

Survey of the Black Howler Monkey, *Alouatta pigra*,
Population at the Mayan Site of Palenque,
Chiapas, Mexico

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ABSTRACT. A survey of the population of the black howler monkey (*Alouatta pigra*) present at the Mayan site of Palenque was conducted during 2000. A total of 911 man/hours, spread over 112 days were spent surveying the 600 ha area of pristine forest at the site for howler troops. We detected the presence of 136 individuals of which 131 were members of 20 troops, the rest were 3 solitary adult males and 2 adult males travelling as a pair. Ecological density was estimated at 23 individuals/km². Mean troop size was 7.0 individuals and it ranged from 2 – 12 individuals; 60% of the troops were multimale. All sighting of howler monkeys were in evergreen rain forest and 75% were in trees ≥ 20 m in height. The reported densities and mean troop size are higher than those reported for the species in Guatemala and in central Quintana Roo, Mexico. The vegetation of the forest contains tree species reported to be used by species of *Alouatta* in the Moraceae, Sapotaceae, Leguminosae, and Lauraceae plant families. Protection of a large perimeter area (ca 1700 ha) around the archeological site by the Mexican government ensures the conservation of the forest and of the black howler monkey population present at the site.

Key Words: *Alouatta pigra*; Palenque; Mexico; Population; Black howler monkey; Mesoamerica; Neotropical primates.

INTRODUCTION

The rain forests of southern Mexico harbor the northernmost geographic distribution of wild primates in the Neotropics. Three species of primates are present in these habitats: *Alouatta palliata*, *A. pigra*, and *Ateles geoffroyi*. The first and the third have a broad geographic distribution in southern Mexico, but the distribution of *A. pigra* is restricted and it is found only in some parts of the states of Tabasco and Chiapas and it is the only *Alouatta* species found in the Yucatán peninsula (SMITH, 1970; HORWICH & JOHNSON, 1986).

The restricted geographic distribution of *A. pigra* in Mesoamerica and the rapid conversion of its natural habitat to pasture lands and agricultural fields places populations of this regionally endemic primate species at risk (RYLANDS et al., 1995). For example, in the southern state of Tabasco, Mexico, that harbors the transitional zone between *A. palliata* and *A. pigra* (both species occur sympatrically in some localities), about 60% of the total surface area of the state (24141 km²) was covered by evergreen rain forest. As a result of human activity, between 1977 and 1991, more than 60% of this rain forest disappeared at a rate of 600 km² per year (SEMARNAP, 1999).

In Mexico, aspects of population, ecology, behavior, and conservation of *A. palliata* have

been investigated over several years in southern Mexico, particularly in the northernmost range of its geographic distribution in Los Tuxtlas, Veracruz (ESTRADA & COATES-ESTRADA, 1996). However, information on such aspects for *A. pigra* is practically non-existent and only a few surveys have been reported (HORWICH & JOHNSON, 1986; WATTS & RICO-GRAY, 1987; DEL CAMPO & JORGENSON, 1998) of which only one, conducted at the Muchunuk forest in the state of Quintana Roo, could be considered systematic (GONZALEZ-KIRCHNER, 1998).

In the case of Guatemala, brief studies have been conducted at the Mayan site of Tikal in northern Guatemala (COELHO & BRAMBLETT, 1976; SCHLICHTE, 1978). Detailed studies of the population, ecology, and behavior of *A. pigra* coupled to sustained conservation efforts have only been carried out in two localities within the entire geographic range of *A. pigra* and both are in Belize (SILVER et al., 1998; OSTRO et al., 1999).

It is thus evident that aspects of population parameters such as size, density, and demographic structure are poorly known for *A. pigra* in its distributional range. Such information, important as part of the natural history of the species, is also relevant to assess its conservation status in Mesoamerica. With the aim of contributing to the knowledge of population parameters of *A. pigra*, in this paper we present information on the results of a survey, conducted during 2000, of the black howler monkey population existing in the forest surrounding the Mayan site of Palenque in northeastern Chiapas, Mexico.

METHODS

STUDY SITE

The Mayan site of Palenque is located in northeastern Chiapas ($17^{\circ} 27' 51''$, $17^{\circ} 30' 05''$ N; $99^{\circ} 01' 30''$, $92^{\circ} 04' 42''$ W). The archaeological site dates back to between 500 and 900 b.c. (BENAVIDES, 1995). As a result of its cultural value the Mexican government declared the site as a cultural monument for humanity, resulting in the creation of Palenque Park in 1981 and in the definitive preservation of its cultural and natural resources (Fig. 1).

The park encompasses 1771 ha of which about 600 ha consist of primary rain forest vegetation. An additional 300 ha consists of second growth vegetation in different stages of regeneration. The rest consist of introduced pasturelands (DÍAZ GALLEGOS, 1996). Continuing archeological mapping and exploration of the Palenque site indicate that the city ruins seem to occupy about 100 – 200 ha, but the majority of the structures are covered by rain forest vegetation (BARNHART, 1998).

Data from an earlier survey of the vegetation (all trees > 2.5 cm in dbh in primary rain forest) showed the existence of about 241 species of trees (DÍAZ GALLEGOS, 1996). These surveys showed that 84% of all trees counted ($N = 1749$; 241 species) were of species common in the lower strata of the forest (0 – 10 m), 6% in the 10 – 20 m strata and the remaining 10% in the 20 – 45 m strata. Importantly, the latter group accounted for 83% of the total basal area recorded and it was represented by tree species of the Moraceae (e.g. *Brosimum alicastrum*, *Poulsenia armata*, *Ficus mexicana*), Lauraceae (e.g. *Nectandra glabrecans*), Sapotaceae (e.g. *Manilkara zapota*), Leguminosae (e.g. *Vatairea lundelli*), and Bombacaceae (e.g. *Quararibea funebris*) plant families (DÍAZ GALLEGOS, 1996).

The terrain at the site is rugged and elevation ranges from 150 – 500 m above sea level. The climate is hot and humid. Average annual precipitation is 2200 mm and it is distributed seasonally, with a drier season between January and April (average monthly rainfall = 62 ± 18 mm) and a wetter period between May and December (average monthly rainfall = 240 ± 106 mm) and a mean annual temperature of 26°C (range 22 – 29°C).



Fig. 1. Location of Parque Nacional Zona Arqueológica de Palenque in Chiapas (CH), Mexico. In the upper map B stands for Belize, the dot is the site of Palenque. In the bottom map, shaded areas represent primary rain forest (597 ha), hatch areas represent second growth vegetation of various ages (300 ha). Open areas represent pastures (874 ha). M : Mayan ruins. Dotted line is a dirt road and continuous line entering the forest is the paved road that gives access to the site.

PRIMATE SURVEYS

Three visits of ten days duration each were made to the site between February and May 2000. A fourth and longer visit was conducted from October 1 to December 22, 2000 for a total of 82 days. Surveys of howlers were conducted in two ways: by triangulation of dawn and dusk choruses and by walking the existing system of 8 km of trails to gain access to different parts of the park. In the first case, the tallest (10 – 20 m) Mayan structures were used to monitor howling exchange among troops. Such monitoring was conducted daily between 05:00 and 07:00 and between 18:00 and 20:00 by three teams of two persons each. Howling by the monkeys could be heard as far away as 2.0 km. The fact that the site of Palenque is located at the bottom of the slope of a mountain covered with rain forest, facilitated acoustical location of

Table 1. Troops of *Alouatta pigra* detected in the area of primary forest (600 ha) at the archeological site of Palenque, Chiapas, Mexico.

| Troop | Adult males | Adult females | Juvenile males | Juvenile females | Infants | Total |
|-------------------------|-------------|---------------|----------------|------------------|---------|-------|
| 1 | 2 | 1 | | 1 | | 4 |
| 2 | 4 | 2 | 1 | 2 | 3 | 12 |
| 3 | 1 | 2 | 2 | 1 | | 6 |
| 4 | 1 | 1 | 1 | 2 | 1 | 6 |
| 5 | 2 | 4 | | 1 | 1 | 8 |
| 6 | 2 | 1 | 1 | 2 | 1 | 7 |
| 7 | 1 | | | 2 | | 3 |
| 8 | 1 | 1 | | | | 2 |
| 9 | 2 | 2 | 1 | 2 | | 7 |
| 10 | 1 | 1 | | | | 2 |
| 11 | 2 | 1 | | | | 3 |
| 12 | 2 | 2 | | 1 | 1 | 6 |
| 13 | 1 | 4 | 1 | 1 | | 7 |
| 14 | 1 | 2 | 1 | | 1 | 5 |
| 15 | 3 | 2 | | | 2 | 7 |
| 16 | 3 | 1 | 1 | 1 | 1 | 7 |
| 17 | 3 | 2 | 3 | | 2 | 10 |
| 18 | 3 | 4 | | | 2 | 9 |
| 19 | 3 | 2 | 2 | 1 | 2 | 10 |
| 20 | 2 | 2 | 2 | 2 | 2 | 10 |
| Total | 42 | 37 | 16 | 19 | 19 | 131 |
| Mean | 2 | 1.9 | 1.5 | 1.5 | 1.6 | 7.0 |
| SD | 0.9 | 1.0 | 0.7 | 0.5 | 0.7 | 2.8 |
| Median | 2.0 | 2.0 | 1.0 | 1.0 | 1.5 | 7.0 |
| Solitary males | | 3 | | | | |
| Males in pairs | | 2 | | | | |
| Total number of howlers | | | | | | 136 |

howlers. Direction in which howling were heard was determined with the use of a compass taking note of orientation degrees. Resulting information was placed on a detailed map of the site provided to us by the archeologists working at the site.

In the second case, the three two-person teams searched for different triangulated troops using the existing trail system. Contacted troops were followed for several hours and repeatedly counted by each team to confirm identification and age and sex composition. Individuals were classified as adults, juveniles, and infants (clinging to their mother).

The majority of the troops detected were followed in consecutive days further aiding in confirmation of their identity. Confirmation was made by examining the consistency in the age and sex composition of each troop and the consistency in the spatial location of the troops in relation to the trail system and to topographical and archaeological features of the terrain and to the relative location of other troops.

RESULTS

We spent a total of 112 days surveying the site for black howler monkey troops and accumulated 911 man hours of field work. Of these, 30% were invested in triangulating dawn and dusk roaring choruses and 70% in counting troops on the terrain.

All sightings of howlers were in evergreen rain forest and in trees > 1.3 m in dbh, and 75% of observations ($N = 627$) of howlers were in trees ≥ 20 m in height. We observed howlers feed-

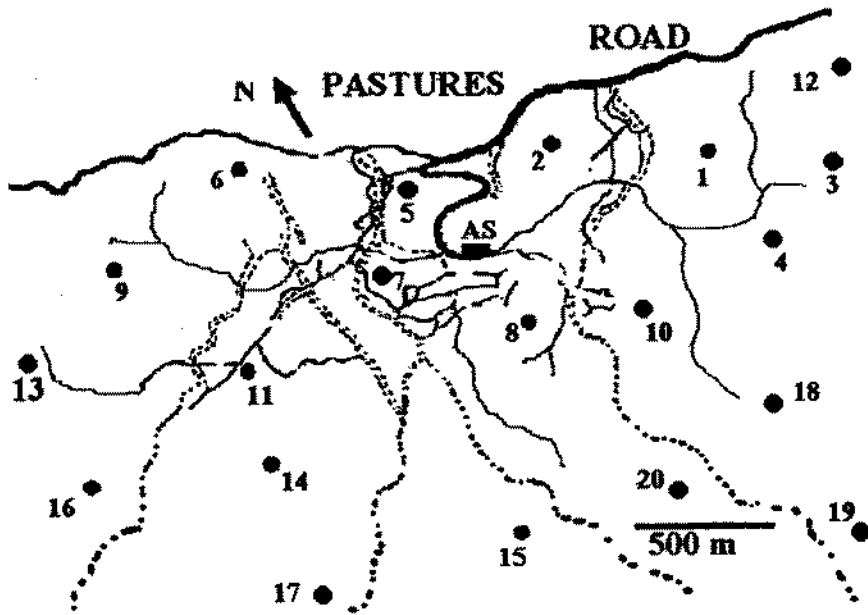


Fig. 2. Relative location of *A. pigra* troops detected in the forested area of the Mayan site of Palenque. Thin continuous lines are trails (some made by archeologists working at the site, other are old Mayan trails). The dotted lines are streams. AS : Archeological site. Altitudinal range from north to south in the area shown is 150 — 500 m above sea level.

ing on leaves and fruits of (among others) *Poulsenia armata*, *Brosimum alicastrum*, and *Ficus* spp. (Moraceae), *Swartzia* sp. (Leguminosae), and *Spondias mombin* (Anacardiaceae). No howler monkeys were detected in the area of second growth vegetation.

Our surveys resulted in the detection of 136 howler monkeys. Of these, 131 individuals were members of 20 troops, three were solitary males and two additional males were observed traveling together (Fig. 2). We estimated crude density of howler monkeys at 0.24 individuals per ha and ecological density at 23 individuals/km². Troop density was estimated at 3.3 troops per km² (density estimates based on the 600 ha area of rain forest vegetation in which howlers were observed through the year).

Adult individuals in the troops accounted for 56% of the counts, 25% were juveniles and 15% infants. Adult males accounted for 30% of the adult individuals counted, adult females for 28%, juvenile males for 12%, juvenile females for 15%, and infants for 15% (Table 1). Troop size ranged from 2 to 12 individuals (average = 7.0 individuals). Sixty percent of the troops had more than one adult male and 60% of the troops had more than one adult female (Table 1).

The average age and sex composition was 2.0 adult males, 1.9 adult females, 0.8 juvenile males, 1.0 juvenile females, and 0.95 infants. The adult male to female ratio was 1:0.93 and in juveniles was 1:1.19, adult to juvenile ratio was 1:0.73 and the adult to infant ratio was 1:0.26, adult female to infant ratio was 1:0.53, juvenile to infant ratio was 1:0.53 (Table 1).

DISCUSSION

The data we presented here are preliminary and further field work will provide information on consistency and variability of the demographic traits we have observed. Bearing this in mind, the black howler monkey density we report for Palenque of 23 individuals/km² is close to

the upper range of densities reported for the species in Belize (8 – 22 individuals/km²) (BOLIN, 1981; HORWICH & GEBHARD, 1983) and higher than that reported for Tikal in Guatemala (5 – 9 individuals/km²) (COELHO & BRAMBLETT, 1976; SCHLICHTE, 1978). At the Muchunuk forest in central Quintana Roo in the Yucatán peninsula, the only other site in Mexico where *A. pigra* populations have been surveyed, densities of 16.53 individuals/km² were reported (GONZALEZ-KIRCHNER, 1998). At Los Tuxtlas, located at about 500 km north of Palenque, *A. palliata* show population densities of 23 individuals/km². In Belize exceptionally high densities for *A. pigra*, ranging from 47 – 124 individuals/km², were detected in strips of riparian vegetation and small forest patches, possibly the result of overcrowding (SILVER et al., 1998).

The high densities found for *A. pigra* in Quintana Roo and Belize as well as in Palenque seem to contradict the assumption that this species has the lowest population densities of the howler monkey species (CROCKETT & EISENBERG, 1987; GONZALEZ-KIRCHNER, 1998). The high densities we detected for *A. pigra* in Palenque may be the result of habitat contraction in the land surrounding the park, but without prior data for the same site this is somewhat difficult to conclude. Even if we were to consider the area of second growth vegetation at the site of Palenque, estimates of ecological density would be about 15.1 individuals/km², a figure similar to that reported for the species in the Muchunuk forest in Quintana Roo (GONZALEZ-KIRCHNER, 1998). The short height (range 2 – 5 m in a random sample of 100 trees) and small stem dbh of trees (range 5 – 15 cm) in the second growth vegetation, coupled to the presence of many open spaces and the fragmented nature of the distribution of this type of vegetation within the park of Palenque, may explain the absence of howlers in this vegetation type. Further surveys will confirm whether they seasonally visit these areas or not.

Troop size at Palenque varied from 2 – 12 and the mean of 7.0 individuals is higher than those reported for *A. pigra* in Belize and Guatemala, where mean troop size varies from 4.4 to 6.3 individuals (COELHO & BRAMBLETT, 1978; BOLIN, 1981; HORWICH & GEBHARD, 1983; OSTRO et al., 1999) and higher than that of 3.16 individuals reported for *A. pigra* in central Quintana Roo, Mexico (GONZALEZ & KIRCHNER, 1998). The smaller troops (2 – 4 individuals) detected by us ($N = 4$) may be troops recently formed by solitary individuals.

About 60% of the troops in Palenque were multimale but at Tikal, Guatemala, troop surveys by different authors consistently report unimale troops (COELHO & BRAMBLETT, 1976; SCHLICHTE, 1978; HORWICH & JOHNSON, 1986). At Palenque the overall adult sex ratio was 1 male to 0.95 females. In contrast, data from Belize showed most recorded troops to be unimale and the adult sex ratio was 1:1 to 1:1.63 (BOLIN, 1981; OSTRO et al., 1999).

The above contrasts in population parameters may be the result of the paucity of data on *A. pigra* available in the literature. These come from studies conducted in only three sites (Tikal in Guatemala, Bermuda Landing in Belize, and Muchunuk forest in Quintana Roo, Mexico). Clearly, more sites need to be surveyed to document the range of variation in density and troop size for *A. pigra* within the range of its current geographic distribution.

Surveys conducted by us of several forest fragments in a 5-km radius in a NE and SE direction from the archaeological site detected the presence of howler monkeys in only 4 of 12 fragments visited (average area 4.2 ha; range 2 – 6 ha). At these sites, troop size ranged from 4 to 8 individuals (average = 5.5 individuals) and average age and sex composition was 3.6 adult males, 2.4 adult females, 0.67 juvenile males, 2.0 juvenile females, and 1.0 infants. The absence of troops in 67% of forest fragments surveyed indicates continued local extinction as a result of fragmentation and isolation of native habitat. These additional surveys also suggest that troops living in very small forest fragments are, on average, smaller than those troops detected at the Mayan site. Similar contrasts have been detected for *A. palliata* troops existing in contiguous forest versus troops existing in isolated forest fragments in Los Tuxtlas (ESTRADA & COATES-ESTRADA, 1996).

The forest in the Mayan site of Palenque possess the structural characteristics and a coterie of tree species suitable for howler monkey sustenance. The important contribution (83%) to the total tree basal area at the site of tree species of the Moraceae (e.g. *Ficus* spp., *Brosimum ali-castrum*, *Poulsenia armata*), Sapotaceae (e.g. *Pouteria campechiana*, *Pouteria zapota*), Anacardiaceae (e.g. *Spondias mombin*), and Lauraceae (e.g. *Nectandra* spp., *Ocotea* spp.) plant families (DÍAZ GALLEGOS, 1996), among others, known to be important in the leaf and fruit diet of howler monkeys in the humid Neotropics (ESTRADA & COATES-ESTRADA, 1993), suggests the presence of adequate resources to support the *A. pigra* population at Palenque.

Rates of deforestation for the area of Northeastern Chiapas, where Palenque is located, are reported at 12.5% per year whereas in Los Tuxtlas, where *A. palliata* has been investigated by our research group in the last two decades, rates reported are 4.3% per year (MASERA, 1996). Our reconnaissance of the area surrounding the site of Palenque indicated that about 70 – 80% of the forest in the vicinity of the site has been converted to pastures for cattle ranching. This information suggests that populations of *A. pigra* have disappeared locally as the forest was converted to pastures. Remnants of some of these populations existing in small isolated forest fragments are under pressure as a result of continued isolation and of deforestation activities in this area of the state of Chiapas.

At the Mayan site of Palenque the forest and the black howler population have been preserved as a result of the presence of the important Mayan ruins present there. Government guards patrol the park daily and access to the forest interior is strictly regulated to protect the archaeological remains and on-going explorations. The secondary growth vegetation as well as the areas of pastures within the park's boundaries also act as important buffers protecting the forested area of the park from edge effects and from incursions from people. These circumstances and the fact that 42% of the detected black howler monkey population at the site of Palenque consists of non adults may ensure the long-term conservation of this important population of *A. pigra* at the northeastern range of its geographical distribution in Mesoamerica.

Acknowledgements. We are grateful for the support provided by the late JOHN SCOTT and by Universidad Nacional Autónoma de México. Special thanks to ED BARNHARD, head of the Palenque Mapping Project, for kindly providing us with a detailed map of the archaeological site and to Lic. JUAN ANTONIO FERRERA AGUILAR, Director of the Archeological Park of Palenque for permission to conduct the surveys of howler monkeys.

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——— Received: May 6, 2001; Accepted: January 28, 2002

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