

A Population Survey of *Alouatta palliata*, *Cebus capucinus* and *Ateles geoffroyi* at Palo Verde, Costa Rica

Adrienne Massey

Zoology Department, North Carolina State University, Raleigh, North Carolina 27695, U.S.A.

(Received February 19, 1986)

Abstract: Calculations of *Alouatta palliata*, *Cebus capucinus* and *Ateles geoffroyi* densities from a census of tropical dry forest in the Guanacaste Province of Costa Rica are provided (69.15 and 0.6/km², respectively). Adult sex ratios, adult female: juvenile + infant ratios, and demographic differences are provided for *A. palliata* troops in riparian and dry forests.

Few primatologists have studied the primates of Costa Rica's dry forest. Freese (1976) conducted a broad survey of three species (*Alouatta palliata*, *Ateles geoffroyi*, and *Cebus capucinus*) in Santa Rosa National Park which emphasized group compositions and habitat preferences. More narrowly focused studies of the howlers (*A. palliata*) of Finca La Pacifica have provided us with a wealth of valuable detail on their ecology and social behavior (Clarke 1982; Glander 1975). So that comparisons of populations in similar habitats could be made, I studied the primate populations of Palo Verde National Park, Guanacaste Province. This site provides opportunities for comparisons with Santa Rosa, because *A. palliata*, *C. capucinus* and *A. geoffroyi* are all at Palo Verde. Additional comparisons can be made between the ecology of the howlers of Palo Verde and those of La Pacifica. Because Palo Verde has recently been designated a wildlife refuge, it provides the opportunity for valuable long term studies of the primates of Costa Rican dry forests.

Vegetation of Palo Verde is a composite of deciduous, tropical dry forests, interspersed with areas of secondary growth, grazed grasslands, riparian forest, seasonal swamp and marsh. Within the dry forest, trees vary in height, reaching 20-25 m, with islands of evergreen vegetation distributed within deciduous and semi-deciduous areas. Elevations within the refuge vary from approximately 3 m to over

200 m. Palo Verde receives an average of 1500 mm of precipitation annually with the mean monthly rainfall during the dry season (November-May) being as little as 15 mm.

This study was conducted during January-February 1980. Seven trails, totalling 18.7 Km in length (range 1.4-5.0 km) were marked at 50 m intervals. These censused areas included upland and lowland forests, riparian and dry forests, derived savannah, second growth areas, and primary forest.

The strip census method originated by Southwick *et al.* (1961) was used. On trails that bordered marsh or pasture, only one side of the trail was censused. Because repeated surveys increase the accuracy of the census, each trail was censused at least four, or as many as eight times. An equal number of surveys was devoted morning and evening hours and to initiation of the survey at both ends of the trail. The dates, times (morning or afternoon), and initiation points (a trail's beginning or end) for surveys of each trail were selected randomly at the beginning of the study. Censusing was restricted to 0600-1100 and 1500-1800. Only actual sightings and not records of vocalizing monkeys were included in the data analysis. On sighting a troop, I recorded the species' group size and compositions, time, distance from trail marker, marker number, behavior, height from ground, tree species occupied, food ingested, a general description of the habitat and direction of tra-

TABLE 1

Mean densities/km² (\pm d.) on each trail

Trail	Length (km)	<i>Alouatta</i>	<i>Cebus</i>	<i>Ateles</i>
1	3.0	116.1 + 53.5	41.1 + 50.3	4.4 + 5.3
2	2.0	108.6 + 74.4	13.8 + 21.9	0
3	1.4	108.0 + 66.0	3.5 + 5.9	0
4	3.2	55.7 + 24.2	27.4 + 25.3	0
5	5.0	24.5 + 21.4	1.2 + 1.6	0
6	2.1	72.0 + 101.8	20.6 + 29.0	0
7	2.0	3.9 + 5.1	0	0
Overall mean density		59.3	15.4	0.62

vel if applicable. Animals were classed as infants if carried by an adult, while an animal was de one word signated as a juvenile only if cleary smaller than an adult female.

A total of 93 hours was devoted to the census, excluding trail cutting mapping and marking time. My walking speed along the trails averaged 1.25 km/hr. Howlers (*A. palliata*) were encountered 84 times, white-faced monkeys (*C. capucinus*) 17 times, and spider monkeys (*A. geoffroyi*), 6 times. Five of the occasions spider monkeys were sighted, they were singletons travelling with howler or white-faced troops. Mean population densities were calculated for each trail and are given in Table 1. As one would expect, the lower densities are found on those trails that transect considerable amounts of grassland savannah and seasonal swamp areas (Trails 5 & 7). Both riparian and dry forests support higher primate densities (Trails 1-4 & 6).

The overall mean densities for all trails surveyed were 69 howlers/km², 15 white-faced/km², and 0.6 spider monkeys/km². In general, the densities calculated for the three species at Palo Verde find little agreement with the densities found by Freese (1976) at Santa Rosa (howlers - 18-25/km²; white-faced - 5-7/km²; spiders - 6-9/km²).

Howler troop sizes ranged from 1-26. The adult sex ratio of troops containing more than two individuals ranged from 0.11 to 0.50 (expressed as proportion of males). Adult males comprised 22.7% of the population, females, 44.5%, juveniles, 14.8%, and infants, 17.9%.

The female: juvenile+infant ratio was 1:0.735, which according to Heltne *et al.* (1976) is approximately the minimum female: juvenile+infant ratio for a stable howler population.

Statistical comparisons between accurately counted troops located in dry forests and those in riparian forests revealed no significant differences in either mean troop size or mean female: juvenile+infant ratios for these two habitats.

Because white-faced monkeys are difficult to census, group composition data were usually unattainable. Of the troops counted with some measure of certainty, troop size ranged from 1-23. In general, *Cebus* troop size at Palo Verde appears to be smaller than the Santa Rosa troops which usually contained between 15 and 20 individuals. Data were insufficient to evaluate the female: juvenile+infant ratio or relationship between troop size and habitat type.

Of the 84 howler sightings, 64 (76%) were in dry deciduous to semi-deciduous forests while 20 (24%) were in riparian forests. This differs from Freese's (1976) finding that during the dry season, howlers "utilize almost exclusively areas of predominately mature evergreen forest." Of the 64 sightings in a dry forest, 8 were in second growth areas, 20 were in dry upland sights along ridges of the Palo Verde hills, while the remainder were in low-lying deciduous or semi-deciduous forests.

Of the 17 *Cebus* sightings, 5 occurred in riparian areas, 1 in second growth areas, and the remainder in dry forests. Twice *Cebus* monkeys were seen foraging on the ground near the edge of the forest and grasslands.

TABLE 2

Plant species eaten by howlers

Scientific name	Common name	Portion ingested
<i>Albizzia caribaea</i>	Gallinazo	flowers, fruits
<i>Anacardium excelsum</i>	Espavel	flowers, leaves
<i>Astronium graveolens</i>	Ronrón	fruits, leaves
<i>Bombacopsis quintata</i>	Pochote	flowers
<i>Brosimum alicastrum</i>	Ojoche	leaves, flowers
<i>Calycophyllum candidissimum</i>	Madrono	flowers, fruits
<i>Cecropia peltata</i>	Guarumo	fruits
<i>Cochlospermum vitifolium</i>	Poroporo	flowers
<i>Combretum farinosum</i>		flowers
<i>Enterolobium cyclocarpum</i>	Guanacaste	leaves
<i>Gliricidia sepium</i>	Madera negra	flowers
<i>Lysiloma seemannii</i>	Quebracho	fruits
<i>Mastichodendron tempisque</i>	Tempisque	fruits
<i>Muntingia calabura</i>	Capulin	fruits
<i>Pithecellobium saman</i>	Cenízaro	leaves, fruits
<i>Pseudobombax septenatum</i>	Ceibo	flowers
<i>Tabebuia neochrysantha</i>	Corteza amarilla	flowers
<i>Tabebuia rosea</i>	Roble de sabana	flowers

A listing of the identifiable food eaten by howlers is provided in Table 2. Most items have been cited before by Glander (1975). Additions to our knowledge of howler diet include *Albizzia caribaea* fruits, *Bombacopsis quintata* flowers, *Brosimum alicastrum* leaves and flowers, *Calycophyllum candidissimum* flowers and fruits, *Combretum farinosum* flowers, *Lysiloma seemannii* fruits, and *Pseudobombax septenatum* flowers.

On only four occasions did I observe white-faced monkeys feeding. In these instances they were consuming fruits of *Anacardium excelsum*, *Sterculia apetala* and *Mangifera indica*, and flowers of *Tabebuia neochrysantha*.

ACKNOWLEDGMENTS

The funds for this research were provided by a RIAS grant, from the Organization for Tropical Studies (OTS). I thank the Costa Rican Wildlife Service for graciously allowing me to conduct the primate survey at Palo Verde, and the OTS for providing logistical support. Special thanks are due F. Gould for technical assistance.

REFERENCES

- Clarke, M. 1982. Socialization, infant mortality and infant-nonmother interactions in howling monkeys (*Alouatta palliata*) in Costa Rica. Ph.D. Thesis. University of California, Davis.
- Freese, C. 1976. Censusing *Alouatta palliata*, *Ateles geoffroyi*, and *Cebus capucinus* in the Costa Rican dry forest, p. 4-9 in Neotropical Primates: Field Studies and Conservation, R. W. Thorington, Jr. and P. G. Heltne, eds., Washington, D.C., National Academy of Sciences.
- Glander, K. E. 1975. Habitat and resource utilization: An ecological view of social organization in mantled howling monkeys. Ph.D. Thesis, University of Chicago.
- Heltne, P. G., D. C. Turner & N. J. Scott. 1976. Comparison of census data on *Alouatta palliata* from Costa Rica and Panama, p. 10-19 in Neotropical Primates: Field Studies and Conservation, R. W. Thorington and P. G. Heltne, eds., Washington, D.C., National Academy of Sciences.
- Southwick, C. H., M. H. Beg. & M. R. Siddiqi. 1961. A population survey of rhesus monkeys in northern India. II. Transportation routes and forest areas. Ecology 42: 698-710.