

definitive statement about the status of *Cebus capucinus* in Nicaragua, although it definitely exists in one or two very large reserves, relatively protected by their remoteness (Río San Juan-Bartola-Indio-Mañíz area and probably Bosawas). Because we never actually saw *Cebus capucinus*, we could not verify its presence in several areas where "white-faced" monkeys were reported, although its presence seems likely in the southwestern part of Nicaragua, west of published distributions. Spider monkeys also occur in at least one large reserve (Bartola-Indio-Mañíz area). The identification of the subspecies seen in Bartola was not verified. It is supposed to be *A. g. geoffroyi*, but is redder than a published illustration (Konstant *et al.*, 1985).

Because Nicaragua is the largest nation in Central America, it has an important role in the conservation of the region's flora and fauna. The recent election of a new president, Arnoldo Alemán, is likely to be accompanied by new economic development. One rumored development is a major rail line to transport goods from the Pacific to the Caribbean, as an alternative to the Panama Canal. Such a massive project could have a major impact on the relatively large forested areas remaining in eastern Nicaragua. It is important to determine the status of potential areas for nature protection before critical areas are lost, and to conduct more systematic censuses of the primates and other fauna. For the moment, Nicaragua still has sufficient numbers of wild primates to be observed by tourists and primatologists on vacation.

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TWO HOWLER SPECIES IN SOUTHERN PIAUÍ, BRAZIL?

In a review of the distribution of the red-handed howler monkey, *Alouatta belzebul*, in northeastern Brazil, Coimbra-Filho *et al.* (1995) brought to light the overlooked record made by Neiva and Penna (1916, p. 106), who observed groups of black howler monkeys with yellowish hands at Angico, left margin of the Rio Parahim, municipality of Parnaguá, state of Piauí, and also reported collecting one individual (p. 202) whose whereabouts are unknown. This record is the southernmost for the species in northeastern Brazil, and apparently the first for Piauí, although Ihering (1914) suspected its presence in the forested northern region.

From the description made by Neiva and Penna (1916) there can be little doubt as to the identity of the howlers they observed, although a specimen would be desirable. Parnaguá lies in a transition area between the Cerrado and Caatinga domains, although still dominated by

semideciduous species. Taller forests are to be found along the rivers, otherwise the vegetation is mostly "Agreste" (RADAMBRASIL, 1989). This habitat is quite unlike the mangrove, "brejo" (montane) and semideciduous forests where *Alouatta belzebul* is known to occur in northeastern Brazil (Langguth *et al.*, 1987).

Besides *Alouatta belzebul*, another howler species is known from Piauí, although in a different ecological context. Chame *et al.* (1985) recorded a relictual population of *Alouatta caraya* at the Serra da Capivara National Park (around 08°26'50"S - 42°45'51"W), a 1,200 km² reserve in a Caatinga-dominated region but not far from the transitional belt with the Cerrado, about 120 km to the west (Emperaire, 1989). There is no perennial water course in the park, the whole region being subject to catastrophic periodical droughts.

On 21 July 1986, Chame observed a group of four *Alouatta caraya* (one adult male and three females) resting in a narrow ravine between the canyons Esperança and Pedra Furada, in the southern sector of the park. This was the only sighting made during several trips to the park between 1984 and 1994.

During 1991, while conducting extensive fieldwork in the park, Olmos found that "guaribas" (a common name for howler monkeys throughout northeastern Brazil) were well known to local people, although considered scarce. The local howlers were always described as being either completely black or straw-colored ("blond"), some hunters identifying the black animals as the males. Niéde Guidon (pers. comm.), who has worked in the area of the park since the early 70's recalls that it was common to hear the howler monkeys calling during the morning 20 years ago, but thinks the species is now very scarce. Calls were never recorded by us until 1996, despite spending thousands of field-hours in areas known to be used by the monkeys.

Howler monkeys have been recorded from the forested canyons that cut the rocky cliffs that make up the southern and western borders of Serra da Capivara. These canyons, deeply cut on the sandstone plateau ("chapada") of the Serra da Capivara, are forested islands, with trees up to 30 m high, surrounded by the dry thorn scrub of the Caatinga (see Emperaire 1989 for a description of the local vegetation). In contrast to the xeric Caatinga, these forests keep their leaves even during the dry season, and water accumulates in natural depressions in the canyon walls ("caldeiras"), providing food and water during the droughts. During several trips to the park between 1984 and 1994, Chame (1992) found howler feces with many seeds of

Cordia rufescens ("grão de galo" - Boraginaceae) and lots of black hair. The faeces also had eggs of *Trypanoxiurus* sp., a common parasitic Oxiuridae (Nematoda) found in the intestines of *Cebus* and *Alouatta* (Chame *et al.*, 1992). Olmos found many howler feces in a canyon (Baixão do Meio) near Pedra Furada, comprised mostly of the half-digested tough leaves of *Tabebuia impetiginosa* ("pau d'arco" - Bignoniaceae), a common tree in the broader canyons, and with many seeds of *Pouteria* sp. ("maçãzeira" - Sapotaceae), a canyon-restricted species.

In 1995, Niéde Guidon (pers. comm.) observed a group of three individuals at Serra Branca, a broad valley with forest patches at the base of sandstone cliffs and in canyons cut into them, the first record from this area since a fire burnt the entire valley in 1985. Chame found howler faeces and tracks during several visits to the park in 1996, attributable to a minimum of four different groups in 12 different localities scattered along the north-west, north-east, south and central regions of the park. Some localities are at least 20 km apart and/or isolated by terrain unlikely to be traversable by the monkeys. Footprints show the howlers will move on the ground for about 1 km in the canyons, sometimes crossing narrow rocky outcrops ("chapadas") separating one canyon from the other. *Pouteria* seeds, plus *Hymenaea* spp. seeds (jatobá - Caesalpinoideae) and the remains of insects (ants, crickets and grasshoppers) were also present in feces attributed to howlers found by Chame in November 1996. These also had *Trypanoxiurus* eggs.

The finding of more howler signs in 1996 compared to previous years, and the recent record of vocalizations by park workers and guides, suggests the population may be increasing from very low levels. Two factors may explain

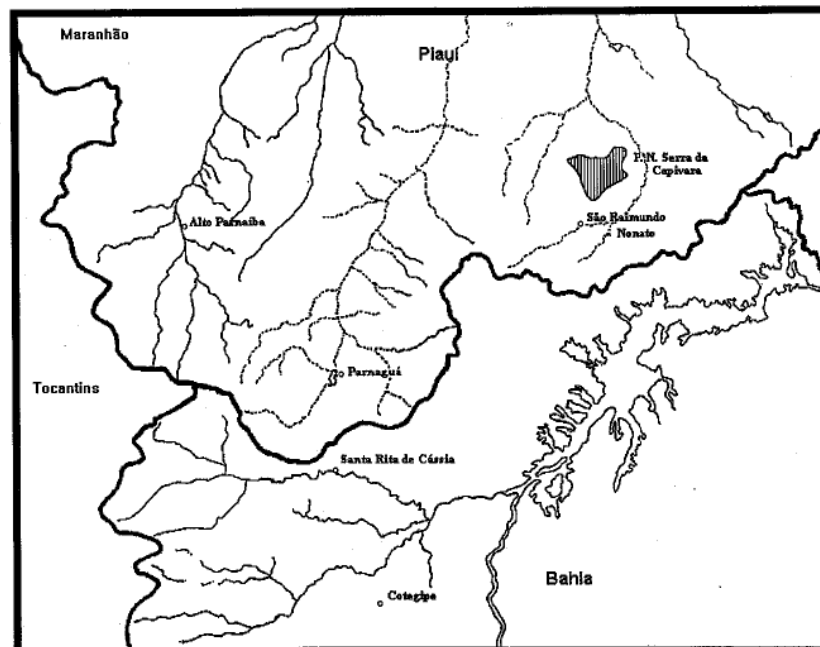


Figure 1. Southern Piauí and adjacent regions of Bahia, Maranhão and Tocantins states, showing localities mentioned in the text and major water courses.

that. Annual rainfall in 1995 was 737 mm and 554 mm during 1996, above average, and extended for a longer period compared to the previous 10 years (for example, 250 mm in 1994), restoring water supplies and allowing a greater availability of food. The greening of the Caatinga may also have allowed monkeys to cross the "chapadas" more easily. Second, the Fundação Museu do Homem Americano (FUMDHAM), which has been working on behalf of the park since 1989, has successfully implemented education, health and alternative activities' programs aimed at the populations living around the park, resulting in a lessening of the human pressures on the park's natural resources. FUMDHAM has also hired wardens, providing increased vigilance in the area, and has purchased land bordering the park to relieve pressure on its habitats and fauna. Mango trees in the areas purchased now have their fruit safely eaten by the monkeys, an unprobable occurrence before.

Although hunting and habitat destruction very probably played a role in limiting the local howler population, the fact that the monkeys are restricted to the forested canyons, the surrounding Caatinga being an unsuitable habitat during the frequent droughts, implies that the population has always been small and may have been in natural decline. A similar situation has been found with the local population of pacas, *Agouti paca*, also restricted to the canyons and currently very small. A paca skull from the park, now in the Museu Nacional do Rio de Janeiro (MNRJ) shows dental abnormalities that may indicate inbreeding depression.

Two other primates occur at the Serra da Capivara. A very variable population of capuchin monkeys *Cebus apella* (individuals ranging from chocolate-brown to pale yellow) live in the canyons and along the rocky walls that limit the chapada. They descend from the almost vertical walls to feed on the trees below. Common marmosets, *Callithrix jacchus* are more widespread, but seem commonest where there are groves of angico trees, *Anadenanthera macrocarpa*, which provide gum for them as well as the local people.

Considering the proximity of the Serra da Capivara to the extensive Cerrado belt of western Piauí, the presence of black howlers is unsurprising, although this might well be a historic range extension resulting from the widespread changes in the predominant vegetation of the region through human activities (see Coimbra-Filho and Câmara, 1996). Further research in this region, that harbors some potentially interesting areas such as the Uruçuí-Una Ecological Station and the Chapada das Mangabeiras Environmental Protection Area, a region with lushier forest and several perennial rivers, would be worthwhile.

Alouatta caraya has been reported from at least two localities in northwestern Bahia, close to the border with Piauí and to the Parnaçuá area: Santa Rita de Cássia (present-day Ibipetuna, 11°50'S 44°52'W) and Cotegipe (11°50'S 44°12'W; Hirsch *et al.*, 1991; Gregorin, 1996).

Like Parnaçuá, both are in a transitional area, with arboreal Caatinga growing on the tops of the hills and along the flatter, broader valleys, while taller Cerradão-like forest occurs on the hillsides and in narrower valleys and canyons, and semideciduous forest on the limestone outcrops. Palm groves and river edge forest grow along the perennial rivers (RADAMBRASIL, 1989; pers. obs.). Considering the similarity of habitats and proximity between southern Piauí and northwestern Bahia, a contact zone between *Alouatta caraya* and *A. belzebul*, if the latter has not become locally extinct, is probably located somewhere in this general area, with greater chances in the forested patches of the Gurguéia valley, where the Parahim drains, and along the headwaters of Parnaçuá river at the Chapada das Mangabeiras, where *Alouatta caraya* has also been recorded at Alto Parnaçuá, southern Maranhão (09°06'S 45°58' W; Gregorin, 1995) probably also extending into Piauí.

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CAPUCHIN MONKEYS IN THE CAATINGA: TOOL USE AND FOOD HABITS DURING DROUGHT

In the interior of the state of Paraíba, about 300 km eastwards from João Pessoa and about 10 km north of the small town of Desterro de Malta, there is a small mountain range inhabited by a few groups of *Cebus apella*. The region is part of the Caatinga biome. We visited this place in November 1983, in the advanced dry season. That year was particularly dry. We had been formerly invited by the Brazilian Forestry Development Institute (IBDF), to check reports that capuchin monkeys were starving because of the strong drought depriving them of their food resources. We learnt later that only one old animal, with heavily-worn teeth, had been found dead, and that people of the vicinity were feeding the animals with boiled or dry corn and bananas. After a reconnaissance of the area, we concluded that the animals were solving the problem of drought in several ways and that the inhabitants of the neighborhood were probably projecting their own necessities and hard life on the wild monkeys.

Local people reported that lactating infants had been seen three months earlier, and that although they were very shy they had entered one of the isolated houses in their range on which occasion an infant had been captured. They were reported to feed on very common lizards, on the seeds of maniçoba (*Manihot* sp.), to suck the juice of crushed coconuts of the catolé palm (*Syagrus oleracea*), and also to chew the juicy macambiras (*Encholirium spectabilis*).

We walked up the mountain range to the area where the capuchins lived. The vegetation was leafless with a general gray appearance. From time to time, green trees drew our attention (pau-pedra, pitombeira = *Tallisia* sp., oiticica = *Licania rigida*, feijão bravo = *Capparis* sp. and espinheiro = *Acacia* sp.). After a while we discovered several thickets of macambira where the plants had been



Fig. 1. A macambira thicket, *Encholirium spectabilis*, with scattered leaves chewed by *Cebus apella*.



Fig. 2. The rock used as a mortar, with *Syagrus* nuts beside it.

pulled out of the ground and the leaves chewed at their white bases, where they are more tender and juicy. This had been done in a disorderly fashion, as would be expected of a capuchin (see Fig. 1).

A little further on we stopped at a large flat, bare rock ("lagedo") where several crushed catolé coconuts were spread around on the ground. Close to them there was a round, about one kg, heavy pebble that on closer examination showed an area where the surface was rough as if it had been recently stricken against a rock. At 10:00 am. we heard stones falling four times, and on several occasions the noise of stones knocking. A short time later we found a group of monkeys that received us by shaking branches. The group was formed of an adult of light pelage, two adults of dark pelage, two young and an adult female with an infant on her back. We have no doubt that the capuchins were using a rock as a mortar, and a stone (pestle) to hit the palm nuts placed on it (see Fig. 2).

The case of the Desterro de Malta capuchins shows that the species is able to survive even under very hard conditions, due to the plasticity of their diet and their rich behavioral repertoire. Nut-cracking behavior by pounding has been observed in captivity several times, but very rarely in the wild. Izawa and Mizuno (1977) described *Astrocaryum* palm nut-cracking behavior by capuchin monkeys in Colombia, but in this case by striking the fruit against a bamboo stalk. *Cebus albifrons* and *C. olivaceus* likewise pound hard fruits such as brazilnut pyxidial (*Bertholetia excelsa*, Lecythidaceae), *Phenakospermum* sp. (Musaceae), and *Duroia aquatica* (Rubiaceae), and smash palm nuts against branches, although not as efficiently as *C. apella* (M. G. M. van Roosmalen, in Rylands, 1987). None of these cases involved, however, the manipulation of a tool as such, although Struhsaker and Leland (1977) observed a tufted capuchin bashing a palm nut held in its hand with another, rather than on a branch or bamboo stalk. Visalberghi (1990) provides an important review of tool use in this genus. Visalberghi (1987) and Anderson (1990) described experiments in captivity where *Cebus apella* used stones as tools for nut-cracking. As pointed out by the first author, the chances for arboreal monkeys of manipulating stones and finding horizontal surfaces on which to pound them are scarce. Desterro de Malta, however, offered the appropriate scenario, and the predic-