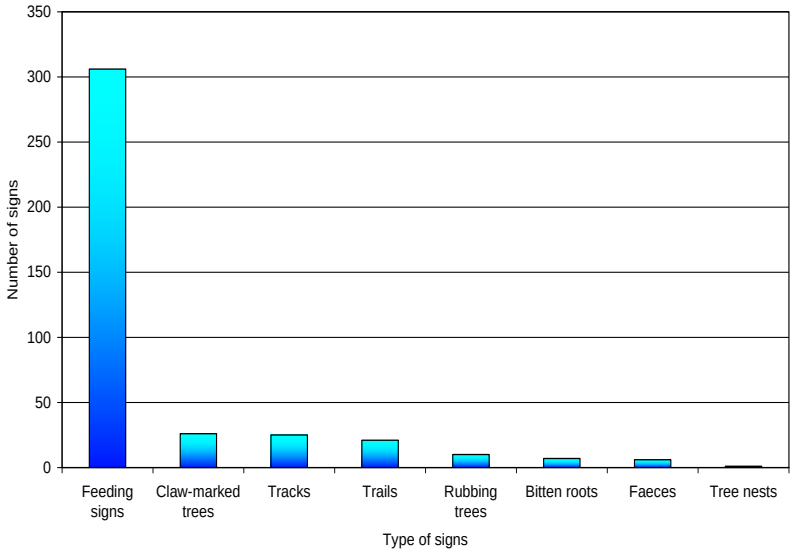


Figure 4.- Absolute encounter frecuency of the types of signs found in Sierra de Portuguesa

Analysis of the data collected arose important questions relating to the data treatment for the generation of the habitat model. The methods chosen for the analysis require independent locations of bear presence. In this case, although sample units are independent, data in side each of these units is not and thus it needs *ad hoc* transformations. Clark (*pers. comm*. 2004) suggested the establishment of a statistical measure of difference between groups of signs to determine independence, while Van Manen (*pers. comm.* 2004) suggested incorporating all data collected to the model given the population level of the analysis. Van Manen (*pers. comm.* 2004) also recommended the use of the "weight of evidence method" as an additional insight. These alternatives will be evaluated during the final analysis stage of the project.

Sign Reliability

Sign reliability was also found to differ significantly between types of signs; some types are more easily mistaken with signs of other species or those caused by rain or wind (See Table 2). These differences on encounter rate and reliability make it difficult to compare between and within sampling units. Feeding signs could be used as "principal signs" in future surveys, given its reliability and high encounter frequency, recording other signs in its presence. However, this could misrepresent areas used by bears for transportation, interaction and refuge/resting. Reynolds (*pers. comm*. 2004), suggested to record every type of signs and to use an activity-based approach in which groups of signs are compared based on the activities they represent in a specific area. This approach was used for data collection during the following fieldwork stages.

Table 2.- Reliability of the type of signs found in Sierra de Portuguesa.

Type of signs	Elements producing similar cues	Reliability
Feeding signs	None in most cases	High
Claw-marked trees	None in most cases	High
Faeces	None	High
Tree nests	None	High
Tracks	Other animal species	Moderate
Trails	Other animal species	Moderate
Bitten roots	Other animal species, root decay	Low
Rubbing trees	Wind, rain, other animal species	Low

Feeding signs

Feeding signs were basically related to stem and leave-base consumption of species of the family Aracaceae and Bromeliacea. Fruit consumption was barely detected (See Figure 5, 6). Questions related to quantification and comparison of different feeding signs arose during this phase of the study, and they will be considered in future analysis.

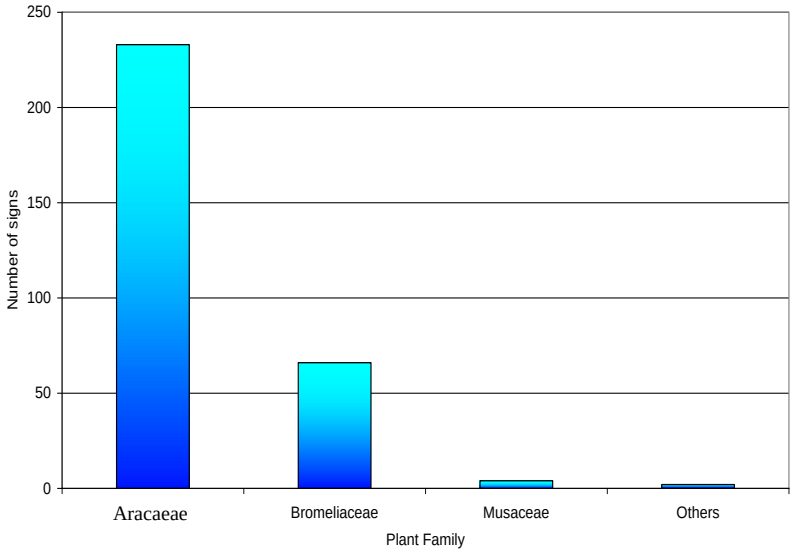


Figure 5.- Absolute encounter frequency of plant families of the feeding signs found

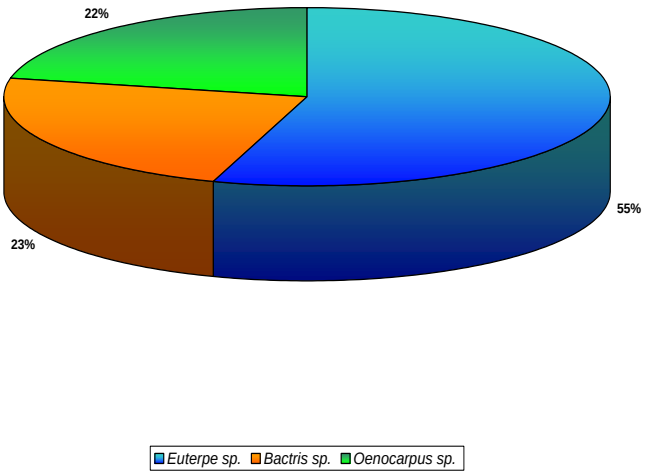


Figure 6.- Percentages of feeding signs from the Aracaeae family found in Sierra de Portuguesa

Sign Aging

Aging characteristics could only be identified for 3 of the 8 types of signs found in Sierra de Portuguesa (See Table 3). These characteristics only allow the establishment of a qualitative time frame for habitat-use, estimating the number of times a sampling unit has being used, by comparison between and within each type of signs (Fresh, Medium, and Old).

Table 3.- Aging characteristics of three types of signs found in Sierra de Portuguesa.

Type of signs	Aging characteristic
Feeding signs	
Aracaceae	Leave and/or stem darkening Open area drying
Bromeliaceae	Leave and leave-base darkening
Claw-marked trees	Wound cicatrisation Symbiotic growth
Faeces	Smell Discoloration Parasite presence Seed germination

Interviews

A total of 36 interviews to local hunters and villagers were performed across the areas visited (See Figure 7). Information on bear presence based on bear-signs, sightings and hunting events, human-bear interactions, and local believes related to the species was collected. The species is known to be deeply attached to the local imaginarum, either by the

use of its parts for medical treatments or legends related to the bears kidnapping woman as a “wild man of the jungle” (See Figure 7).

Figure 7.- Farmers residents to near by areas of Guache National Park: A) PI with Carabalí family. B) Jose Lalú Pérez with family C)PI inteviewing Victor Celestino Vizcaya. F) Juan Blanco.

Other Activities

- Attendance to meeting of local environmentalist groups towards the integration of efforts targeting Sierra de Portuguesa’s biodiversity long-term conservation.
- Attendance to the V Congreso Venezolano de Ecología.
- Meeting with local environmentalist groups and national NGO’s for workshop in conservation of natural resources.
- Attendance to the 15th International Conference on Bear Research and Management.
  - Poster presentation: A study design to model Andean bear (*Tremarctos ornatus* Cuvier 1825) habitat Sierra de Portuguesa, Venezuela: Phase 1.
  - Poster presentation: Andean bear distribution (Tremarctos ornatus Cuvier 1825) in Venezuela's Sierra de Portuguesa.

Vegetation cover map

Period: March – April 2004.

Site: Caracas, Venezuela.

Objectives

- To develop a Vegetation cover map for Sierra de Portuguesa.
- To determine if the Vegetation cover map generated for Sierra de Portuguesa reflects the on-the-ground reality.

Procedure and results

A Vegetation Cover Map of the study site was generated in Erdas 3.0, from an NDVI of the satellite image Landsat 7 +ETM obtained from WWF-OC/FUDENA. The index identified five main vegetation cover categories according with "the best possible composition":

1. Primary forest
2. Disturbed or secondary forest
3. Bushes or shrublands
4. Savanna
5. Agriculture or intensively disturbed areas

Using P.C. Arc 3.5.1, the index image was transformed to a raster format, erasing polygons < 95,000m^2 (Naveda, J. National Parks Institute *pers. comm.* 2004). A map of vegetation types was overlapped considering only the first two vegetation cover categories, resulting in 19 combinations that were grouped into 12 categories (See Table 4 and See Figure 8):

Table 4.- Vegetation cover categories, area and percentage of coverage in the Vegetation cover map developed for Sierra de Portuguesa.

Vegetation Cover Category	Area (Km^2)	Percentage of coverage (%)
Secondary evergreen pre-montane forest (BISvMB)	1094.73	46.61
Primary evergreen pre-montane forest (BPSvMB)	831.56	35.41
Primary evergreen montane forest (BPSvMN)	229.06	9.75
Secondary evergreen montane forest (BISvMN)	51.67	2.20
Secondary semideciduos forest (BISdTB)	43.44	1.85
Secondary semideciduos pre-montane forest (BISdMB)	25.26	1.08
Primary semideciduos low-land forest (BPSdTB)	24.60	1.05
Secondary semideciduos montane forest (BISdMN)	15.90	0.68
Primary semideciduos pre-montane forest (BPSdMB)	14.89	0.63
Primary semideciduos montane forest (BPSdMN)	11.08	0.47
Secondary evergreen low-land forest (BISvTB)	4.02	0.17
Primary evergreen low-land forest (BPSvTB)	2.51	0.17
Primary forest coverage	1,113.70	47.41
Secondary forest coverage	1,234.96	52.58

Low-land: 0 -500m asl Submontane: 500 – 1,400m asl Montane: 1,400 – 2,500m asl

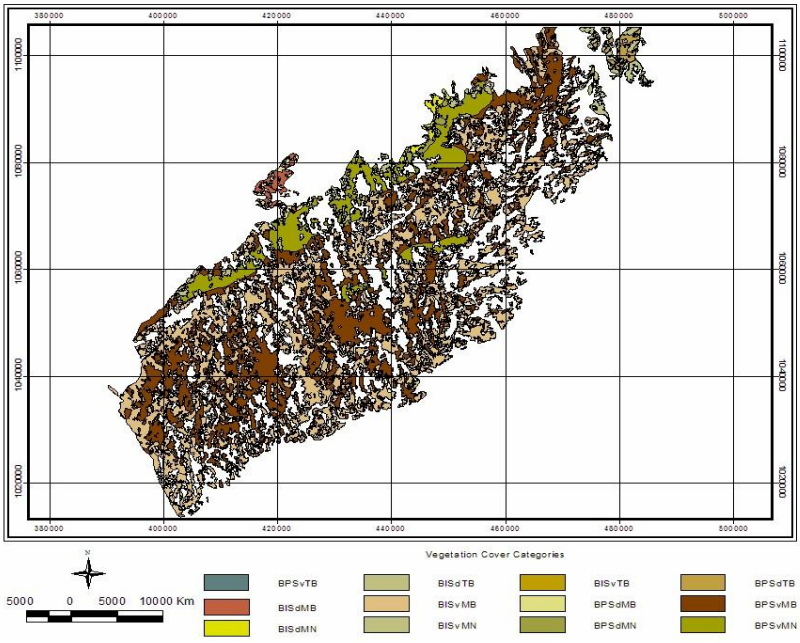


Figure 8.- Vegetation cover map for Sierra de Portuguesa. Only forested cover categories are considered.

The intense impact of human activities on Sierra de Portuguesa is evidenced by the large percentage of the secondary forest coverage category (See Table 4 and Figure 9). All categories but BPSvMN showed > 55% of secondary growth (See Figure 9). The slope steepness and low agricultural value of soils above 1,600m asl have probably set a limit to human expansion in BPSvMN. Vegetation cover categories showed different patterns of patch sizes and distribution, some categories had few small and isolated patches, some medium-size ones scatter across the mountain range, while a few large blocks of vegetation. The first three vegetation cover categories represent more than 90% of the vegetation coverage in Sierra de Portuguesa (See Figure 10). The larger blocks of forest are included in BPSvMN, BPSvMB and BISvMB (See Figure 10).

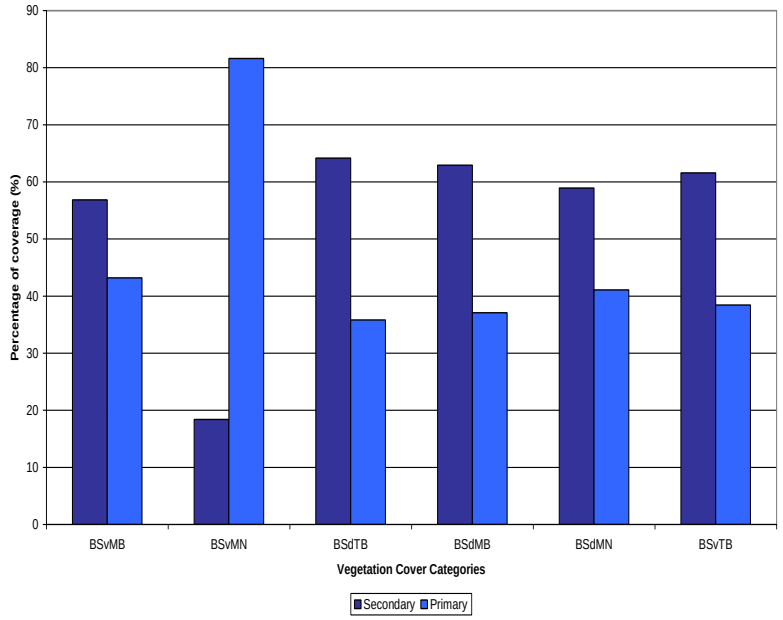


Figure 9.- Percentages of human disturbed areas by vegetation cover categories in Sierra de Portuguesa.

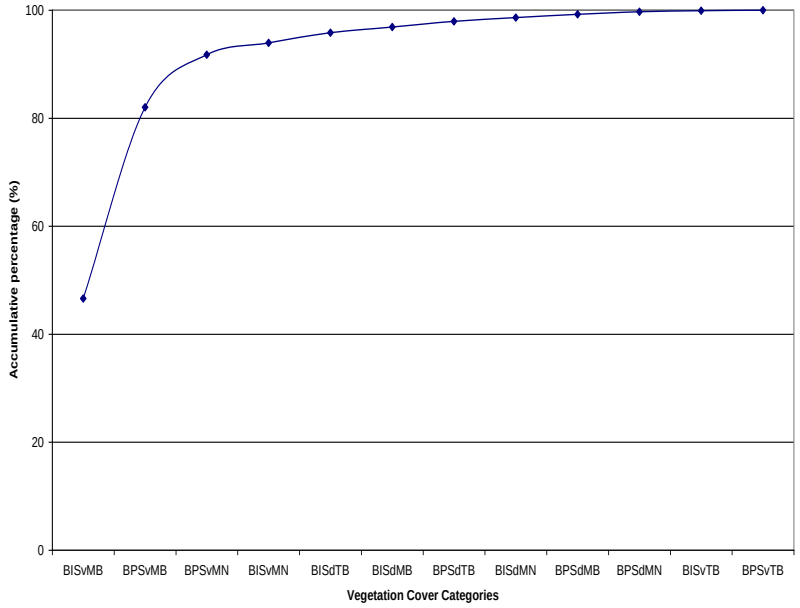


Figure 10.- Accumulative percentages of area by vegetation cover categories in Sierra de Portuguesa.

Pilot Study

Period: Planning April 2004. Fieldwork May – August 2004. Analysis August – December 2004.

Site: Sierra de Portuguesa, Venezuela.

Objectives

- To evaluate the method chosen for bear-sign census, according to statistical assumptions and logistics.
- To train field-assistants on field procedures.

Procedure

Study site

During the Pilot Study, only a group of the vegetation cover categories found on the Vegetation cover map where surveyed given the need for standard sampling conditions. The selection of these units was based on the gain in accumulative frequency of vegetation cover by each category. BPSvMN and BISvMB were the only categories selected, representing more than 56% of the vegetation cover in Sierra de Portuguesa (See Figure 10). Patch sizes on these categories allowed the location of all sampling units for each category in one patch, making the logistics considerable easier.

The "Ecological Corridor" was chosen as study site for this stage, based on the close proximity of the two vegetation cover categories to be sampled, the need for Andean bear information in the area, and the similar size of both vegetation patches (See Figure 11).

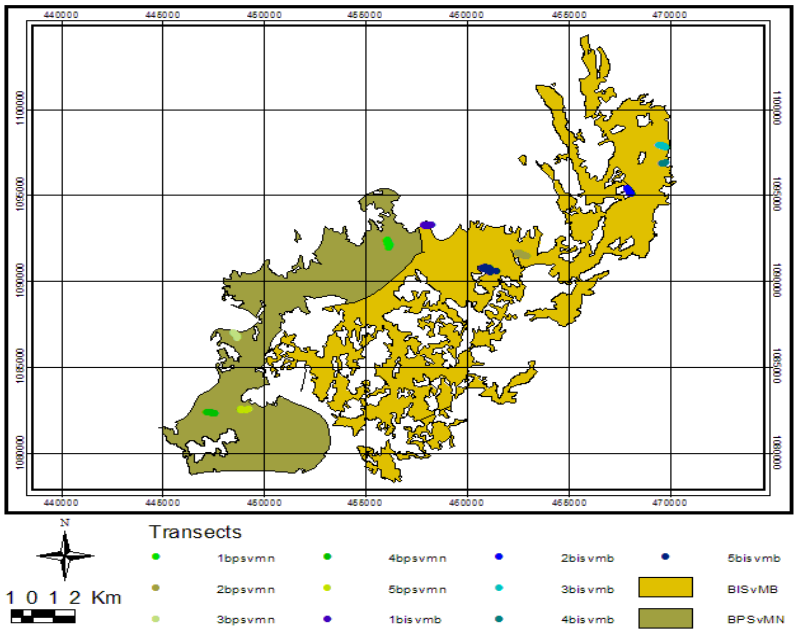


Figure 11.- Pilot study site and transects passing-through points.

Study Design

The Pilot Study was designed following these considerations:

- A minimum of 100 presence points is needed for the generation of a habitat model, and no less than 10% of this sample for the Pilot Study (Van Manen *pers. comm*. 2004).
- A minimum of 5 transects should be sampled at each vegetation type for the Pilot Study (Augeri *pers. comm.* 2004, Peyton *pers.comm.* 2004).

A total of 15 transects were sampled at this stage, but only 10 were use for data analysis (See Table 5, Figure 11). Transects were placed with a minimum distance of 800m between each other, educated guess of Andean bear day travelling[33]. Each transect had a passing-through point chosen by logistic considerations, from 30 pre-generated random points by vegetation cover category. Transect direction was randomly chosen from this point.

Table 5.- Pilot Study time table.

		May
Locality	**Date**	**Activity**
Cerros Pegados	05-08	Field training
Cerros Pegados	09	3BPSvMN
Cerro Las Virtudes	16	4BPSvMN
Qda. Grande	17	5BPSvMN
Montana Bombom	21	1BPSvMN
Qda. Guayamure	22	1BISvMB
Montana Macanillal	24	2BPSvMN
Rio Claro	25	Vegetation control points
Las Rosas	26	5BISvMN
		July
Fila de Cocodrilo	04	Vegetation control points
El Zanjon	05	2BISvMB
Meseta Los Gachos	07	Vegetation control points
Riecito	09	Vegetation control points
La Capilla de Bucaral	12	Vegetation control points
		August
Fila los Potros	01	Vegetation control points
Fila los Potros	02	4BISvMB
Fila los Potros	03	5BISvMB
Fila los Potros	04	3BISvMB

Sign census

Two field-assistants (Eugenio Guzman Pérez and Alfredo Freitez) performed intensive searches for bear-signs inside the transects. Sampling area on each transect was divided in 100m units to record GPS locations, altitude, slope, human impact and vegetation. These units were subdivided into 20m segments for sign search. Data was collected depending on the type of sign found. Aging characteristics were recorded for each sign in order to generate a *post-hoc* aging scale.

Results

Sampling feasibility

All transects from BPSvMN had 500m length while, but this parameter varied on BISvMB (mean = 444m σ= 8.94) given dense understory coverage and steepness of some areas. An average of 8 hours were needed for sampling every day; this added to travelling time mean = 2hours 16 minutes one way (σ= 136.56) shows that an entire day of work is needed by sampling unit.

Sing encounter rate

A total of 322 bear-signs where found during fieldwork, value higher than expected based on the Exploratory Phase, where no excursions were carried out on secondary forest cover. From the total obtained, 232 bear-signs were found on 8 of the 10 transects sampled (See Table 6). Significant differences were found for the number of signs encountered between vegetation cover categories, result that was expected given the species' well-known preference for primary and montane forest (See Table 7).

Table 6.- Number of signs found by transect sampled on the Pilot Study

	Number of signs found	
Transects	**BPSvMN**	**BISvMB**
1	55	0
2	64	0
3	14	2
4	33	46
5	17	1
Total number of signs	**183**	**50**
Total number of signs found	**322**	
Pvalue X^2 df 4 α=0.05	**4.001 10-11**	**3.726 10-35**
Pvalue X^2 df 2 α = 0.05	**$1.61\ 10^{-49}$**	
Mean number of signs	**36.6**	**9.8**
Standard deviation	**22.34**	**20.25**

Table 7. Sign density by transect sampled on the Pilot Study

	Sign density (sign/Km2)	
Transects	**BPSvMN**	**BISvMB**
1	0.011	0
2	0.012	0
3	0.0028	0.00045
4	0.0066	0.01045
5	0.0034	0.00023
Pvalue X^2 df 4 α=0.05	**0.999**	**0.999**
Mean sign density (sign/km^2)	**0.00732**	**0.0022**
Standard deviation	**0.0044**	**0.0046**

A total of 183 signs were found across the 5 transects sampled in BPSvMN (See Table 7). Mean number of signs encountered was 36.6 (σ= 22.34) and mean sign encountered rate was 0.00732 sign/km^2 (σ= 0.0044) (See Table 6 and 7). Significant differences were found for the number of signs between sampling units, but not for the sign encounter rate (See Table 6 and 7). There appears to be a spatial pattern explaining this differences, given that transects with larger number of signs (Transect 1 and Transect 2) and transects with the smaller number of sings (Transect 3 and Transect 5) are closer together; Transect 4 looks as an intermediate value (See Figure 11).

For BISVMB, 49 signs were encountered in only 3 of the 5 transects sampled (See Table 7). Mean number of signs encountered was 9.8 (σ= 20.25) while mean sign encountered rate was 0.0022 (σ= 0.0046) (see Table 6 and 7). Similar to BPSvMN, significant differences were found for the number of signs per transect but no for the sign encounter rate (See Table 6 and 7). Signs were not found in Transects 1 and 2, while 93.8% of the sings were found in Transect 4. There not appears to be any spatial relationship explaining these results since transects closer together have important differences in the number of sings (See Figure 11). Thus, differences on sign encountered rate could be due to other variables not included in the analysis.

Variances were similar for BPSvMN and BISvMB, but only the sampling units from BISvMB accounted for the whole spectrum of variation in the number of signs (See Figure 12). The variance on each category was higher than expected, given the Poisson distribution of the data (Mean = σ), indicating that data distribution is not only explained by vegetation cover (See Table 6).

Type of signs

Five different types of signs were found during the Pilot Study, all corresponding to well-known Andean bear-signs (See Table 8)[3, 5, 7, 15, 22, 29]. Trails were not considered as a different type of sign, since they are accounted for by the other type of signs found on them. A new type (Pruning) was found, increasing the sign spectrum and strengthening the hypothesis that missing types will be encountered with an increase on sampling size. Faeces, rubbing trees or hairs were not found at this stage, probably because fieldwork was carried out during the months with the heaviest rain during the rainy season. Tree nests were also not encountered although some intensive searches with binoculars were undertaken, especially on claw-marked trees. Close canopy cover caused by ferns, orchids and bromeliads made not possible the detection of these structures. This drawback will be considered during the final analysis.

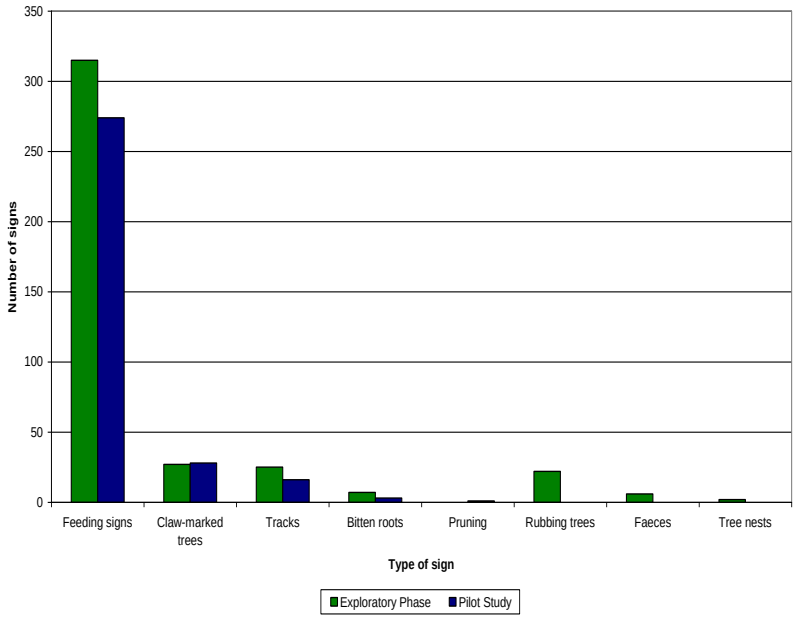


Figure 12.- Variance contribution in the number of signs found by sampling unit for each vegetation cover category.

Table 8.- Number of signs found on each type of signs encountered during the Pilot Study

Type of Sign	Number of signs
Feeding sign	274
Claw-marked trees	28
Foot-prints	16
Bitten roots	3
Pruning	1
Pvalue X^2 df 4 α = 0.05	**$7.4\ 10^{-185}$**

The number of signs found for each type is similar to that from the Exploratory Phase (See Figure 13). Feeding signs represent more than 80% followed by claw-marked trees and foot-prints with very low percentages. Differences on this parameter are significant, and depending on a wide variety of factors (See Table 8). Rain erases tracks, faces, marks on rubbing trees and hairs, while appears to have no effect on feeding signs, bitten roots and claw-marked trees. Andean bears probably generate more feeding signs than any other type. Some types of signs are more easily marked than others[5-9, 15, 16, 23-26, 28, 29, 32, 34-37]. Thus, no comparison between types is appropriate, and the analysis should be done individually or by pulling types together. These results support the use of the activity-based approach suggested by Reynolds (*pers. comm.* 2004).

Types of signs were not evenly distributed between vegetation types; while every type was found on BPSvMN, only feeding signs and claw-marked trees were encountered in BISvMB (See Table 9). Absence of foot-prints in BISvMB could be due to faster disappearance rates and of bitten-roots a consequence of lack of stilt-rooted palms.

Differences in the number of signs from the first categories could be an effect of faster decomposition rates or due to differences in floristic composition, with smaller density of elements to be marked or eaten in the secondary and pre-montane vegetation cover category. Thus, in order to draw conclusions on Andean bear habitat-use, it is necessary to compare resource availability and aging processes of each type of sing between vegetation types. No further statistical analysis were carried out due to sample size.

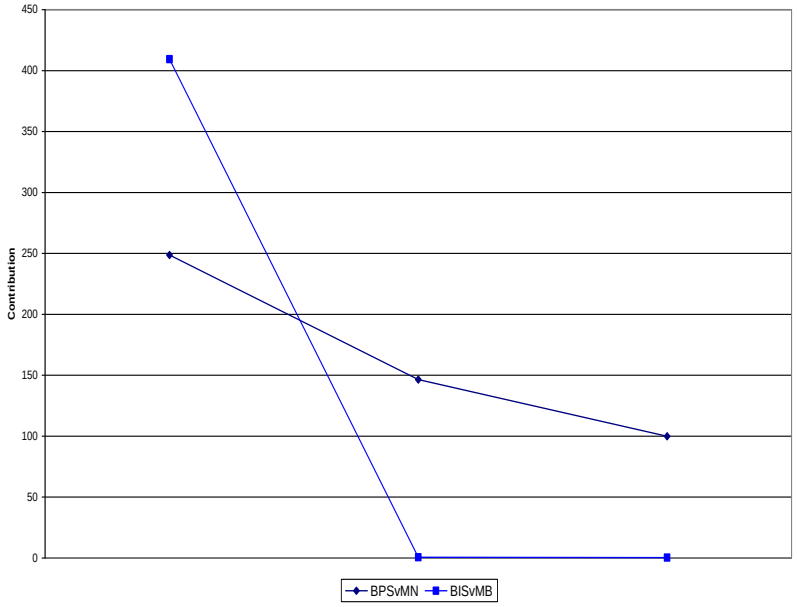


Figure 13.- Number of signs found during the Exploratory Phase vs. the Pilot Study.

Table 9.- Distribution of type of signs by vegetation cover categories

Type of Sign	BPSvMN	BISvMB
Feeding sign	160	42
Claw-marked trees	15	7
Foot-prints	4	0
Bitten roots	3	0
Pruning	1	0

Sign Reliability

A unique pattern for Andean bear claw-marks was detected based on the closeness of its two middle claws, enhancing the reliability of this type of signs when 3 or 4 claws are visible in the sign (See Figure 14). The incorporation of a field-assistant able to differentiate foot-prints between species improved its reliability (See Figure 14).

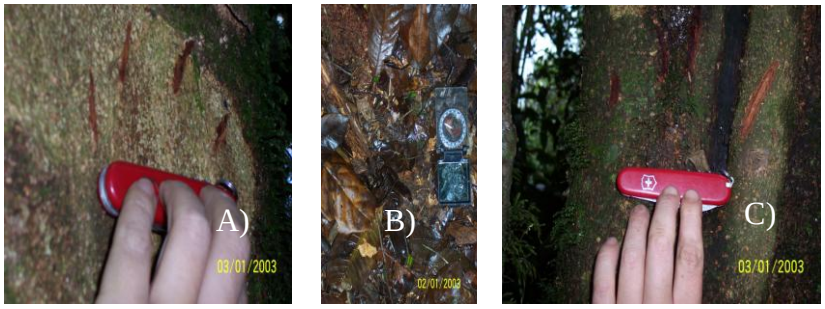


Figure 14.- A) and C) Andean bear claw-marks with four fingers B) Andean bear foot-print.

Feeding signs

A total of 274 feeding signs were found in the Pilot Study (See Table 8). 245 records correspond to the Aracaceae Family and 29 to the Bromeliaceae Family (See Table 10). Similar to the Exploratory phase, significant differences were found between this two food items, showing what it appears to be a shift on the species diet towards palms trees, since bromeliads are reported as principal food resource for Andean bears (See Table 8)[3, 5, 7, 15, 22, 29]. No fruit consumption was detected as part of Andean bear diet, because fruiting period was finished by the time this phase of the study started.

Table 10.- Number of feeding signs found during the Pilot Study according to plant families

Plant Family	Number of feeding signs
Aracaceae	245
Bromeliaceae	29
Total	**274**
Pvalue X^2 df 1 α = 0.05	**$6.43\ 10^{-39}$**

Feeding signs for both families are significantly more abundant in BPSvMN (See Table 11). This probably reflects previously mentioned differences in the floristic composition of the two vegetation cover categories. Bromeliads are not expected to be present on the pre-montane forests of Sierra de Portuguesa, due to its reduced humidity[38]. Plants of the Aracaceae Family are found basically on areas with primary vegetation[39].

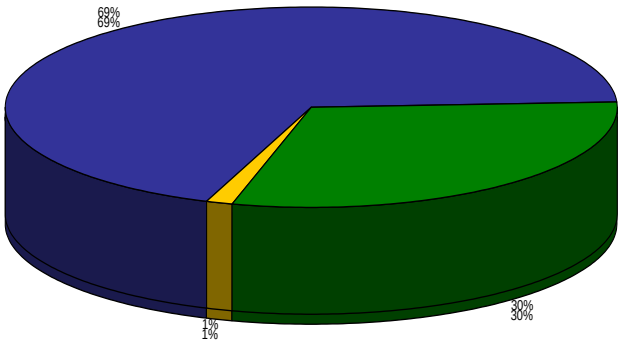
Table 11.- Number of feeding signs by plant family found on each vegetation type during the Pilot Study.

	Number of feeding sing	
Vegetation cover categories	**Aracaceae**	**Bromeliaceae**
BPSvMN	147	13
BISvMB	42	0
Pvalue X^2 df 1 α = 0.05	**$2.21\ 10^{-14}$**	**$3.11\ 10^{-4}$**

Aracaceae Family

Prof. Miguel Niño from Universidad Experimental de Los Llanos Occidentales "Ezequiel Zamora" (UNELLEZ) and Dr Fred Stauffer from Conservatoire et Jardin Botaniques de la Ville de Genève, identified 35.4% of the records from the Aracaceae Family to genus level and 33.6% to species level, using 73 botanical samples and 34 photographs obtained during fieldwork. Both methods proved to be adequate for identification of specimens up to the species level, and in the future will be used discretionary according to field conditions. 16% of the remaining records are still to be identified, while 54% of them could not be identified due to sample collection inadequacy or lack of sample due to time constraints, damage caused by bears or plant decomposition. Instructions from experts have already being received to ensure appropriate sample collection.

In the Aracaceae Family, records correspond to 3 genera and 4 different species (*Geonoma undata*, *G. lingulata*, *Wettinia praemorsa*, *Prestoea acuminata*). *Geonoma sp.* and *Prestoea acuminata* have being reported as Andean bear food resources in Colombia and Bolivia[28]. *Wettinia praemorsa* was probably registered for Venezuela and Colombia as *Catoblastus sp.*, due to changes on the nomenclature of this Family[5, 28]. Lack of previous information on Andean bear diet to a species level does not make possible further discussion on this subject. Significant differences in the number of records between genera were found, reflecting either abundance or Andean bear preference (See Figure 15).



Pvalue $X^2 = 5.2\ 10^{-12}$ df 2 α = 0.05

Figure 15.- Percentage of number of signs found by genera of the Aracaceae Family found eaten by Andean bears during the Pilot Study.

Geonoma sp. is one of the largest genus of the Aracaceae Family in America[39]. It involves solitary or clustered, small to medium-sized palms trees abundant in rainforest understory [39]. *Geonoma simplicifrons,* is an endemic species distributed across Cordillera de la Costa, northern Venezuela from 400 to 1,400m asl. Individuals are both solitary and clustered from 1 to 3m tall[39-42]. Although the species has not being found in the Andes, the closeness of Sierra de Portuguesa to the Cordillera de la Costa makes possible its presence in the area. Records of Andean bear signs for the species show higher elevations than its reported range (1,800m asl), while mean size of the eaten stems (mean = 0.7m σ= 0.29) indicates a larger proportion juveniles consumed. *Geonoma undata* one of the commonest species of this genus, is distributed in the Lesser Antilles, Central America and through the Andes mountain range[39]. It is found in mountain rain forest from 1,400 to 2,400m asl[39]. In Venezuela the species altitudinal range stretches to 1,200 - 2,000m asl being found across the Cordillera de la Costa and the Andes[40-42]. Individuals are solitary from 3 to 5m tall, although during vegetative phase could form clusters[39]. Andean bear feeding records correspond with the species altitudinal distribution, as well as with the stem size of adult plants (mean = 3.05m σ = 6.92) (See Figure 16).

Figure 16.- *Geonoma undata* eaten by an Andean bear found during the Pilot Study.

Prestoea sp. is a predominant Andean genus grouping middle-canopy or understory palm trees[39]. *Prestoea acuminata*, are solitary or clustered 6-15m tall individuals, distributed from 1,000 to 2,000m asl in the Greater Antilles, Central America and specially in the Andes[39]. They are widespread across submontane, humid montane and flooded areas but not very abundant[39]. In Venezuela the altitudinal distribution has shifted to 1500 – 2400m asl[40, 41]. The only bear-sign found corresponds to a juvenile encountered within the species altitudinal distribution. *Prestoea acuminata* has only been reported as Andean bear food resource in Colombia by Rodriguez y Cadena (1991), but this could be due to the use a different nomenclature system, since the species has also been named *Euterpe acuminata*, genus reported as part of Andean bear's diet in Venezuela and Perú[5, 7].

Wettinia sp. is a large but homogenous group of species distributed from Panama to Bolivia from sea level to 2,600m asl[39]. Most of the species are found between 500 and 2000m asl,

specially those on Andean montane forest[39]. *Wettinia praemorsa* "the only Andean *Wettinia* with clustered stems", is found in Colombia and Venezuela with individuals up to 15m tall[39]. In Venezuela it is distributed across the Cordillera de la Costa, Cordillera de Merida and Sierra de Perijá within submontane and montane rain forest from 400 to 2,400m asl, but most commonly at 1,000 – 1,500m asl[40, 41]. Andean bear signs were found within the species altitudinal range (1795m asl), mean size of stems show preference for juveniles groups (mean = 3.5m σ= 6.4), with mean size of the eaten stems is smaller than average stem group size (mean = 7.56m σ= 8.56) (See Figure 17). *Wettinia praemorsa* is used as principal material for household construction across Sierra de Portuguesa, and it is being heavily logged in areas such as Los Rifles (See Figure 11).

Figure 17.- A) *Wettinia praemorsa*. B) *Wettinia praemorsa* eaten by Andean bear. C) *Wettinia praemorsa* used as household construction material. D) *Wettinia praemorsa* logged in Los Rifles.

Bromeliaceae Family

Prof. Miguel Nino and Francisco Oliva-Esteva Landscape architect, Bromeliaceae expert, identified 1 species (*Guzmania lingulata*) from 22 botanical samples collected. Two samples collected could not be identified, neither three of the photos taken. Identification of bromeliads requires the collection of flowers that are not always present on Andean bear feeding signs (Oliva-Esteva *pers. comm.* 2004). *Guzmania* is a genus containing 160 species distributed in tropical rain forest across Central and South America from sea level to 3,000m asl. *Guzmania lingulata* is distributed across the Antilles, Central America and in South America up to Bolivia. In Venezuela it is found in Cordillera de la Costa from 1,000 to 1,100m asl[38]. Although it is not reported for Sierra de Portuguesa, its presence in the area is possible similar to the case of *G. simplicifrons*. Andean bear feeding signs show an increase on the species altitudinal range with mean elevation 1,786m and records found up to 2,017m asl. *Guzmania sp.* is well known as part of Andean bear diet and it has being registered for Venezuela, Perú, Colombia including more than 4 different species[5, 7, 28]. *G. lingulata* has not being recorded so far[5, 7, 28].

Sign Aging

With the information collected about the aging characteristics of each sign found, an aging scale was established for every type of sign. Feeding signs were divided by plant family given the differences in decomposition processes. As first step, the characteristics of each type of sign were compared inside transects to homogenized the descriptions and establish aging categories. Using this information, a qualitative scale was generated for each type of sign on each transect ranking with numbers from very recent to old. Finally, the scales were compared between transects redefining both categories and ranking, to obtain an aging scale that could be used across sampling units. This single scale was established for both vegetation types given the small sample size of BISvMB (See Table 12). Categories defined as different within a transect remained that way on this last scale. Aging scales could not be established for pruning or for bitten roots due to the small sampling size.

Table 12.- Aging scale by type of signs found during the Pilot Study.

Feeding Signs Aracaceae Family	
Age	**Category**
1	No sings of decomposition
2	Yellow or orange affected area
3	Green affected area, dry leaves
4	Dark affected area, green and dry leaves
5	Dark affected area, dry leaves
6	Cicatrized affected area
7	Dry affected area
8	Sprout
9	Open sprout
10	Rotten or decomposed stem
Feeding signs Bromeliaceae Family	
Age	**Category**
1	No signs of decomposition

2	Leave base starting to get dark
3	Light dark leave base
4	Dark leave base, green or dry leaves
5	Dark leave base, dark end of leave
6	Leave completely dark
Claw-marked trees	
Age	**Category**
1	Presence of tree bark, moss and lichens recently removed
2	Presence of tree bark, light wooden area, starting cicatrisation
3	Cicatrisazed
4	Cicatrisazed with moss or lichens
Foot-prints	
Age	**Category**
1	Not cover by leaves
2	Cover by some leaves
3	Completely cover by leaves

Each type of signs has different numbers of categories showing the differences on decomposition processes mentioned previously. Categories are not equivalent within type of signs and neither between vegetation types. The scale obtained for foot-prints is not accurate, given the alterations caused by leave-covered soils and falling leaves.

An analysis of age distribution across sampling units and vegetation cover categories was performed for feeding signs of the Aracaceae Family. Other types of signs were not evaluated due to sample size constraints. Significant differences on sign age distribution were found for the entire group of signs and for each vegetation cover category (See Table 13). This information evidences that Andean bears are using different areas at different times. Patterns of use according to sign aging were similar between closer transects for BPSvMN, supporting the hypothesis of spatial relations on sign distribution (See Figure 18). Transects 3 and 5 are used sporadically while Transects 1 and 2 are used continuously with concentration of signs on 4-7 ages. Areas with sporadic use appear not to be so relevant for Andean bears given that they also have the smallest number signs found. Results show the capacity of the chosen method to evaluate Andean bear habitat use. Patterns were not evaluated for BISvMB given small sample size (See Figure 19).

Table 13.- Age of sign distribution for feeding signs of the Aracaceae Family.

	Age										**P value X^2 df 9 α = 0.05**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
BPSvMN	10	9	7	27	20	4	30	16	1	12	$9.54\ 10^{-10}$
BISvMN	11	1	0	6	0	1	17	2	0	0	$1.04\ 10^{-13}$
Total	**21**	**10**	**7**	**33**	**20**	**5**	**47**	**18**	**1**	**12**	**$1.07\ 10^{-17}$**

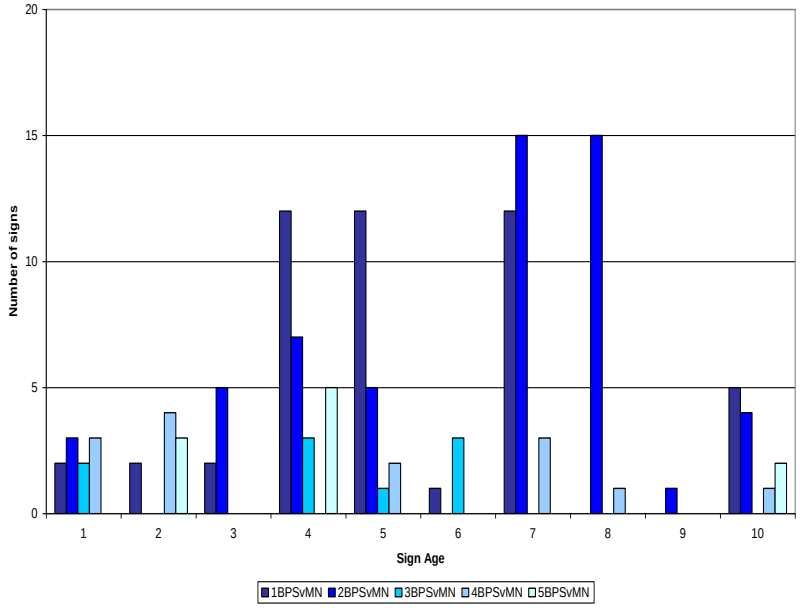


Figure 18.- Sign-age distribution for the feeding signs of the Aracaceae Family found on BPSvMN during the Pilot Study.

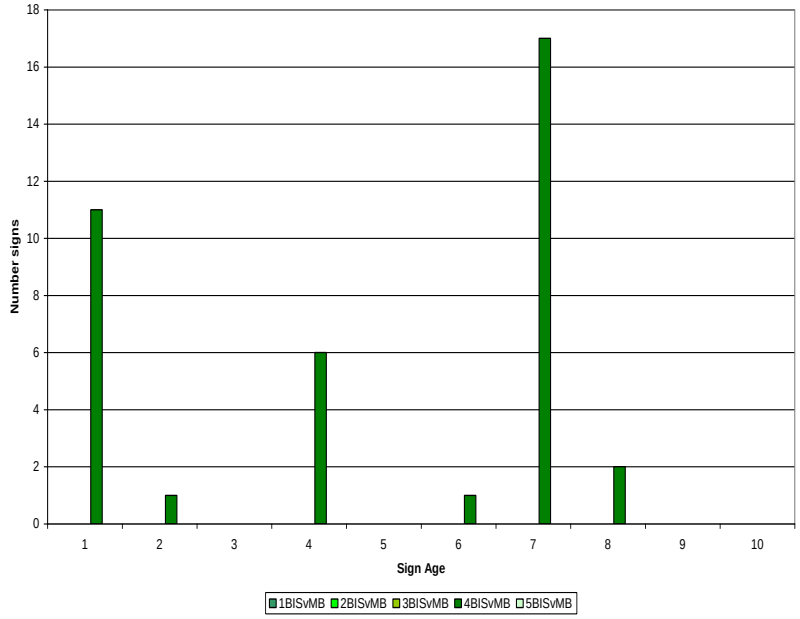


Figure 19.- Sign-age distribution for the feeding signs of the Aracaceae Family found on BISvMB during the Pilot Study.

Vegetation cover map reliability

A superficial reliability evaluation of the Vegetation cover map generated for Sierra de Portuguesa was carried out with 555 ground-checking points (GCPs) were obtained during the Pilot Study (See Figure 20). Results revealed discrepancy between the map generated and on-the-ground reality. Areas classified as primary forest included shadow-coffee plantations, savannas and secondary forest (See Figure 20). Secondary forest categories contained crops (e.g. corn, tomato, and coffee), roads and villages (See Figure 20). The map was corrected before planning the Large Scale Survey.

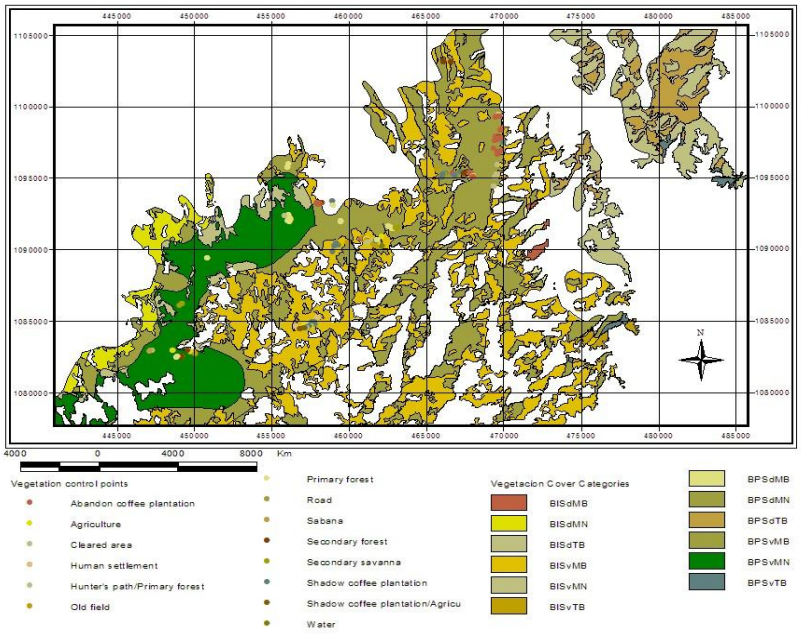


Figure 20.- Ground-checking points recorded for each vegetation cover category sampled during the Pilot Study.

Additional activities

- Attendance to the 2nd Seminar on Andean bear biology and conservation. Fundación Andígena - Guardaparques Univesitarios, Barquisimeto – Venezuela.
- Attendance to the Workshop "Andean Corridor Project in Sierra de Portuguesa, Lara and Portuguesa. Venezuelan Andes" Fudena-The Nature Conservancy, Sanare – Sierra de Portuguesa.
- Attendance as Speaker. Workshop "Biodiversity and Ecological Corridors in the mountains of Lara". A.C. Chunikai-Frecopal, Palenque - Sierra de Portguesa.
- Identification Botanical samples (MSc. Miguel Niño, Universidad Experimental de los Llanos Ezequiel Zamora).
- Attendance to the International Mountain Corridors and Peace Parks Conference. Rocky Mountains, Canada:
    - Talk: "Project Sierra de Portuguesa: Mountain corridors, Andean bear conservation and local consensus"..
- Attendance to the Workshop "Programa de Entrenamiento y Enriquecimiento en Osos Frontinos". WCS – Queens Zoological Park – Parque Zoológico y Botánico Bararida, Barquisimeto – Venezuela.

Vegetation cover map and Andean bear habitat availability

Period: December 2004 – April 2005.

Site: Caracas, Venezuela.

Objectives

- To correct previously developed Vegetation cover map, based on the GCPs collected during the Pilot Study.

Procedure and Results

A set of 4 ETM^{+} and TM5 satellite images obtained from the Global Landcover Facility (GLFC), University of Maryland, were processed under a supervised classification (555 Ground Control Points, GCP) using Erdas 3.0, Idrisi32, ArcView GIS 3.2 and P.C. Arc 3.5.1. During the classification process BELCLASS was used as soft-classifier after which MAXBEL was applied as hardener (See Figure 21). A total of 14 vegetation cover categories where identified, five of which are related to Andean bear habitat: Primary forest, Secondary forest, Open-agriculture, shadow-coffee plantations. Map accuracy according to the ERRMAT algorithm on Idrisi32 was approximately 60%. Thus, GCPs coverage needs to be extended across Sierra de Portuguesa to increase accuracy. This activity was undertaken during the Large Scale Survey.

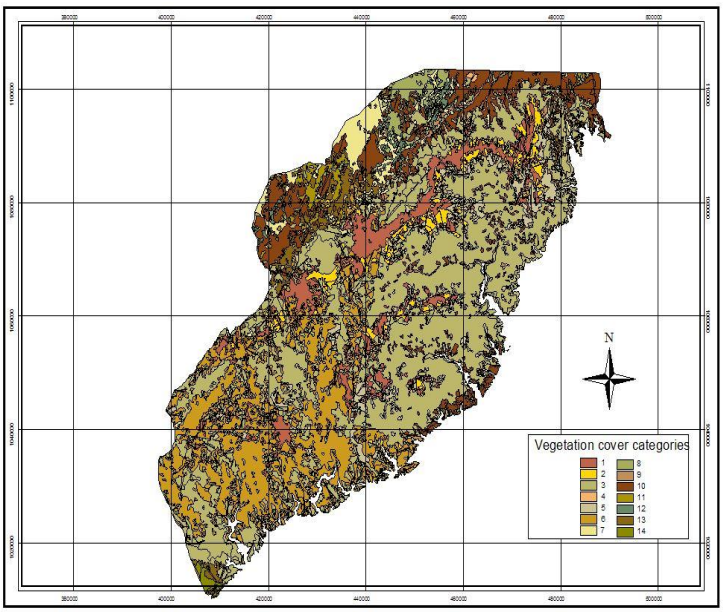


Figure 21.- Vegetation Cover Map of Sierra de Portuguesa.

Once the Vegetation cover map was obtained, an evaluation of Andean bear habitat availability was carried out, extracting from the GIS database only the primary and secondary forest categories (See Figure 22). Contour lines and precipitation were incorporated to the analysis. Results showed that bear habitat in Sierra de Portuguesa (430Km^2) corresponds only to 4.78ha, from which 7.45% represents primary forest and

3.54% secondary forest. Seven large patches of primary forest were identified and the evaluation of Andean bear presence started during the following field-season.

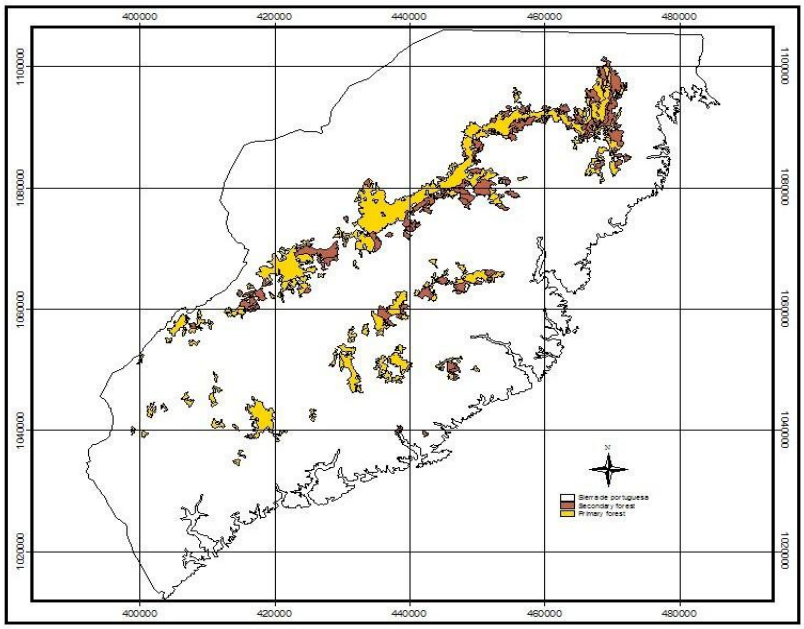


Figure 22.- Andean bear habitat availability map in Sierra de Portuguesa.

Project visit by Dr David J. Chivers. Supervisor

Period: April 9th – 14th 2005.

Site: Sierra de Portuguesa, Venezuela.

Objectives

- To evaluate fieldwork overall development.

Activities undertaken

The Head of the Wildlife Research Group, University of Cambridge, PI's supervisor, and the student Natalia Ceballos visited the study site to evaluate field activities carried out and planned (See Figure 23). Activities undertaken included:

- Visit to the Parque Zoológico y Botánico Bararida: Andean bear exhibition.
- Visit to the Terepaima National Park (NP): Meeting with Regional Authorities of the National Institute of Parks.
- Visit to the Yacambú NP.
- Two field trips across the Ecological Corridor in search for Andean bear-signs.

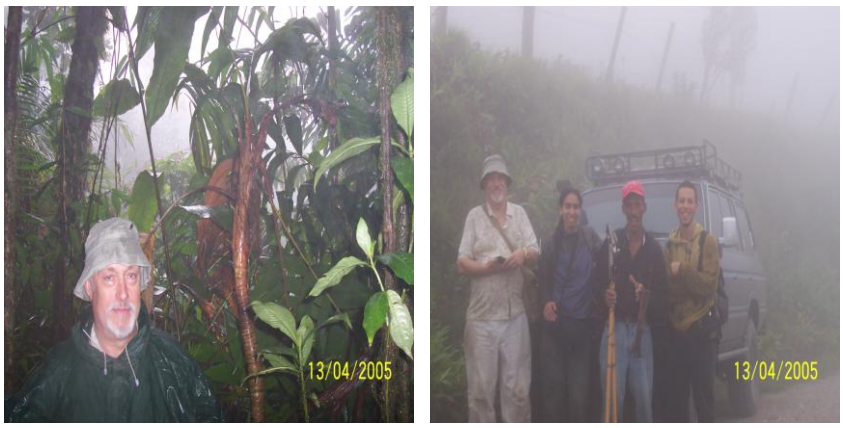


Figure 23.- Dr David J. Chivers' visit to Sierra de Portuguesa: A) Dr David J. Chivers behind a palm eaten by the Andean bear. B) Dr

Venezuelan Andean bear Action Plan Update

Period: Planning May 2005. Workshop June 14th – 16th 2005.

Site: Barquisimeto – Lara State, Venezuela.

Objectives

- To evaluate and Update the Venezuelan Action Plan for Andean bear conservation.

Activities undertaken

In a joint effort the Wildlife Research Group - University of Cambridge, Fundación para la Defensa de la Naturaleza (FUDENA), Universidad Simón Bolívar and Red Tremarctos sponsored by Larfarge-WWF Canada and the Houston Zoo-Fundación Andígena, carried out the workshop "Estrategias para la Conservación del Oso Andino en Venezuela" to evaluate and update the Venezuelan Andean bear Action Plan (See Figure 24). The workshop brought together national and regional decision-making authorities, Andean bear experts, students and communities. A full-session on the species status across the country was held during the first day, and papers on the findings will be published shortly. The manuscript with the updated Action Plan is underdevelopment.

Figure 24.- Workshop "Estrategias para la Conservación del Oso Andino en Venezuela": A) Workshop attendees B) Attendees at the luch lounge.

Aging method, visibility profiles and error estimations

Period: August – December 2005.

Site: Cubiro, Lara State – Sierra de Portuguesa, Venezuela.

Objectives

- To evaluate correspondence between aging categories within a type of sign.
- To determine time scale of aging categories within a type of signs.
- To establish equivalences between aging categories of different types of signs.

Procedure

Under the PI's supervision, an undergraduate student from the Universidad Simón Bolívar established a Sign Aging Project in the locality of Cubiro, Sierra de Portuguesa. Over 200 signs including feeding, claw-marks, faeces, hair, tracks, day-beds were placed on non-disturbed and heavily disturbed primary forest (See Figure 25). Changes on aspect, colour, smell, presence of parasites, re-growth was monitored every other day for a month, and once a month after that (See Figure 25). An aging scale was developed from this activity and it was used during the following bear-sign censuses. Four field-assistants, other than the ones hired during the Pilot Study, were trained on field methods and data collection techniques (See Figure 25).

Figure 25.- Sign Aging Project: a) PI and Anna Veit (undergraduate student) collecting bear hair at the Parque Zoologico y Botanico Bararida b) Bear claw-mark create for the sign aging project c) Anna Veit and Henry Sanchez (field-assistant) during field work d) Field team Henry Sanchez, Armando Valenzuela, Anna Veit, Eugenio Gusman Perez, Alfredo Freitez.

Error assessments and analysis of visibility between vegetation cover categories were undertaken, to estimate percentage of bear-signs missed during tracking. Results showed a consistent lost of 20% of signs on both vegetation cover categories included in the sampling. Thus, visibility appears not to be affecting differently sign encounter across vegetation cover categories. Data loss is contemplated on the distance sampling procedure of analysis and it will allow assessing the accuracy of the fixed-width sampling method.

Resource availability

Finally during this period, a set of 4 vegetation plots (100mx10m) were surveyed as a Pilot Study, to evaluate the feasibility of collecting information related to resource availability within transects, while performing bear-sign censuses. Each plot was divided into subplots (20x10m) for data collection. Starting and finishing times were recorded, and estimations of abundance for different food resources were obtained:

- Abundance of bromeliads was estimated by percentage of canopy covered of two different trees every 20m segment[43-51].
- Fruit abundance was indirectly assessed by tree-species count (>10cm dbh, rooted inside plot), together estimating height and dbh. Presence of leaves, flowers (bud, open) and fruits (green or ripe) was also recorded[43-51].

- Palm trees abundance was calculated by species, height, group perimeter and number of individuals by each group was obtained[43, 44, 46, 50, 51]. Presence of leaves, flowers (bud, open) and fruits (green or ripe) was also recorded[43, 44, 46, 50, 51].

The method chosen proved to be feasible and it was incorporated with minor changes during the Large Scale Survey.

Large Scale Survey

Period: Planning June – September 2005. Fieldwork September – December 2005.

Site: Sierra de Portuguesa, Venezuela.

Objective

- To design of the Large Scale Survey plan to assess Andean bear distribution, habitat and landscape-use.

Procedure

Using the GIS database developed for Sierra de Portuguesa, a total of 100 non-permanent fixed-width transects (500x10m) with a truncated-distance sampling alternative, were selected for sampling following a stratified-random sampling approach that included both primary and secondary forest in Sierra de Portuguesa[52, 53]. A minimum distance of 800mt was chosen between transects to ensure independency[33]. Half the transects were of to be surveyed during Wet season (May to December) and the half on Dry season (December to May). For each sign standard measurements were recorded, including sign-age and rates of sign importance to overall bear ecology.

On each transect a randomly selected vegetation plot (100x10m) was sampled to estimate food resources availabity:

- Abundance of bromeliads was estimated by percentage of canopy covered of two different trees every 20m segment[43, 47, 49-51].
- Fruit abundance was indirectly assessed by tree-species count (>10cm dbh, rooted inside plot), together estimating height and dbh. Presence of leaves, flowers (bud, open) and fruits (green or ripe) was also recorded together with a superficial estimation of age (young, adult)[43, 47, 49-51].
- Palm trees abundance was calculated by species counting the number of clusters or individuals, and recording the presence of leaves, flowers (bud, open) and fruits (green or ripe). Finally, a superficial estimation of the age (young, adult) of the individual or cluster was also determined[43, 47, 49-51].

GCPs were also recorded based on the sites chosen for bear-sign census. Data collected includes GPS measurement, altitude, main vegetation cover category and overall human disturbance. Additionally, set of 200 GCP were randomly chosen for field-checking from the GIS to validate the corrected Vegetation cover map.

Results

A total of 33 truncated-distance sampling transects (500x10m) with its vegetation plots (100x10m) were conducted in search for bear-signs in three different areas of Sierra de Portuguesa (Terepaima NP, "Ecological Corridor", Yacambú NP) (See Table 14). A four-people team conducted systematic censuses inside transects recording well-known indicators of bear presence (See Figure 26)[5, 7, 8, 15, 28, 29, 54, 55].

Table14.- List of sites where truncated-distance sampling transects were undertaken. The vegetation cover category of each transects has being also specified.

September 2005		
Date	**Site**	**Vegetation Cover category**
7	La Florida. Yacambú NP.	Primary Forest
8	La Florida. Yacambú NP.	Primary Forest
10	Santo Domingo. Yacambú NP.	Primary Forest
12 - 13	La Pica del Padre. Yacambú NP.	Primary Forest
15	Potrerito. Yacambú NP.	Primary Forest
17	Altos del Viento. Yacambú NP.	Primary Forest
18 - 19	Pozo Azul. Yacambú NP.	Primary Forest
20	Caspito. Yacambú NP.	Secondary Forest
21	Caspo. Yacambú NP.	Secondary Forest
24	El Blanquito. Yacambú NP.	Secondary Forest
25	El Nuezal. Yacambú NP.	Secondary Forest
October 2005		
Date	**Site**	**Vegetation Cover category**
7	Qda. Agua Blanca. Terepaima NP.	Secondary Forest
8	Fila Los Potros. Terepaima NP.	Secondary Forest
11	Portachuelo.	Primary Forest
13	Qda. Abajo.	Primary Forest
15 - 16	San Esteban. Terepaima NP	Primary Forest
18	Cerro Negro. Terepaima NP.	Primary Forest
20	Piedra del Tigre. Terepaima NP.	Secondary Forest.
22	Los Rosas. Ecological Corridor.	Primary Forest
24	Riecito. Ecological Corridor.	Primary Forest.
November 2005		
Date	**Site**	**Vegetation Cover category**
17	El Páramos. Ecological Corridor.	Primary Forest
19	La Cruz del Nuezal. Ecological Corridor.	Primary Forest
20	El Rincón. Ecological Corridor.	Secondary Forest
22 - 24	Nuezalito.	Primary Forest
26	Bucaralito. Ecological Corridor.	Primary Forest
28	Palmichal. Ecological Corridor.	Secondary Forest.
December 2005		
Date	**Site**	**Vegetation Cover category**
4-8	Volcancito. Ecological Corridor	Primary Forest and Secondary Forest
10 - 11	Bombón. Ecological Corridor	Primary Forest and Secondary Forest

Figure 26.- Fieldwork conducted for bear-sin censuses and resource availability estimations: A) Polo, PI, Eugenio Gusman Perez, Cruz Valenzuela, local farmer. B) Palm eaten by an Andean bear. C) Andean bear claw-mark. D) Nerio Valenzuela, PI and Eugenio Gusman Perez.

Project visit by Dr David Augeri. Field Supervisor

Period: December 1st – 7th 2005.

Site: Sierra de Portuguesa, Venezuela.

Objectives

- To evaluate study design.
- To evaluate fieldwork overall development and efficiency.

Activities undertaken

Dr David Augeri, Coordinator of Conservation Biology at the Denver Zoological Foundation, visited the study site to advice on study design, fieldwork techniques and efficiency. Activities carried out included:

- Visit to the Parque Zoológico y Botánico Bararida: Andean bear exhibition.
- Visit to Yacambú NP.
- Visit to the Sign Aging Project.

▪ Two field trips across the Ecological Corridor to carry out two fixed-width transects on search for Andean bear-signs.

Dr Augeri's suggestions to improve data quality where the followings:
▪ Include forest edges, agriculture and dirt roads as categories to be sampled together with primary and secondary forest.
▪ Increase sample size to incorporate 20% of replicates on each sampling category.

Large Scale Survey II planning and fieldwork

Period: Planning January. Fieldwork February – December 2006.

Site: Caracas, Venezuela.

Objectives

- To re-plan the Large Scale Survey to incorporate Dr Augeri's.
- To undertake the final and large scale stage of field-data collection.

Procedure

Using the GIS database of Sierra de Portuguesa, 75 non-permanent fixed-width transects (500x10m) with a truncated-distance sampling alternative, were selected following a regular (equal sample size N = 25) - random sampling approach for each Habitat Type: Primary and Secondary Forest, Agriculture (See Figure 27). Minimum distance between transects was increased to 1.5km to assure data independency. No confident records are available on Andean bear daily-travel or home-ranges. Thus, the distance chosen was a compromised between the largest distance that allowed to fit 25 transects on each Habitat Type, and the average daily-travel distance estimated from the smallest home-range reported for the species (7km^2), assuming its circular shape[33].

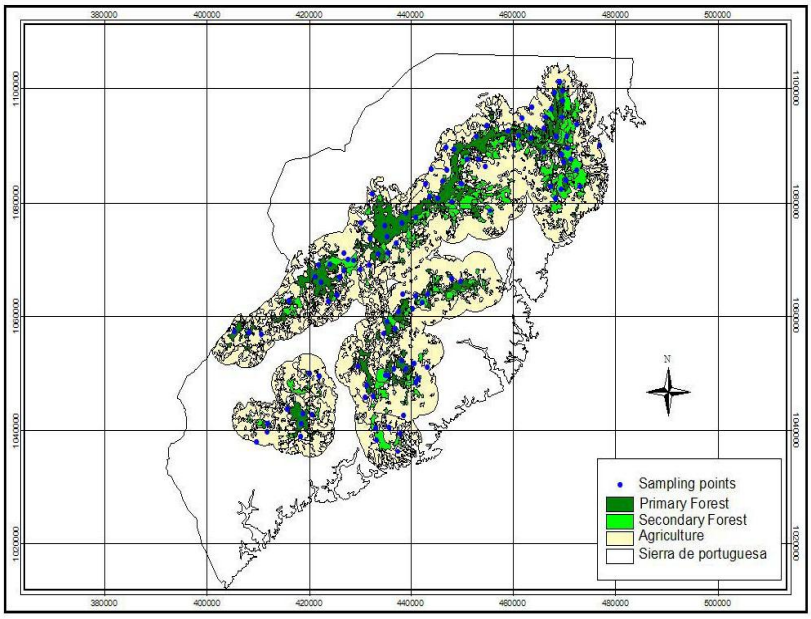


Figure 27.- Large scale survey plan II.

Evaluation of Andean bear use of Microhabitats was included for each Habitat Type by placing its 25 transects on a regular-random sampling layout according to the number of Microhabitats selected on each:

- Primary Forest: Montane and Sub-Montane.
- Secondary Forest: Young (Up to 15 years old) and Old (Over 15 years old) / Montane, Sub-Montane and Lowlands.
- Agriculture: Open (No canopy cover) and Close (Shadow-coffee) / Montane, Sub-Montane and Lowlands.

Due to time constraints, seasonal changes were not contemplated on the sampling design. Andean bear seasonality on habitat and landscape-use is indirectly assessed from sign-aging.

Andean bear use of Edges and Dirt Roads was also incorporated on data collection, to allow an in-depth analysis of bear habitat and landscape-use of these particular habitat elements. Edges were defined as the first 100m between two Habitat Types, and a set of 32 transects (500x10m) were to be sampled across the different Microhabitats available following a regular-random sampling approach: 1) Primary Forest - Agriculture, 2) Secondary Forest – Agriculture, 3) Primary Forest - Secondary Forest / Montane and Sub-Montane. For 1) and 2) transects were to be lay inside the forest in parallel to the Edge at either 0m or 50m from it. For 3) transects were placed perpendicular to the Edge sampling both Habitat Types, given that the Edge was difficult to identify along the survey area. Dirt Roads were defined as the categories *Carretera de Tierra* and *Camino Carretero* of the 1:100.000 cartographic maps of the Instituto Geográfico Simón Bolívar. A total of 25 transects (500x10m) were to be placed along randomly-selected roads across those previously mentioned Habitat Types. Equal sample size was kept between them.

Finally, 20% randomly chosen pseudo-replicates were included on the sampling design for each main category (Habitat Type, Edges and Dirt Roads) to evaluate possible outliers. Randomly chosen vegetation plots (100x10m) were to be survey on each transect for estimation of food resources availability, as mentioned earlier. GCPs for validation of the Vegetation cover map were also to be collected during fieldwork.

Results

Fieldwork was set to start by mid-February with a total of 20 field-journeys to be performed, but it was delayed due to changes and training of field-staff. By mid-March, the team was set and ready to go, and a total of 10 field-journeys were conducted continuously until July (See Table 15 and Figure 28). Thanks Dr Augeri's suggestions field efficiency increased from 10 transects per month to over 15 transects, and a better understanding of vegetation coverage, human activities, local impact and bear habitat-use was being obtained after the survey modifications.

Table 15.- Fieldwork conducted from February to July 2006 for the Large Scale Survey II.

Field–journeys	Site	Period	Number of Transects
1	La Florida	February 20th – 27th	6

2	El Manzanal	March 13th –22nd	8
3	La Victoria	March 25th – 3rd	6
4	Riecito – Pica Alta	April 6th – 15th	8
5	Piedra del Tigre	April 20th – 28th	9
6	Las Quintas de Terepaima	May 4th – 10th	5
7	Paujisal	May 23rd - June 2nd	9
8	El Blanquito	June 8th – 13th	8
9	Caspo 1	June 19th – 25th	8
10	Caspo 2	July 2nd – 13th	8
Total of transects conducted			**75**

During mid-July, the PI developed a serious allergy to a tree species found across the Study Site, "Palo de Tigre" or "Pepeo" (*Mauria puberula*), and had to be taken to Caracas (Capital City) for medical treatment; thus fieldwork was suspended. Following physician's advised coming activities were reduced; pseudo-replicates were eliminated together with 3 of the remaining 10 field-journeys. The ones kept for survey were selected to ensure sampling coverage across the entire Sierra de Portuguesa. Fieldwork continued by the end of August and finished by mid-December (See Table 16 and Figure 29). The services of a Botanist were hired to help with the vegetation plots and to proceed with the identification of the already collected vegetation samples (See Figure 29). The PI is confident that the objectives of this project will be fulfil with the data collected, given that it represents over 80% of the original sample plan, and that the changes were carefully chosen to attend sample needs at that cut-up point.

Figure 28.- Field-assistants and PI during fieldwork: A) in La Cuchilla with local children. B and D) in Cubiro. C) with the Escalona Family in Guamacire.

Table 16.- Fieldwork conducted from August to December 2006 for the Large Scale Survey II.

Field–journeys	Site	Period	Number of Transects
11	Montaña Mundo Nuevo	August 25th – 31st	4
12	Sanarito – Villanueva	September 5th –11th	4
13	Guache de Garabote	September 16th – 24th	9
14	Cerro La Mucutía	October 8th – 15th	6
15	Marilonza I	November 10th – 15th	5
16	Marilonza II	November 19th – 27th	5
17	Cerro El Pingano	December 7th – 11th	3
Total of transects conducted			33

Figure 29.- Field activities: A) The PI, Dorangel Nuñez (Botanist), Henrry Sánchez, Francisco Daza in Cerro Papelón. B) Palm tree eaten by an Andean bear in Piedra Hueca. C) Andean bear claw marks in Guariquito.

Other Activities

- Educational Talk: ¿Quién es el Salvaje?, Matatere Community - Sierra de Portuguesa.
- Education Talk: Misión Sucre, Cubiro – Sierra de Portuguesa.
- Educational Talk: " Proyecto Oso Andino Sierra de Portuguesa", Cubiro – Sierra de Portuguesa.

Sing Aging Project

Period: January – August 2006.

Site: Cubiro, Lara State – Sierra de Portuguesa, Venezuela.

Results

Continuing with the activities started on August 2005, a monthly visit was conducted to the Sign Aging Project set in Cubiro, by the project team as a whole. Eaten bromeliads, "Mapora" (*Prestoea acuminata*) palm trees, rubbing trees, day-beds, superficial claw-marks, tracks, scats, hairs and some bitten roots were no longer distinguishable as bear-signs after six months (See Figure 30). The visits concluded after on year survey, and only deep claw-marks on trees and some palm tress of the *Geonoma* and *Wettinia* genera were identify as bears-signs until the end (See Figure 30).

Figure 30.- Andean bear signs of the Sign Aging Project : A) Macanilla (*Wettinia praemorsa*) no longer distinguish as bear-sign after eleven months. B) Andean bear deep claw-mark distinguishable as bear-sign after twelve months. C) Palmiche (*Geonoma undata*) distinguishable as bear-sign after twelve months. D) Andean bear deep claw-mark distinguishable as bear-sign after twelve months.

Venezuelan Andean bear Action Plan Update

Period: January – December 2006.

Site: Caracas, Venezuela.

Results

The manuscript summarizing the results on the workshop "Estrategias para la Conservación del Oso Andino en Venezuela", organized by the Wildlife Research Group - University of Cambridge, Fundación para la Defensa de la Naturaleza (FUDENA), Universidad Simón Bolívar and Red Tremarctos to evaluate and update the Venezuelan Andean bear Action Plan is almost ready and looking for funding for publication. The compiled document presents a through review on the species threatens in the country and the actions required during the following ten years ensuring its long term conservation.

Statistical Consulting - Colorado State University and Visit to the Denver Zoological Foundation.

Period: February 2007.

Site: Denver - Colorado, EEUU.

Objectives

- To establish contact with Dr Jim zumBrunnen from the Statistics Department at Colorado State University.
- To present a report of the project to the Denver Zoological Foundation.

Activities undertaken

A total of 2 meetings were carried out at Colorado State University, and plans for future consultancy were developed. An oral presentation of the project's up-to-date results was conducted at the Denver Zoological Foundation. Additionally, the PI visited the Rocky Mountains National Park carnivore complex baseline study of the Denver Zoological Foundation together with Dr Dave Augeri.

Field-data entry, GIS database generation and identification of botanical samples.

Period: March 2007 – June 2008.

Site: Wildlife Research Group - University of Cambridge, UK

Objectives

- To develop a database and enter the data collected during fieldwork.
- To digitize hard-copy maps of Sierra de Portuguesa and develop a GIS database of this study site.

- To process and identify the botanical samples collected during fieldwork.

Activities undertaken

After the PI's returned to Cambridge, a database on Microsoft Office Access 2003 was developed for data entry and the data collected during fieldwork was entered. In parallel, 7 hard-copy maps 1:100,000 from the Instituto Geográfico de Venezuela Simón Bolívar were digitized by Venezuelan personnel, to generate a comprehensive GIS database for Sierra de Portuguesa. This process was finished on April 2007, and the quality of the generated layers was verified by the PI. All the botanical samples collected were identified by the the BioCentro-UNELLEZ Herbario Universitario (PORT).

Other Activities

- Project presentation to the Wolfson Wildlife Society - Science Colloquium: Establishing distribution, habitat and landscape-use of the Andean bear (*Tremarctos ornatus*) population inhabiting Sierra de Portuguesa, northeast end of the Venezuelan Andes. Cambridge, UK.
- Project presentation to the Conservation Science Group – Department of Zoology, University of Cambridge: Conservation of the Andes in Venezuela. Cambridge, UK.
- Project presentation at the Science and Conservation Seminars of Institute of Zoology, London Zoological Society: Establishing distribution, habitat and landscape-use of the Andean bear (*Tremarctos ornatus*) population inhabiting Sierra de Portuguesa, northeast end of the Venezuelan Andes. London, UK.
- Project presentation at the Wolfson Science Day 2008: Andean-bear habitat availability assessment across Sierra de Portuguesa, Venezuelan Andes, using remote-sensing, GIS and landscape ecology. Third Price.
- Project presentation at the Ecology Lunch Talks - Department of Zoology, University of Cambridge: Establishing distribution, habitat and landscape-use of the Andean bear in Sierra de Portuguesa, Venezuelan Andes. Cambridge, UK.

Action Plan for Andean-bear conservation in Venezuela (2006-2016).

Period: June 2007.

Site: Venezuela.

Results

After a long wait and years of hard work, the final version of the Action Plan for Andean-bear conservation in Venezuela was published the 24th of June 2007[56, 57] (Figure 31). This document presents an up-to-date review of the Andean-bear conservation status in Venezuela and summarizes the actions required towards its preservation during the next 10 years. It reflects the joint effort of Fundación para la Defensa de la Naturaleza (FUDENA), Universidad Simón Bolívar, Fundación Andígena, the Wildlife Research Group-University of Cambridge, and Red Tremarctos, that sponsored by Lafarge-WWF Canada, the Houston Zoo-Fundación Andígena, Universidad Simón Bolívar and Red Tremarctos, gathered in two different workshops an important number of governmental bodies, researchers, students and organized communities to evaluate all aspects involved with the species long-term survival. This product was long awaited and we are certain that it will power

our efforts to ensure the preservation of the most emblematic creature within the Andes mountain range. Currently, we are looking for interested organizations that could contribute to the application of this document, and that could sponsor its English translation.

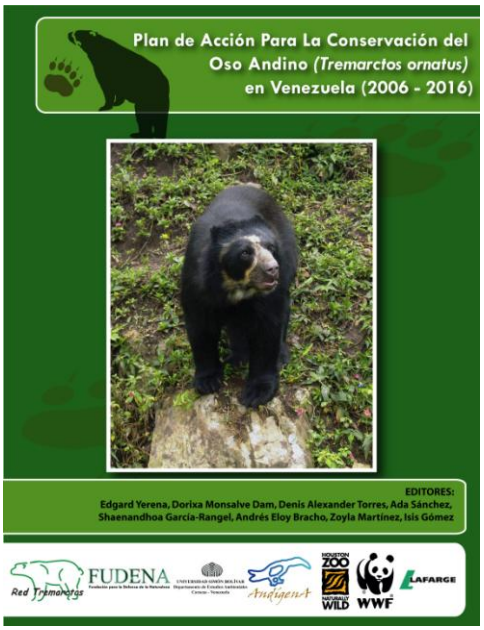


Figure 31.- Cover page: Action plan for Andean bear conservation (2006-2016)

To download the document please visit:
http://andigena2.iespana.es/proyecto_oso_andino/publicaciones_divulgativas/Plan_Accion_Oso_Andino_Vzla_2006-2016_FINAL.pdf

For an English summary:
García-Rangel, S.; Yerena, E.; Monsalve Dam, D.; Torres, D., Bracho, A.E.; Martinez, Z. and I. Gómez. 2007. Action Plan for Andean-bear conservation in Venezuela (2006-2016). International Bear Newsletter 16 (4): 18-22p.
http://www.bearbiology.com/fileadmin/tpl/Downloads/IBN_Newsletters/IBN_November_2007.pdf

Andean-bear habitat availability assessment

Period: September 2007.

Site: Wildlife Research Group - University of Cambridge, UK.

Objectives

- To update the Andean-bear habitat availability analysis carried out for Sierra de Portuguesa from December 2004 to April 2005.

Results

The analysis of Andean-bear habitat availability across Sierra de Portuguesa carried out from December 2004 to April 2005 was updated with data collected during the 2006 field-season. Preliminary results showed that the habitat available (322.12km^2, 7.22% of Sierra de Portuguesa) is limited, divided into 169 fragments, and encroached by human activity (Figure 32). The altitudinal range was found to be narrow and possibly restricting the remaining individuals to mountain tops. A total of 50% of the habitat available is currently protected within national parks, but their spatial configuration is risking further fragmentation. In general, levels of fragmentation across Sierra de Portuguesa were high and modulated by fragments $\geq$5km^2. The species may be absent in some patches, and individuals and groups could be isolated.

Other Activities

The results from this analysis were presented at the 18th International Conference on Bear Research and Management in a poster titled: Andean-bear habitat availability assessment across Sierra de Portuguesa, Venezuelan Andes, using remote-sensing, GIS and landscape ecology (Figure 2)[58]. Finally, a brief presentation of the Venezuelan Andean-bear Action Plan mentioned above was given by the PI at the Bear Specialist Group meeting that took place during this conference.

Figure 2: a) Photo by Marco Enciso M.D. Principal Investigator and Marco Enciso during the poster session at the 18th International Conference on Bear Research and Management. b) Bear Specialist Group Meeting at the 18th International Conference on Bear Research and Management.

GIS training and data analysis.

Period: July - December 2008

Site: Wildlife Research Group - University of Cambridge, UK.

Objectives

- To train the PI on the use of use of ArcGIS 9.3 and ENVI software.
- To start the analysis of the data collected in the field.

Activities undertaken

In September 2008, data analysis started on a regular basis, with the redefinition of the boundaries of Sierra de Portuguesa, based on a review of the geological and physiographic features of the area. Currently, the PI is focused on incorporating the new satellite images to the existing assessment of Andean bear habitat availability. Results are expected by the end of January 2009. In November 2008, Dr Nathalie Pettorelli from the Institute of Zoology – London agreed to join the existing advisory team to supervise data analysis and thesis outcome.

Other Activities

In November, the PI attended the II International Symposium on the Andean bear. This meeting proved to be paramount for the consolidation of an international community working towards the species conservation. Venezuelan researchers working as a group presented 13 talks and posters on issues such as: 1) evaluation of the impact of protected areas and education programs to reduce the species threats, 2) guidelines for the management of rescued individuals, and 3) the Action Plan for Andean-bear conservation in Venezuela. As part of this effort, the PI presented a brief summary of the Action Plan and an overview of the Andean bear – Sierra de Portuguesa Project[59, 60]. In addition, she was part of the organizer team of the workshop "Gaps in Andean bear knowledge". Following this meeting, the **Equipo Venezolano Oso Andino** (EVOA) (Andean bear Venezuelan Team) was consolidated as a platform to foster project development, collaboration and step-change towards the species conservation.

Figure 1: Photo by MSc. Edgard Yerena: Principal Investigator together with members of the EVOA and other conference participants.

FINANCES REPORT

GRANTS AWARDED

Table 2.- Grants awarded during 2008.

Source	Amount (UK £)
North England Zoological Society - Chester Zoological Gardens	3,000
Fund for Women Graduates	1,500
Lundgren Fund – University of Cambridge	964
Denver Zoological Foundation	3,400
Planet Action	In kind – Satellite Imagery
The ESRI Conservation Program	In kind – Software and training

PROJECT SCHEDULE 2009

Table 3.- The following table represents the schedule proposed for the coming year when the project is expected to be finished.

2008												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Analysis Stage												
2009												
Analysis Stage												
PhD Thesis Submission												
Results Dissemination												

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