

# Food habits of Andean bears in the Oyacachi River Basin, Ecuador

Verónica Troya<sup>1</sup>, Francisco Cuesta<sup>2</sup>,  
and Manuel Peralvo<sup>2</sup>

*EcoCiencia, Francisco Salazar E14-34 y Coruña,  
Quito, Ecuador*

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The Andean bear may be considered an umbrella species in South America because it uses large areas and a wide diversity of habitats. In addition, protection of Andean bear habitats is directly connected to the conservation of watersheds to safeguard future water supplies. Finally, the charisma of the species has been instrumental in improving the public's attitude toward wildlife (Cuesta 1998). However, Andean bears are threatened by habitat loss and conflicts with humans (Suárez 1999). In Ecuador, habitat loss due to agricultural activities has resulted in fragmentation and isolation of bear populations (Cuesta et al. 1999, Suárez 1999), whereas poaching has contributed to population reductions. Annual bear mortality due to poaching is estimated at 70–120 individuals (Adams and Mazariegos 1994 in Suárez 1999).

Information about the ecology of Andean bears is crucial to provide a more solid basis for bear conservation. Diet studies provide such important information. Our study objective was to improve the knowledge of the ecology of this species in Ecuador by examining Andean bear diets in the Oyacachi area and the habitats that provide those foods.

## Study area

Our study took place in the 72,100 ha along Oyacachi River Basin in the Province of Napo, 50 km east of the capital city of Quito. The study area was inside the Cayambe-Coca Ecological Reserve and was part of the territory of the Quichua Community of Oyacachi (Fig. 1). The elevation of the study area is between 1,600–4,500 meters. Topography is very irregular, with a mean slope of 41° (Cuesta et al. 2003). The lowest and highest mean annual temperatures were 5°C and 17°C, respectively. Mean annual rainfall was 3,500 mm, but

rainfall varied greatly during the year. Rainfall was relatively low from November to March and greater during July and August. Six major vegetation types were identified in the study area (Table 1): montane cloud forest, evergreen upper montane forest, alder (*Alnus* spp.) forest, mixed páramo forest, cushion páramo, and grass páramo (Baez et al. 1999, Iturralde et al. 2000).

## Methods

Scat analysis is one of the most effective methods to determine the diet of an animal (Putman 1984), particularly for species such as the Andean bear, whose activities are difficult to observe in their natural habitats. We collected scats from January to December 2000 as part of an ongoing Andean bear research project. Fifty-three transects were established according to survey techniques discussed by Kendall et al. (1992), with survey routes stratified according to the proportion of the 6 major vegetation types within the study area. To sample a broader altitudinal range, transects were established perpendicular to the course of the Oyacachi River. All transects were surveyed once every 2 months.

We collected 65 scats and analyzed their contents according to methods described by Korschgen (1987). We identified plant remains with a microscope and compared them with plant samples collected in the study area during 2000. All plants collected had been previously reported as Andean bear foods by other authors (Peyton 1980; Suárez 1985, 1989; Mondolfi 1989). Additional plants were collected based on information from residents about food habits of Andean bears. Plants were identified to the species level when possible at the Herbario Nacional del Ecuador (QCN) before comparing them with remains found in the scats. Scientific names for plants follow Jørgensen and Leon-Yanez (1999). For some plants, identification to the species level was difficult because all that remained in the scats were fibres and portions of leaves. In those cases, identification only was made to the family.

We used  $\chi^2$  tests of independence (Sokal and Rohlf 1981) to determine whether the frequency of scats containing bromeliads varied among vegetation types or time of scat collection. Bromeliads were the only food class encountered frequently enough to generate sufficiently large expected values.

## Results

We collected 65 scats during 2000; 4 scats were not included in the analysis because of inaccurate collection data or because they had already decayed.

<sup>1</sup>Present address: Cite Universitaire de Geneve, A 12-12, 46 Av. de Miremont, 1206, Geneve, Switzerland, troyasu3@etu.unige.ch <sup>2</sup>osos@ecociencia.org



Fig. 1. Location of the Oyacachi River Basin, Ecuador.

Contents of 4 other scats included unidentifiable plant items, so we excluded those samples as well. We collected 16 scats during January–February, 3 during March–April, 13 during May–June, 5 during July–August, 12 during September–October, and 8 during November–December.

Based on the frequency with which they appeared in scats, Andean bears fed mostly on the hearts of bromeliads, primarily of the genera *Puya* and *Greigia*. Fruits of *Hyeronima macrocarpa*, a plant of the Euphorbiaceae family, represented the second most common item in scats (Table 2). The only animal remains we found in scats were those of beetles and ants ( $n = 4$ ).

The frequency of bromeliads found in scats varied among vegetation types ( $\chi^2 = 11.35$ , 4 df,  $P < 0.05$ ), but not among sampling periods ( $\chi^2 = 2.25$ , 5 df,  $P > 0.05$ ). Terrestrial bromeliads were the most common item in scats collected in páramo habitats. Fifteen of 18 scats collected in the grass páramo contained bromeliads. This item also occurred most frequently in scats collected in cushion páramo, and it was the only item in scats from mixed páramo forest.

Scats collected in the evergreen upper montane forest primarily contained bromeliads and seeds from *Hyeronima macrocarpa*. Among scats from the montane cloud forest, seeds of *H. macrocarpa* were the most common item, followed by bromeliads. We identified 2 items from plants that showed signs of consumption by

Table 1. Vegetation types in the Oyacachi River Basin, Ecuador, 2000 (from Iturralde et al. 2000).

Vegetation type	Elevation range
Montane cloud forest	2,600–3,600
Evergreen upper montane forest	3,000–3,600
Alder forest	2,500–3,200
Mixed páramo forest	3,600–4,300
Cushion páramo	3,400–3,600
Grass páramo	3,600–4,300

bears but were not observed in scats: *Anthurium* spp. (Araceae) and *Asplundia* spp. (Cyclanthaceae).

## Discussion

Several factors could have influenced scat collection. More scats were collected during January–February, when the weather was dry and scats were more easily observed and preserved for collection. Rain likely was the reason for the low number of scats collected during July–August (the peak of the rainy season). The abundant rains made it more difficult to survey and locate bear sign, and scats decayed faster. March and April had the lowest number of scats; although it begins to rain heavily in April, March remains a rather dry month. Unlike July and August when fruits are abundant in montane forests, fruits are scarce during March and April, and that reduction in food availability may have reduced food intake and resulted in fewer observed scats. Bears could have moved outside the study area during those months, although we have no data to support either assertion.

Bears apparently fed most frequently on the meristematic tissues and leaf bases of terrestrial bromeliads, such as *Puya* spp. and *Greigia* spp. Both genera occurred in distinct patches, but the former genus was abundant in the grass páramo, whereas the latter was abundant in mixed páramo forests. Other genera of bromeliads, such as *Tillandsia* spp. and *Pitcairnia* spp., also were eaten by bears (Table 3), although less frequently. In Peru, Peyton (1980) found that bear diets included various plants and animals, with bromeliads and fruits as the main items. In Bolivia, D. Rumiz (D. Rumiz, C. Eulert, and R. Arispe, 1997, Situación del oso andino [*Tremarctos ornatus*] en los Parques nacionales Amboro y Carrasco, Bolivia, Ponencia presentada en el Tercer Congreso Internacional sobre manejo de fauna en la Amazonia, Santa Cruz de la Sierra, Bolivia, unpublished presentation) also observed that bears fed on a variety of plants and animals; bromeliads were the most abundant item in the diet of Andean bears. Suárez

**Table 2. Number of occurrences of plant families in scats of Andean bears, Oyacachi River Basin, Ecuador, 2000.**

Family	Number	%
Bromeliaceae	34	59.6
Euphorbiaceae	11	19.3
Poaceae	5	8.8
Ericaceae	2	3.5
Myrtaceae	2	3.5
Arecaceae	2	3.5
Rosaceae	1	1.8
Total	57	100

(1985, 1989) studied bear diets in Antisana, Ecuador, and reported that Andean bears were omnivorous and most frequently consumed bromeliads.

The high frequency of bromeliads in bear scats in our study area may be explained by the fact that these plants can be found in 5 of the 6 vegetation types within the study area. Moreover, because bears only consume the stem and leave bases, this food source is available all year. The distribution of bromeliads in the páramo is patchy, and bears may be able to feed for some time within such patches. Indeed, Goldstein (2004) found that Andean bears in Venezuela selectively fed within patches of *Puya* spp. with a greater concentration of plants.

Other food habit studies on Andean bears have reported that animals such as rodents, deer, tapirs (*Tapirus pinchaque*), cattle, and even birds are part of the diet (Peyton 1980, Suárez 1985, Mondolfi 1989, Goldstein 1992). No mammal or bird remains were found in scats during our study. Although scats containing remains of white-tailed deer (*Odocoileus virginianus*) and cattle were collected in 2001, animal matter did not seem to represent an important food source for bears in our study area. It is possible, however, that animal matter was underestimated in our study because it tends to be more efficiently digested and thus underrepresented in scats (Pritchard and Robbins 1990, Hewitt and Robbins 1996).

The different vegetation types in the Oyacachi River Basin offer a variety of plants to which bears have easy access. Moreover, páramo habitats also provide berries such as *Escallonia myrtilloides*, *Pernettya prostrata*, and several species of the genus *Rubus*. Montane and cloud forests provide bears with berries from the family Ericaceae and fruits of the genus *Rubus*, which have been reported as part of Andean bear diets in other countries (Peyton 1980, Mondolfi 1989). Trees of the genera *Oreopanax*, *Miconia*, *Eugenia*, *Ocotea*, *Hyeronima*, and *Ficus* also are abundant in those forests (Baez et al. 1999), potentially providing additional food sources for bears.

**Table 3. Plants consumed by Andean bears in Oyacachi River Basin, Ecuador, 2000.**

Family	Genus and species	Common name
Bromeliaceae	<i>Greigia</i> spp.	piñuelo <sup>a</sup>
	<i>Pitcairnia</i> spp.	piñuelo de oriente <sup>a</sup>
	<i>Puya</i> spp.	achupalla
Araceae	<i>Tillandsia</i> spp.	huicundo/bromelia
	<i>Anthurium</i> spp. <sup>b</sup>	bijahua <sup>a</sup>
Cyclanthaceae	<i>Asplundia</i> spp. <sup>b</sup>	macana
Ericaceae	<i>Pernettya prostrata</i>	huangashig <sup>a</sup>
	<i>Vaccinium</i> spp.	mortiño
Rosaceae	<i>Hesperomeles</i> spp.	pinan de páramo <sup>a</sup>
Arecaceae	<i>Ceroxylon</i> spp.	palma de ramos
	<i>Geonoma</i> spp.	macana
Euphorbiaceae	<i>Hyeronima macrocarpa</i>	motilón
Myrtaceae	<i>Eugenia</i> spp.	arrayán blanco
Poaceae	<i>Aulonemia gueko</i>	tunda <sup>a</sup>
	<i>Chusquea</i> spp.	suro

<sup>a</sup>Local name.

<sup>b</sup>Items not found in the scats but identified from plants that showed signs of consumption by bears.

Fruits were the second most frequent item we observed in the diet. Fruits of 5 species of plants were eaten by bears (Table 3); fruits of motilón (*Hyeronima macrocarpa*) were eaten most frequently. These fruits are fleshy and relatively large (3 × 2 cm). The higher frequency of these fruits in the diet may be related to factors such as availability, taste, texture, or size. *H. macrocarpa* produces sweet, edible fruits that are consumed by people in the Oyacachi River Valley (F. Quinatoa, park guard, Cayambe Coca Ecological Reserve, personal communication). Fruits of this species were abundant in the montane forests during June, July, and January. Indeed, observations of habitat use indicate that these 2 habitats received more use by bears during January and July (Cuesta et al. 2003). However, more information on the phenology of this plant species is needed. During other months (May–Jun and Sep–Dec), bears fed more frequently in the grass páramo and the mixed páramo forest, where food is available all year long. Peyton (1980, 1987) found that bears in Peru used páramo between February and April, when fruits were scarce in the lower humid forests; bears moved through the study area according to the fruiting periods of the species they consumed. Similarly, Suárez (1985) found that bears in Antisana, Ecuador, visited páramos only between February and July.

Although the sample size of scats in our study was too small to thoroughly examine differences in the diet among vegetation types, differences we observed throughout the year seemed to coincide with habitat use patterns reported by Cuesta et al. (2003), suggesting

that seasonal shift in habitat use occurred in response to food availability. Bears seemed to spend more time in the montane forests while fruits were more available there and stayed in the higher páramo habitats the remainder of the year, using a food source that is available all year long.

We observed 2 items identified only from plants showing signs of bear consumption, *Anthurium* and *Asplundia*. Both are herbaceous plants, and their absence from scats could be due to the consistency of their stems and leaves, which are softer and thinner than those of *Puya* or bamboo species. Bears likely digest these items more efficiently. However, even when they are abundant in the montane forests, only a few plants of these genera showed signs of bear consumption.

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