

## Survey and Census of Howler Monkeys (*Alouatta palliata*) in the Rain Forest of "Los Tuxtlas," Veracruz, Mexico

ALEJANDRO ESTRADA

Estación de Biología Tropical, "Los Tuxtlas," Instituto de Biología, Universidad Nacional Autónoma de México

Howler monkey troops were censused at the biological reserve "Los Tuxtlas" in Veracruz, Mexico. The reserve includes 700 ha of rain forest. Twenty howler monkeys were also trapped, measured, marked, and released. Censuses were conducted for a period of 26 months, and they indicated the existence of 17 troops. The mean troop size was 9.12 (SD  $\pm$  2.93), and mean troop composition was 3.0 adult males, 4.12 females, 1.56 juveniles, and 1.54 infants. Ecological density was 0.23 howlers/ha or 23.29 howlers/km<sup>2</sup>. The male to female ratio was 1:1.37. No discrete seasonality in births was noted. Howler monkeys in this locality inhabit the northernmost limit of the neotropical rain forest. The population parameters fall within those reported for *Alouatta palliata* at other sites.

**Key words:** Howlers; *Alouatta palliata*; rain forest; censuses; Veracruz, Mexico

### INTRODUCTION

Howler monkeys (*Alouatta palliata*) and spider monkeys (*Ateles geoffroyi*) are the only two primate species found in the tropical rain forests of southern Mexico. Some populations of these two primates have survived the rapid disappearance of the rain forest in Mexico as a result of existing in very isolated areas or in nature reserves. These two primates are the northernmost occurring primates in North America and occur naturally in the northern limits of the rain forest in this continent. Except for a brief study of *Ateles geoffroyi*, by Eisenberg & Kuehn [1966] in southern Mexico, the wild howler and spider monkeys of Mexico have not been studied systematically or on a long-term basis until now. Howler monkeys have been intensively surveyed and studied in Panama [e.g., Carpenter, 1934; Collias & Southwick, 1952; Bernstein, 1964; Chivers, 1969; Richard, 1970; Mittermeier, 1973; Milton, 1977; Smith, 1977; Milton & Mittermeier, 1977]. They have been studied on a smaller time scale in Costa Rica [Glander, 1975], Argentina [Pope, 1966], Venezuela and Trinidad [Neville, 1972a,b], Venezuela [Rudran, 1979; Mack, 1979; Sekulic, 1981], Colombia [Klein & Klein, 1976] and Guatemala [Coelho et al., 1976; Schlichte, 1978].

Received September 1, 1981; accepted January 1, 1982.

Address reprint requests to Alejandro Estrada, Estación de Biología Tropical, "Los Tuxtlas," Apartado Postal 94, San Andrés Tuxtla, Veracruz, México.

In May 1977, a systematic and long-term study of the ecology and behavior of the howler monkeys occurring at the biological reserve "Los Tuxtlas" was initiated. The reserve belongs to the Instituto de Biología of the Universidad Autónoma de México and is located in the mountainous areas of "Los Tuxtlas" in the southern portion of the state of Veracruz.

Howler monkeys at the biological reserve "Los Tuxtlas" have been under continuous monthly observations from May 1977, to the present time. About 6000 h have been spent in the field observing this primate and monitoring its behavior at many levels. The study is geared to description and analysis of the ways in which these primates are integrated within their rain forest ecosystem and, especially, the role they play in ecosystem dynamics. Our objective in this paper is to present demographic information on the howler monkey population collected in the reserve between January 1978, and March 1981. Data on home range sizes for three troops are also presented.

## METHODS

### Study Site

The research station "Los Tuxtlas" is located at long. 95°09' W, lat. 18°34' to 18°16' N in the southern portion of the state of Veracruz (Fig. 1). It consists of a 700-ha strip of land, 5 km long, east to west, and 1.5 km wide, north to south. "Los Tuxtlas" is in the eastern portion of the Sierra de San Martín range, an area of volcanic origin dominated by the San Martín Volcano.

The vegetation of the biological reserve is high evergreen rain forest [Miranda & Hernández, 1963]. Descriptions of the vegetation of the area can be found in Pennington & Sarukhán [1968], Sousa [1968], Flores [1971], Piñero et al [1977], and Carabias [1980]. Important arboreal elements in the upper level of the forest (20–35 m) are *Nectandra ambigens*, *Brosimum alicastrum* and *Poulsenia armata*. In the middle level (10–20 m) *Pseudolmedia oxyphyllaria* and *Stemmadenia donnell-smithii* are among the most dominant species. *Astrocaryum mexicanum* and *Faramea occidentalis* are the dominant species in the lower level (0–10 m).

The climate at the site is hot and humid with a mean annual precipitation of 4953 mm and mean maximum and minimum temperatures of 29°C and 17°C, respectively. The mean temperature is about 27°C. Figure 2 shows the annual patterns of rainfall for the area for the years 1972–1980. While it rains throughout the year, there is a wet season from June to February and a dry season from March to May. The driest month is usually March; the wettest month is usually October. From September to February the region where the station is located is regularly hit by hurricanelike weather from the north.

### Censuses

Survey of the howler monkey troops within the reserve was conducted by walking through 25.0 km of existing access trails which cross the reserve from north to south and from east to west at various points. In addition, whenever a troop was detected because of vocalizations or movements, an attempt was made to establish visual contact with the troop. A useful method of locating howler monkeys was playback at high volume of a tape recording of their howling vocalization, or the imitation of vocalizations by the observer. This often caused the monkeys to respond by howling, grunting, or emitting low-level barks which aided in their location. While much difficulty was encountered when tracking howler troops under heavy rain and strong winds, monkeys tended to howl under these conditions, facilitating their location.

Once the troops were located either from the trails or while moving off the trail and through the forest, visual contact was maintained with the monkeys for several hours in order to obtain reliable counts of individuals. The pelage of howler monkeys at the study site is usually medium brown, but some individuals have a very dark chocolate shade.

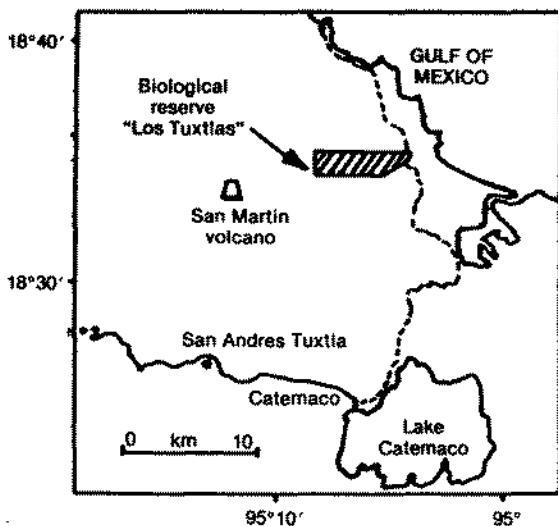


Fig. 1. Location of study site in the southeastern portion of the state of Veracruz. Dotted line is a dirt road.

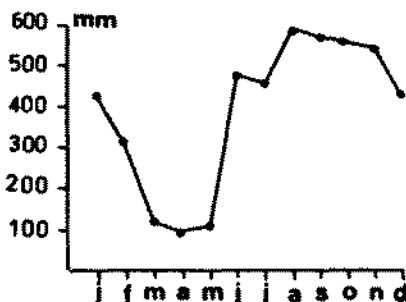


Fig. 2. Monthly precipitation at study site. Note restricted dry season in the months of March, April, and May. Data cover the years 1972-1980.

They also present rufous or blond hair which is occasionally cream white on the chest, abdomen, and sides. Variable patches of blond fur have been noted in adults of both sexes and in immatures (as rings or patches on their tails, as patches at the tail base, or on the dorsal surfaces of hands and feet). These individual markings were noted along with scars, because they helped reidentify the troop if it was encountered again.

In order to obtain an accurate location for the troops within the reserve boundaries and in adjacent forested areas, maps made from aerial photos (scale 1:7000) were used. Observations of the troops were made with the aid of binoculars, and all information was recorded with a portable tape recorder and later transcribed. Once the troop was in sight, repeated censuses were made of its individuals noting their sex and age class. The latter was determined according to Carpenter's [1934] classification of howler monkey's developmental stages, with the exception that individuals were classified as adults, juveniles, and infants. The reason for this was the difficulty encountered when trying to place with precision an infant or a juvenile in stage II or III as other authors have done [Baldwin &

Baldwin, 1972]. Additionally, the sex of both infants and juveniles was difficult to detect at a distance (20 m), even with the aid of binoculars, as the howler monkeys showed no obvious differences in their external genitalia at these two age-stages of development.

Trapping and marking of 20 individuals in some of the troops with the aid of a Cap Chur gun using ketamine as a sedative (50-mg concentration) provided information on their body weights. The adult howlers were marked with the chain collars with brightly-colored plastic beads placed around one of their ankles. This permitted repeated successful identification of individuals and the markings have lasted more than a year at the time of writing this report (June 1981).

### Home Range Size

The size of the home range for the howlers was determined quantitatively from observations on three troops (67S, 67W, 67G) during a period of 4.0 yr. Maps scale-made from aerial photos were employed to map the troops' positions and movements over time [Estrada & Trejo, 1978; Estrada, in preparation]. A grid superimposed on the map with quadrants 1 ha in size each was used as a guide to estimate home range size by noting all quadrants entered by the troops during 36 months of continuous observations.

## RESULTS

Our surveys show a total of 17 troops of howlers that occupy the forest within the boundaries of the biological reserve. Figure 3 shows the approximate location of each troop in the reserve. Some of these troops also occupy forested areas adjacent to the reserve. Table I shows the age and sex composition of each of the recorded troops.

Mean troop size ( $\pm$  SD) was 9.12 ( $\pm$  2.93) with a range of 5-16 animals. The mean ( $\pm$  SD) troop composition was 3.0 ( $\pm$  1.4) adult males, 4.12 ( $\pm$  1.32) adult females, 1.56 ( $\pm$  0.73) juveniles, and 1.54 ( $\pm$  0.66) infants. The mean ( $\pm$  SD) number of immatures in the mean troop was 2.62 ( $\pm$  1.45) individuals. The mean adult sex ratio (M:F) calculated from the troop's data (Table I) was 1:1.37, with a range of 1:0.50-1:3.00; the ratio of adults to immatures was 1:0.28; the ratio of infants to adult females was 1:3.50; and the ratio of juveniles to infants was 1:0.70.

The survey also indicated the existence of five solitary adult males and three solitary adult females which were encountered and relocated at different time intervals and in the same areas. These data indicate the existence of 155 individuals belonging to the troops and 8 solitary howlers for a total of 163 howler monkeys in the reserve. The density of the animals was 0.23 howler monkeys/ha or 23.29 howlers/km<sup>2</sup>.

The weight measurements obtained from the trapped animals yielded a mean weight ( $\pm$  SD) of 7.75 ( $\pm$  1.32) kg for adult males (N = 5); 6.5 kg ( $\pm$  1.50) for adult females (N = 7); 2.0 kg ( $\pm$  0.50) for juveniles (N = 4); and 1.0 kg ( $\pm$  0.50) for infants (N = 4). Mean troop biomass equaled 54.59 kg. Using these results, howler monkey biomass for the reserve was estimated at 898.25 kg/700 ha or 1.28 kg/ha.

During the period of time howlers were surveyed and censused no discrete seasonality in births was noted. Recently born infants were noted in all months of the year in several troops.

## DISCUSSION

Table II shows a summary of demographic data available on howler monkey species studied in Central and South America. The data from our study has been included for comparison. It is clear that howlers at "Los Tuxtlas" display mean troop sizes and densities within the range found for howlers elsewhere. The mean socioeconomic sex ratio at "Los Tuxtlas" is also within the range known for howlers at other sites but is close to the lower limit. We do not presently have sufficient information on the possible

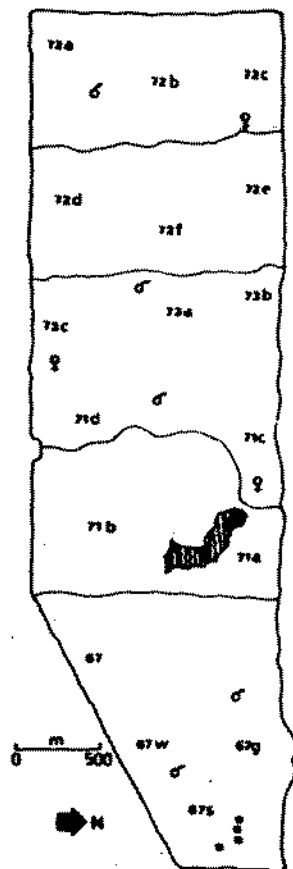


Fig. 3. Approximate location of howler monkey troops and of solitary howlers within the reserve's boundaries. Continuous lines are the reserve's perimeter trail and major trails running south-north. Smaller trails are not shown. Shaded area is a lagoon and black squares are the station's buildings.

relationship between the sex ratio and sex-related differential mortality after birth, because it was too difficult to track individuals in many troops over time while simultaneously obtaining accurate identification of sexes of infants. However, our continuous observations on marked individuals in some troops may, at a later time, suggest some possible explanations.

Mean troop composition at "Los Tuxtlas" also falls within the reported range for howlers at other sites. Home range size was also included in Table II, where it can be noted that at "Los Tuxtlas" howlers display an unusually large home range size (similar in magnitude to those reported by Carpenter [1965] for the Barro Colorado Island howlers in 1932).

Determination of demographic parameters, biomass, and trophic role is very important for determining the food consumption and the role in nutrient cycling of mammalian populations [Eisenberg & Thorington, 1973]. Information of this sort is also essential in efforts to conserve primates in native habitats. In the case of the howlers at "Los Tuxtlas" reserve our long-term observations indicate that they are extremely selective in their choice of species of trees used as a source of food [Estrada & Trejo, 1978], using

TABLE I. Troop Composition for the Howler Monkey Population at the Biological Reserve "Los Tuxtlas," Veracruz.

Number	Troop code	Males	Females	Sex ratio (M:F)	Immatures		Total
					Juveniles	Infants	
1	67	4	2	1: .50	-	-	6
2	67S	4	6	1:1.50	3	3	16
3	67W	3	5	1:1.67	2	2	12
4	67G	3	5	1:1.67	-	2	10
5	71A	4	6	1:1.50	-	1	11
6	71B	2	4	1:2.00	-	-	6
7	71C	3	6	1:2.00	1	2	12
8	71D	3	3	1:1.00	1	2	9
9	72A	2	5	1:2.50	1	1	9
10	72B	2	2	1:1.00	1	1	6
11	72C	1	3	1:3.00	-	1	5
12	72D	4	3	1:0.75	-	1	8
13	72E	3	4	1:1.33	1	1	7
14	72F	5	4	1:0.80	2	2	13
15	73A	3	3	1:1.00	2	1	9
16	73B	3	5	1:1.67	-	-	8
17	73C	2	4	1:2.00	1	1	8
Total		51	70		14	20	155
Percent		33%	45%		9%	13%	

only 36 from which they eat leaves and fruit. Their diet consists of 45% leaves, 51% fruit, 2% vines, 1% flowers, and 1% petioles [Estrada, 1981a,b]. Our data also indicate that they display a marked preference for young leaves and mature fruits, which account for 34% and 42%, respectively, of their time spent feeding in a given annual cycle. These two food items are extremely seasonal in their availability in the rain forest of "Los Tuxtlas."

The strong preference by the howler monkeys for very seasonal food items, coupled with their dietary preferences for only 36 species of trees and the very low density at which these species occur in this forest, may explain the very large home ranges observed. These features become very important when considering the impact of deforestation on the survival of this primate in areas of forest near the reserve which are not protected or that consist of hilltops or of "islands" of forest and where the troops may exist under a precarious situation. For example, our census data of other troops in forest patches near the reserve and within a radius of 8 km show a mean troop size of 6.0 animals ( $N = 8$ ). Evidently the home range of these troops is much smaller and its size depends probably on the size and "richness" of those forest patches. These troops are not only suffering the impact of habitat destruction and reduction of available resources, but are also subjected to illegal hunting. We have observed troops move over the ground from one forest patch to another forest patch, probably searching for sources of food. The continuing destruction of the remaining forest in areas near the biological reserve seriously jeopardizes the survival of those troops still remaining in them.

#### Immigrations

During the time we observed the behavior and studied the ecology of the howlers in troops 67G, 67S, and 67W, we have witnessed the successful immigration of one young adult female from troop 67G to troop 67S. Since troop 67S has been under intensive surveillance since 1977, we were able to conduct a very careful observation of this immigra-

TABLE II. Summary of Demographic Data for Howler Monkey Populations at Other Sites and Data From Present Study

Author <sup>a</sup>	Mean group size	Home range size	Density animal km <sup>2</sup>	Socionomic sex ratio	Adult		Immatures		Species	Site
					M	F	Juveniles	Infants		
1 <sup>b</sup>	17.30	44.60	31.00	1:2.7	2.7	7.4	4.0	3.1	<i>A. palliata</i>	B.C.I.
2 <sup>b</sup>	27.40	76.00	31.00	1:2.4	2.9	6.9	4.2	3.5	<i>A. palliata</i>	B.C.I.
3 <sup>b</sup>	18.00	—	31.00	1:2.1	3.3	7.0	5.4	2.5	<i>A. palliata</i>	B.C.I.
4 <sup>b</sup>	7.96	16.20	15.00	1:3.75	1.2	4.5	1.0	1.2	<i>A. palliata</i>	B.C.I.
5	10.50	15.10	—	1:3.5	1.0	3.5	3.5	2.5	<i>A. palliata</i>	B.C.I.
6	19.00	—	52.00	1:2.8	3.3	9.1	3.1	3.0	<i>A. palliata</i>	B.C.I.
7	7.90	—	—	1:0.9	3.2	2.8	1.6	0.4	<i>A. caraya</i>	Argentina
8	16.5	17.50	—	1:2.3	3.0	7.0	4.0	2.5	<i>A. palliata</i>	B.C.I.
9	4.30	—	11.50	—	—	—	—	—	<i>A. seniculus</i>	Colombia
10	12.80	7.90	57.00	1:1.8	3.3	6.0	2.9	2.5	<i>A. palliata</i>	B.C.I.
11	7.50	.66	—	—	—	—	—	—	<i>A. seniculus</i>	Trinidad
12	8.50	7.08	—	1:1.6	1.61	2.54	1.7	1.3	<i>A. seniculus</i>	Venezuela
13	16.2	7.50	—	1:1.9	3	5.8	4.3	2.8	<i>A. palliata</i>	B.C.I.
14	18.90	—	1040.00	1:2.1	3.8	8.0	3.75	3.25	<i>A. palliata</i>	Barqueta Panamá
15	19.5	9.90	—	1:2.4	2.6	6.16	5.12	2.0	<i>A. palliata</i>	Costa Rica
16	6.25	—	5.00	—	—	—	—	—	<i>A. palliata</i>	Tikal, Guatemala
17	18.17	31.00	—	1:2.0	3.85	7.67	6.67	—	<i>A. palliata</i>	B.C.I.
18	8.9	—	150.00	1:1.6	1.65	2.68	6.09	1.38	<i>A. seniculus</i>	Venezuela
Present study	9.12 (n = 17)	60 (n = 3)	23.29 (n = 17 + 8 sol)	1:1.37	3.0	4.12	1.56	1.54	<i>A. palliata</i>	"Los Tuxtlas" México

<sup>a</sup>1 = Carpenter, 1932; 2 = Carpenter, 1933; 3 = Carpenter, 1935; 4 = Coillas & Southwick, 1952; 5 = Altmann, 1959; 6 = Carpenter, 1959; 7 = Pope, 1968; 8 = Bernstein, 1964; 9 = Klein & Klein, 1976; 10 = Chivers, 1969; 11 = Neville, 1972; 12 = Neville, 1972; 13 = Mittermeier, 1973; 14 = Baldwin & Baldwin, 1972; 15 = Glander, 1975; 16 = Coelho et al, 1976; 17 = Milton, 1977; 18 = Rudran, 1979.

<sup>b</sup>Calculated from data presented in Carpenter [1965]; M = males, F = females.

tion case. In summary, the female left the 67G troop and a week later had successfully entered troop 67S. She was incorporated very well into the troop and spent much time with the other adult females in the group. Later she became pregnant and gave birth to an infant. Another observed case of successful immigration was that of a solitary male. This male had been alone for at least 3 yr before he was able to enter troop 67S. About 6 months before he attempted to enter the troop he followed troop 67S throughout different areas of its home range, always remaining about 200–300 m away. In these instances an exchange of howling between the solitary male and the males of troop 67S was a common feature. On one occasion a month before he actually entered the troop, he made an attempt to join the troop and was repelled aggressively by the resident adult males who chased him to the ground and successfully away from the troop. Shortly after this happened we captured and marked this male and were able to record a few weeks later its successful entrance to the troop. He seemed to be well tolerated by the resident males and at the time of writing of this report (a year after his successful immigration) he still is with the troop. Does this mean that the troops are less permeable to males than to females? At the moment we can not answer this question, albeit these examples may suggest that troops may be more permeable to females than to males. The existence of eight solitary individuals in the reserve as of March of 1981, also attests to the fact that the degree of permeability of the troops is low.

To what extent the demographic characteristics described for the howlers of the biological reserve "Los Tuxtlas" reflect an undisturbed situation is difficult to know due to the fact that we lack knowledge about the past history (last 10 yr) of the troops. The rapid disappearance of the rain forest in areas near the reserve may cause the howlers (as well as other animals) to seek refuge in the protected forest of the reserve. This may produce pressures of unknown nature on the resident howler population and on its structure. The very low number of immatures as compared to the number of adult females suggests a population in decline. The odd adult sex ratios in some instances (e.g., 1:0.50) may suggest a disturbance in the breeding structure of the troops.

However depressing this picture of the howlers may be at "Los Tuxtlas," the existence of the reserve nevertheless will ensure the temporary survival of the howler monkey. It also offers the possibility of carrying out long-term, intensive studies of its ecology and behavior that may give us the necessary tools to ensure the existence of this primate species in protected areas of forest in the rest of southern Mexico.

## CONCLUSIONS

1. The demographic characteristics of the howlers existing at the biological reserve "Los Tuxtlas" in Veracruz, Mexico fall within the range reported for the species at other sites in Central and South America.
2. The howler monkeys at the biological reserve "Los Tuxtlas" occupy the northern limit of the rain forest in the American continent.

## ACKNOWLEDGMENTS

Partial support for this research came from the grant # PCCBNAL 790028 (217) from Consejo Nacional de Ciencia y Tecnología de México. The author is grateful to Eucario Malaga and Rogelio Xolo, two field assistants, for aiding in the census of the howler troops; to Rosamond Coates-Estrada and Dr. R. J. Russell for valuable help when trapping and marking the howlers.

## REFERENCES

- Altmann, S. Field observations of howling monkey society. *JOURNAL OF MAMMALOGY* 40:317–330, 1959.
- Baldwin, J.D.; Baldwin J.I Population density and use of space in howling monkeys (*Alouatta villosa*) in Southwestern Panama. *PRIMATE* 13:371–379, 1979.
- Bernstein, I. A field study of the activities of



- howler monkeys. *ANIMAL BEHAVIOR* 12:92-97, 1964.
- Carabias, J. Análisis de la Vegetación de la Selva Alta Perennifolia y comunidades derivadas de este en una zona cálido-húmeda de México, Los Tuxtlas, Veracruz. Bsci Thesis. Universidad Nacional Autónoma de México, México, 1980.
- Carpenter, C.R. A field study of the behavior and social relations of howling monkeys (*Alouatta palliata*). *COMPARATIVE PSYCHOLOGICAL MONOGRAPHS* 10(2):81-168, 1934.
- Carpenter, C.R. The howlers of Barro Colorado Island. pp. 250-291 in *PRIMATE BEHAVIOR. FIELD STUDIES OF MONKEYS AND APES*. I. Devore, ed. New York, Holt Rinehart and Winston, 1965.
- Chivers, D. On the daily behavior and spacing of howling monkey groups. *FOLIA PRIMATOLOGICA* 10:48-102, 1969.
- Coelho, A.M.; Bramblett, C.A.; Quick, L.; Bramblett, S.S. Resource availability and population density in primates: A sociobioenergetic analysis of energy budgets of Guatemalan howlers and Spider Monkeys. *PRIMATES* 17:63-80, 1976.
- Collias, H.; Southwick, C.A. Field study of population density and social organization in howling monkeys. *PROCEEDINGS OF THE AMERICAN PHILOSOPHICAL SOCIETY* 92:143-156, 1952.
- Eisenberg, J.F.; Kuehn, R.E. The behavior of *Ateles geoffroyi* and related species. *SMITHSONIAN MISCELLANEOUS COLLECTIONS* 151(8):1-63, 1966.
- Eisenberg, J.; Thorington, R.W. A preliminary analysis of Neotropical Mammal fauna. *BIO-TROPICA* 5(3):150-161, 1973.
- Estrada, A. Howler monkey feeding selectivity and resource availability in the high evergreen rain forest of "Los Tuxtlas," Veracruz, México. Abstract. *AMERICAN JOURNAL OF PRIMATOLOGY* 1(3):315-316, 1981a.
- Estrada, A. A preliminary view of howler monkeys as seed dispersal agents in the high evergreen rain forest of "Los Tuxtlas," Veracruz, México. Abstract. *AMERICAN JOURNAL OF PRIMATOLOGY* 1(3):323-324, 1981b.
- Estrada, A.; Trejo, W. Dieta y selectividad en el mono aullador (*Alouatta villosa*) en la Selva Alta Perennifolia de la Estación de Biología "Los Tuxtlas," Veracruz, pp. 447-453 in *MEMORIAS DEL II CONGRESO NACIONAL DE ZOOLOGIA*. Jimenez, G., A. Zuñiga R., H. López S., C. Palomo, C., R., Cervantes, G. Trejo B., R. Huerta Rincon, eds. Universidad Autónoma de Nuevo León, Monterrey, México, 1978.
- Flores, J.S. Estudio de la Vegetación del Cerro el Vigía de la Estación de Biología Tropical "Los Tuxtlas," Veracruz. Bsci Thesis, Universidad Nacional Autónoma de México, 1971.
- Glander, K. Habitat description and resource utilization: An ecological view of social organization in mantled howling monkeys. Ph.D. Dissertation, The University of Chicago, 1975.
- Klein, L.L.; Klein, D.J. Neotropical primates: Aspects of habitat usage population density and regional distribution in La Macarena, Colombia. pp. 70-78 in *NEOTROPICAL PRIMATES, FIELD STUDIES AND CONSERVATION*. R.W. Thorington; P.G. Heltne, eds. Washington, D.C. National Academy of Sciences, 1976.
- Mack, D. Growth and development of infant red howler monkeys (*Alouatta seniculus*) in a free ranging population. pp. 127-136 in *VERTEBRATE ECOLOGY IN THE NORTHERN NEOTROPICS*. J.F. Eisenberg, ed. Washington, D.C., Smithsonian Institution, 1979.
- Martínez, M.; Trejo, W. LISTA PRELIMINAR DE LAS PLANTAS VASCULARES EN LA ESTACIÓN DE BIOLOGÍA TROPICAL "LOS TUXTLAS." Universidad Nacional Autónoma de México, México, 1981.
- Milton, K. The foraging strategy of the howler monkey in the tropical forest of Barro Colorado Island, Panama, Ph.D. Dissertation, New York University, New York, 1977.
- Milton, K.; Mittermeier, R. A brief survey of the primates of Coiba Island. *PRIMATES* 18(4):931-936, 1977.
- Mittermeier, R. Group activity and population dynamics of the howler monkey on Barro Colorado Island. *PRIMATES* 14:1-19, 1973.
- Montgomery, G.G.; Sunquist, M.E. Habitat selection and use by two-toed and three-toed sloths. pp. 329-360 in *THE ECOLOGY OF ARBOREAL FOLIVORES*. G.G. Montgomery, ed. Washington, D.C., Smithsonian Institution, 1978.
- Neville, M.K. The population structure of red howler monkeys (*Alouatta seniculus*) in Trinidad, Venezuela. *FOLIA PRIMATOLOGICA* 17:56-26, 1972.
- Pennington, T.; Sarukhán, J. *Arboles Tropicales de México*. Instituto Nacional de Investigaciones Forestales. SAG, 1968.
- Piñero, D., Sarukhán, J.; González, E. Estudios demográficos en plantas. *Astrocaryum mexicanum* Liebm I. Estructura de las poblaciones. *BOLETIN DE LA SOCIEDAD BOTANICA DE MEXICO* 37:69-118, 1977.
- Pope, B.L. Biology of the howler monkey (*Alouatta caraya*): Population characteristics. *BIBLIOTHECA PRIMATOLOGICA* 7:13-20, 1966.
- Ramírez, A.; Casas, G.; Pérez, G. LISTA PRELIMINAR DE LOS REPTILES Y ANFIBIOS DE LA ESTACION DE BIOLOGIA TROPICAL "LOS TUXTLAS." Universidad Nacional Autónoma de México, México, 1981.
- Richard, A. A comparative study of the activity patterns and behavior of *Alouatta villosa*

- and *Ateles geoffroyi*. FOLIA PRIMATOLOGICA 12:241-263, 1970.
- Rudran, R. The demography and social mobility of a Red Howler (*Alouatta seniculus*) population in Venezuela. pp 107-126 in VERTEBRATE ECOLOGY IN THE NORTHERN NEOTROPICS. J.F. Eisenberg, ed. Washington, D.C., Smithsonian Institution, 1979.
- Schlichte, H. A preliminary report on the habitat utilization of a group of howler monkeys (*Alouatta villosa pigra*) in the National Park of Tikal, Guatemala. pp 551-560 in THE ECOLOGY OF ARBOREAL FOLIVORES. G.G. Montgomery, ed. Washington, D.C., Smithsonian Institution, 1978.
- Sekulic, R. The significance of Howling in the Red Howler Monkey *Alouatta seniculus*. Ph.D. Thesis, University of Maryland, 1981.
- Smith, C.C. Feeding behavior and social organization in howling monkeys. pp. 97-126. PRIMATE ECOLOGY: STUDIES OF FEEDING AND RANGING BEHAVIORS IN LEMURS, MONKEYS AND APES. T.H. Clutton-Brock, ed. New York, Academic Press, 1977.
- Sousa, M. Ecología de las Leguminosas de Los Tuxtles, Veracruz. ANALES DEL INSTITUTO DE BIOLOGIA UNAM (Ser. Botánica) (1):121-160, 1968.