

A CENSUS OF *ALOUATTA PALLIATA* AND *CEBUS CAPUCINUS* MONKEYS IN SANTA ROSA NATIONAL PARK, COSTA RICA

Linda Marie Fedigan*, Laurence Fedigan** and Colin Chapman***

Department of Anthropology University of Alberta, Edmonton, Alberta, Canada T6G 2E1*

Faculte Saint-Jean University of Alberta, Edmonton, Alberta, Canada T6C 4G9**

Departments of Anthropology and Zoology, Universidad of Alberta, Edmonton, Alberta, Canada T6G 2E1***

Key Word Index: Census, Primates, Santa Rosa National Park, *Cebus capucinus*, *Alouatta palliata*

ABSTRACT

A direct count census of *Alouatta palliata* and *Cebus capucinus* monkeys in Santa Rosa National Park, Costa Rica, was carried out in July and August, 1983 and between March and May, 1984. A total of 25 *Alouatta palliata* groups totalling 342 individuals were counted, giving a park density of 3.4 howling monkeys per km². Twenty-eight *Cebus capucinus* groups were located, totalling 393 individuals and giving a crude density of 3.9 cebus monkeys per km². Population densities of intensively studied groups of known home range, were higher than the overall park density. Group totals, age and sex compositions, and locations in Santa Rosa are described.

Primates are among the largest and most numerous arboreal mammals in the New World. In some tropical forests they are the major frugivorous and folivorous vertebrates, accounting for a significant proportion of the total biomass and playing a large role in seed dispersal (Terborgh 1983, Milton 1980). Their roles in the ecology of dry, semi-deciduous forests, such as those found in Santa Rosa National Park, are not well studied. In addition many New World primates, including two of the three species represented in Santa Rosa National Park, are classified as endangered or vulnerable (Hearn 1983). Thus the need to understand their part in the maintenance of local ecosystems becomes more urgent as these species become increasingly disturbed by human activity. Long term studies of the life histories of groups and populations in such areas also should help parks personnel in their goals of conservation of habitat and species diversity. A first step in one such long term study is the inventory presented below.

The lowland semi-deciduous forests of the Pacific Coast of Costa Rica are occupied by, *Cebus capucinus*, the white-faced capuchin, *Ateles geoffroyi*, the red spider

monkey, and *Alouatta palliata*, the mantled howling monkey. The numbers and distribution of all three species have been severely affected by rapid deforestation, especially in northern Puntarenas Province and Guanacaste Province. Spider monkeys, for example, now survive in only a few sites in Guanacaste Province, of which Santa Rosa National Park is the most secure and thus the most appropriate for the study of a relatively undisturbed population.

As the first step in a long-term project to study the demography and behavior of the three primate populations in Santa Rosa National Park, a census was carried out in July-August 1983 and March-May, 1984, the results of which are presented below. Group compositions, locations and density estimates are reported for cebus and howling monkeys. Unfortunately, the changing and dispersed nature of spider monkey social organization and range use makes estimates drawn from the sampling of spider sub-groups potentially unreliable. Thus until we know more about the spider monkey communities in Santa Rosa, we withhold our estimation of population size. However, all *Ateles* subgroups encountered were censused, allowing us to make some very general comments about distribution and abundance. It is our hope that as our own project continues and as we receive additional information and sightings from other researchers working in the park, as well as from park personnel, we can complete and maintain accurate census records for all three species in the park.

Santa Rosa National Park was established in 1970. Shortly thereafter a preliminary census of numbers and distribution of the three primate species and an intensive study of the behavioural ecology of one cebus group was carried out (Freese, 1976a, b, 1978). Since then no further studies of the primates in Santa Rosa have been published. The census method used in the present study (total count of the members of all groups) is different from that employed by Freese (1976a), making direct comparisons with his figures impossible. However, some general comparative statements about population distribution, and change in the park during the intervening ten years, can be made.

The park is situated approximately 35 km northwest of Liberia in Guanacaste province, Costa Rica. It lies between the Pan-American highway and the Pacific Ocean and covers approximately 10,800 ha. It consists of a number of stepped plateaus which start at an elevation of 300 m and gradually drop down to a coastal plain, which includes beach front, mangrove swamp, and flood plains. Rainfall in the park has averaged 1630.5 mm (range 900 mm to 2200 mm) annually (Janzen pers. comm.), most of which falls in the rainy season between early May and mid-December. During the dry season many of the non-riparian tree species lose their leaves. The park consists of a mosaic of distinct habitat types which result from the past land use patterns and from naturally varying environmental conditions. Originally the park was covered by a semi-deciduous, species-rich forest with patches of oak forest (*Quercus oleoides*) along the highest and eastern side (Janzen 1982). However, over the past 300 years, 50% of the upper plateau has been cleared for cattle pasture and planted with *Hyparrhenia rufa*, and the remaining forests have been selectively log-

ged. With the establishment of the park, cattle were gradually removed, and the pastures have been reverting to woody vegetation. The mosaic of habitat types which has resulted from this diverse land use pattern includes various serial stages of dry deciduous forest, dominated by *Spondius mombin*, *Luehea candida*, *Guazuma ulmifolia*, *Bursera simaruba*, *Ficus* sp., *Chlorophora tinctoria*; evergreen to semi-evergreen forest of relatively pristine nature with a canopy between 10 m and 25 m in height dominated by *Hymenaea courbaril*, *Masticodenron capiri*, *Manilkara zapote*; and abandoned pastures, which are almost entirely *Hyparrhenia rufa*, but contain patches of trees such as *Crescentia alata* and *Guazuma ulmifolia* scattered throughout (Bonoff and Janzen 1980, Jansen pers. comm.).

Within this mosaic, forested patches have sharp boundaries and are semi-isolated. As a consequence, primate ranges are sometimes linked only by narrow "corridors" of trees, along quebradas (ravines) or ridges. By being semi-isolated, these patches of forest may limit the range of many groups and restrict emigration and immigration largely to these corridors. An extreme example is Playa Nancite, where a small, heavily wooded area of approximately 0,5 km² supports groups of howling and cebus monkeys which appear to be isolated from the rest of the park by the surrounding dry and brush-covered hills. Another consequence of the park having these semi-isolated patches is a significant reduction in the area of the park available to, or suitable for, primates. Approximately 70% of the park's 10,800 ha can be described as useable primate habitat.

Methods

Census counts. Cebus and howling monkeys were censused by direct observations of groups. Social groups were repeatedly located, counted by age/sex class and followed where possible. In this way, a mosaic, or group map of the park was constructed. Since we were covering a large, yet well-bounded area in Santa Rosa (10,800 ha), ranging information was more important in establishing the number and exclusivity of groups, than in measuring range overlap. We calculated home ranges for two adjacent groups of each species, and then relied upon extrapolations from them, identifiable individuals, and the exclusivity of group counts to ensure the independence of the remaining groups. The independence of counts proved the best way of distinguishing between neighboring and lesser known groups. Neighboring groups with similar counts were carefully re-checked, and simultaneous contact with both groups was made by different observers whenever possible. In some cases the presence of one or more readily identifiable individuals (because of facial scars, short tails, broken limbs, piebaldism, etc.) also helped to distinguish between the neighboring groups of similar size. In these ways, we established the identity of each of the groups we counted, but it is of course possible that we missed one or several groups, especially small ones, of each species. We expect that the on-going nature of this project will allow us to delimit the ranges of an increasing number of groups and to refine the census results presented here.

These census was carried out in three stages. In July and August, 1983 (wet season) three observers located and counted groups of cebus and howling monkeys throughout the park, and began estimation of home range size of groups of both species in a selected area. The following March and April of 1984 (dry season), two observers completed the mapping of home ranges in this area. Finally, in May 1984, four observers attempted to relocate and recount the groups censused in 1983, looking for previously missed groups and following up reports of sightings in areas where no group had been located.

Howling monkeys were located whenever possible by tracing the source of their loud vocalizations, especially in the morning. However, not all groups called regularly and some, especially small groups, were never heard to howl. Distant *Alouatta* loud calls are not easy to localize, and since many groups howled only briefly, it sometimes served just to indicate a general area for searching. All trails and river beds and all wooded areas were walked several times. The park is crossed by an extensive network of trails and rivers (which are dry most of the year), so that all parts of the park are accessible. Park guards patrol the fence lines regularly and were helpful informants, as were other researchers working in specific areas of the park. Age and sex class composition and total count were repeated on different occasions until stable, at which time a count of a group was considered complete. Some group counts were more stable than others and we have indicated in the results section those groups whose counts we consider incomplete. The relatively sedentary nature of howling monkeys made relocations soon after initial contact quite easy in most cases.

In contrast, the mobile cebus monkeys were difficult to relocate, but most groups were cohesive and two observers generally were sufficient to assure complete coverage of a group for a count. Observers made counts of the same group, sometimes individually, comparing age/sex counts afterwards, and sometimes together, in an effort to obtain counts that were both complete and reliable. Cebus groups showed variable tolerance of observers, some habituating rapidly to our presence, others maintaining a distance, or fleeing, even after several encounters. Park officials report some hunting of monkeys and other animals on some of the park boundaries, but boundary groups were not noticeably shyer or more fearful of people than some centrally located ones.

Alouatta palliata age-sex classes. The sexing of adult howling monkeys presents no difficulties for the observer: the fully developed, white scrotum of the adult male is clearly visible and distinctive. Similarly, adult females can be readily identified by size and external genitalia. However, the development of the scrotum is variable in young male howling monkeys, with some two-year old males having fully descended testicles and thus a large scrotum, while other are still poorly developed at age three (Glander, pers. comm.). At earlier ages, and before the scrotum is full sized, young males and young females can be confused. Only in the intensively studied groups of the present study, were immature howling monkeys classified by sex. In the results presented below, immatures and infants are not divided into sex classes.

Cebus capucinus age-sex classes. The sexing of infant and immature white-faced cebus is difficult. The scrotum in subadult males is not easily seen except at very close range and younger animals are even more difficult to sex by external genitalia. Only in the intensively studied groups of the present study, were immature cebus monkeys classified by sex. In the results presented below, immatures and infants are not divided into sex classes. Patterns of facial and head hair growth have been used to identify adult female cebus in previous studies (Oppenheimer 1968), and were found to be useful indicators in the present census. The shape of the head and absence of facial hair helped to identify adult males. In particular, the lower face becomes very square looking when canines become fully developed in the adult males. The prominent tufts of facial hair common in adult females, are usually lacking in adult males but increased hair growth around the shoulders and upper arms gives them a noticeably robust appearance. Adult males are more visible when a group is first contacted, they often approach an observer, give loud calls, break branches and threaten.

It is not clear yet whether there is a seasonal or yearly birth pulse in the Santa Rosa cebus monkeys, however for well studied groups it is possible to designate 3 infant stages, I_1 , I_2 , and I_3 as other researchers have done. I_1 refers to a very young, grey, clinging infant in the first month of life, carried across the mother's shoulders. I_2 is an intermediate stage, often called dependent infant, one who frequently leaves the mother to explore, play, and even forage, but will ride dorsally during troop travel. I_3 infants are quite independent and travel as well as forage, etc. alone. However, they still have the large head to body proportions that characterize infants, and may, when the troop is alarmed, travel on their mothers' backs. In counting groups that are not intensively studied, the latter categories can be problematic, and for the present census, all infants are grouped in one class, corresponding to the first 12 months of life.

The juvenile or immature class which covers the age period from about 1 year to puberty (4 to 5 years) has been divided into two parts, as it was possible with a good amount of agreement to distinguish small and large juveniles or "immatures". Since a large immature female becomes adult on having her first infant, this boundary is a difficult one: some females with infants, hence adult, seemed very small and would have been difficult to classify in the absence of the infant. Subadult males (males of 4 + years) with fairly well developed scrota, but lacking the full development of face and shoulders, were not frequent in groups of either species.

Results

Alouatta palliata. The location, composition, and total size of each howling monkey group contacted and counted in Santa Rosa, is listed in Table I. The group number and location refers to its position on the Santa Rosa map in Figure 1. The 25 groups listed give a total of 342 howling monkeys for the whole park, or a crude population density of 3.4 howling monkeys per km^2 . However, since, as we have noted,

only some 70% at most, of the habitat in the park is available to the monkeys, the ecological density (density in utilizeable habitat), is closer to 4.9 howling monkeys per km².

Cebus capucinus. The location, composition, and total of each cebus monkey group located and counted, is listed in Table 2. The distribution of the groups is shown in Figure 2. The 28 groups listed give a total of 393 cebus monkeys in the whole park, or a crude population density of 3.9 per km² and an ecological density of 5.6 cebus monkeys per km².

Solitary animals. In addition to the 25 howling monkey groups and 28 cebus groups located and counted, a total of 10 solitary howling monkeys and 4 solitary cebus monkeys were counted in different locations over both years of the census. Of the 10 solitary howling monkeys, 9 were adult and subadult males, one was a female. Only 4 solitary cebus monkeys were counted during the 2 census periods; all were males.

Given the large number of howling and cebus groups in the park, it seems quite possible that the numbers of solitary animals is underestimated: they tend to be silent and discrete and are often unnoticed. Male and female immature howling monkeys are reported to leave their groups (Clarke and Glander 1974) and immature cebus males change groups. There could then, at least in theory, be a number of animals "between groups" at any time, some of which could have been missed in our census.

Conclusions

Howling and cebus monkeys are to be found in wooded areas throughout Santa Rosa National Park. In only two areas, Los Perros (group F, Table 2), and the mid El Duende area (group K, Table 2), a riverine strip surrounded by grassy hills, was only one species, *Cebus capucinus* found. In all other areas howling and cebus monkeys were sympatric. Cebus monkeys however do appear to range more widely into the younger successional forest and even cross grassy, abandoned pasture in the dry season. The cebus home ranges we measured were, in most cases, larger than howling monkey home ranges, and included more semi-deciduous forest than the latter.

The densities of intensively studied groups whose home ranges were measured is much higher than the park average; 15.0 per km² for two howling monkey groups, 10.0 per km² for two cebus monkey groups. It could be hypothesized then that the utilizeable area of the park is a good deal less than 70 percent or, that there is room for more expansion of both species (they may have been expanding since the establishment of the park 12 years ago), or that the measure of numbers per km² is not a good indicator of the relationship of biomass to resources in Santa Rosa National Park.

In spite of the differences in methods between the present census and that carried out by Freese in 1972 (Freese 1976a), some comparisons can be made and some, albeit tentative, conclusions can be drawn. Howling monkeys are now more widely distributed and numerous than reported 10 years ago when Freese found them in the lower part of the park only. Yet, although more widely distributed, howling monkeys still are to be found in all the areas designated by Freese, so there has been no retreating from former ranges. Freese did find cebus monkeys to be more widespread than howling monkeys, but he did not designate specific groups, making direct comparisons impossible. The range of the group of cebus monkeys studied intensively by Freese in 1972 is similar to that occupied by a smaller cebus group today.

Ateles association patterns consist of temporary parties of variable size which are usually sex segregated. Male groups are reported to travel further, over larger ranges than female groups (Fedigan and Baxter 1984). This fluidity and variable day travel makes *Ateles* communities or groups difficult to define and their populations difficult to estimate without individual identification of a large number of animals. We expect to obtain such identification in the future and to be able to give reliable estimates of the *Ateles geoffroyi* population in Santa Rosa National Park. Until then we can state only that spider monkeys are found in most areas of the park, but that, like howling monkeys, they are encountered less often than cebus monkeys in the areas of dry forest. In both census years overall encounter rates of spider monkeys were lower than those of howling monkeys and cebus monkeys, probably reflecting a lower overall density. However, given the variable fission-fusion association patterns of spider monkeys, encounter rates cannot be used to generate reliable population estimates.

It would appear that primate populations have been growing and spreading in the park since its creation until now it constitutes an important "refugium" for the Guanacaste primates. The present census will be maintained and updated as we collect and receive more, and more precise, information. These latter will allow us to not only maintain an up to date census, but to plot and predict the changes in the primate populations and the forces causing these changes.

Acknowledgements

The authors would like to thank Sr. Fernando Cortez, Jefe, Sección de Investigaciones, Sr. José Salazar, Director of Santa Rosa National Park, and other Park Service personnel, for their help. We would also like to thank Jeff Bullard for assistance in collecting census data and Dr. Daniel H. Janzen for his advice during the fieldwork and for his comments on an earlier draft of this paper. This research was supported by an N.S.E.R.C. (Canada) operating grant A7723 and a N.S.E.R.C. (Canada) Post-graduate Scholarship.

Literature Cited

- Bonoff, M.B. and D.H. Janzen. 1980. Small terrestrial rodents in eleven habitats in Santa Rosa National Park, Costa Rica. *Brenesia* 17:163-174.
- Clarke, M.R. and K.E. Glander. 1984. Female reproductive success in a group of free-ranging howling monkeys (*Alouatta palliata*) in Costa Rica. In Small, M.F. ed., *Female Primates. Studies by Women Primatologists*. Pp. 111-126. Alan R. Liss: New York.
- Fedigan, L.M. and M.J. Baxter. 1985. Sex differences and social organization in free-ranging spider monkeys *Ateles geoffroyi*. *Primates* 25.
- Freese, C. 1976a. Censusing *Alouatta palliata*, *Ateles geoffroyi* and *Cebus capucinus* in the Costa Rican dry forest, In Thorington Jr., R.W. and Heltne, P.G. eds., *Neotropical Primates. Field Studies and Conservation*. Pp. 4-9. National Academy of Sciences: Washington D.C.
- Freese, C.H. 1976b. Food habits of white-faced capuchins *Cebus capucinus* (Primate: Cebidae) in Santa Rosa National Park, Costa Rica. *Brenesia* 10/11:43-56.
- Freese, C.H. 1978. The behaviour of white-faced capuchins (*Cebus capucinus*) at a dry-season waterhole. *Primates* 19:275-286.
- Hearn, J.P. 1983. *Reproduction in New World Primates*. M.T.P. Press Ltd., Boston.
- Janzen, D.H. 1982. Natural history of guacimo fruits (Sterculiaceae: *Guazuma ulmifolia*) with respect to consumption by large mammals. *Amer. J. Bot.* 69:1240-1250.
- Milton, K. 1980. *The foraging strategy of howler monkeys*. Columbia University Press, New York.
- Oppenheimer, J.R. 1968. *Behaviour and ecology of the white-faced monkey, Cebus capucinus, on Barro Colorado Island, Canal Zone*. Doctoral Dissertation, University of Illinois, Urbana.
- Terborgh, J. 1983. *Five new world primates. A study in comparative ecology*. Princeton University Press, Princeton.

Table 1. Howling Monkey (*Alouatta palliata*) groups in Santa Rosa National Park, Costa Rica 1984

MAP REFERENCE No. NAME/ LOCATION	ad m	ad f	BEST COUNT		inf	Total	COMMENTS
			large imm	small imm			
1 R. Cuajiniquil gp 1.	4	5	2	2	—	13	Range over park boundary; heard frequently
2 R. Cuajiniquil gp 2.	3	6	1	2	2	14	Between Cafetal trail and highway; heard frequently
3 R. Cartago/boundary rd.	3	7	2	1	1	14	Range in area of large fruiting trees surrounded by bamboo thicket
4 Cruz de Piedra	1	3	—	—	1	5	Small group on edge oak forest
5 Upper Bosque Humido	8	18	1	4	9	40	Under intensive study
6 Q. Puercos	3	3	2	1	1	10	Lower Rio Puercos to fenceline and up smaller tributaries
7 Laguna Escondida 1	1	2	—	2	2	7	Range East and North of Laguna Escondida
8 Laguna Escondida 2	2	4	1	—	1	8	
9 Q. El Duende	3	7	2	2	3	17	Range between 2 arms of Que. El Duende near fence
10 Sendero/San Emilio	2	7	2	1	2	14	Under intensive study
11 Upper Rio Calera	1	3	—	1	2	7	Near waterfall
12 Q. El Guapote 1 (upper)	3	7	3	1	2	16	Range to fenceline (Hacienda Rosa Maria)
13 Q. El Guapote 2 (mid)	4	7	3	2	3	19	Heard and counted on same day as group 12
14 Q. El Guapote 3 (fenceline)	3	4	—	1	1	9	Range over park boundary
15 Q. Costa Rica	1	3	1	—	2	7	Range east and South of waterfall

Continúa . . .

Table 2. *Cebus capucinus* groups in Santa Rosa National Park, Costa Rica 1984

MAP REFERENCE No. NAME/ LOCATION	ad	m	ad f	BEST COUNT			Total	COMMENTS
				large imm	small imm	inf		
A Finca Sta. Elena Boundary	1	5	2	3	2	13	From waterfall area of Rio Cuajiniquil	
B Cuajiniquil/upper Cafetal	2	6	2	3	1	14	From Rio Cuajiniquil waterhole Northeast to oak forest	
C Cuajiniquil/boundary rd.	2	4	3	5	1	15	From Rio Cuajiniquil waterhole West & North of boundary road	
D Cruz de Piedra	2	6	2	1	1	13	West side of Rio Cuajiniquil near the Cruz de Piedra	
E Lower Cafetal/Bosque Humido	4	10	4	5	3	26	Ranges in Bosque Humido to Mirador Santa Elena; under intensive study	
F Los Perros (upper Nisperal)	3	6	3	4	2	18	Open grazing on 3 sides; range down Nisperal (waterhole)	
G Queb. Puercos	2	4	2	4	3	16	One unid. animal (adult)	
H O. Puercos/Finca Jenny	3	4	2	3	—	12	Ranges over fence line into Finca Jenny (waterhole)	
I Guanacaste Bat site	3	5	1	4	2	15	From Guanacaste site area North to Ojo de Agua La Pencia (waterhole)	
J Laguna Escondida	3	9	2	3	2	19	Around and West from the Laguna	
K Quebrada El Duende 1	2	4	2	2	2	13	East side San Emilio, across El Duende (waterhole) along East bank	
L Quebrada El Duende 2	2	5	3	3	1	14	Along both arms El Duende (waterhole) to boundary with Finca Jenny	
M Sendero/San Emilio	3	2	2	2	1	10	Under intensive study	

Table 2. *Cebus capucinus* (Cont. . .)

N	Quebrada El Guapote I	4	6	2	5	3	20	—	From upper Guapote to Casona and campground some overlap with group M
O	Quebrada El Guapote II	2	5	1	3	1	12	—	Mid Guapote to boundary (waterhole) and to Hac. Rosa Maria (1 unid)
P	Quebrada Costa Rica	3	6	2	2	2	16	—	From below waterfall to beach road
Q	Upper Rio Calera	1	4	1	1	1	8	—	Waterfall and upper reaches of Rio Calera to plateau
R	Mid Rio Calera	2	5	2	2	1	13*	—	(1 unid) Mid Calera North and South, (waterhole)
S	Lower Rio Calera	2	6	—	2	1	11	—	Lower Rio Calera East & West to junction with Rio Pozo Salado
T	La Cuesta	2	5	3	2	2	14	—	North and South of Mirador and into Rio Calera
U	El Pedregal	1	5	1	4	1	13	—	(1 unid) From Codo del Diablo South and West into Rio Pozo Salado
V	Rio Pozo Salado I	2	4	—	2	1	10	—	(1 unid) Rio Pozo Salado to boundary with Hac. Bejuco at Q. Los Dantas
W	Rio Pozo Salado 2	1	3	1	1	—	7		
X	Playa Nancite	2	3	3	4	1	13	—	Dispersed range apparently cut off from rest of park
Y	Estero Real	3	5	2	3	2	15	—	Lower Nisperal to Estero Real
Z	Bosque El Ojochal	3	8	2	2	2	17	—	Area of Bosque Humido between lower Rio Pozo Salado and dry hills to Southeast
YY	Laguna Limbo	2	3	1	1	1	7*	—	Incomplete: area of Ojo de Agua Carbonal
ZZ	Hacienda Bejuco	3	5	3	5	3	19	—	North from Ojo de Agua Carbonal to boundary of Hac. Bejuco

28 TOTALS (* includes unidentified animals)

PARQUE NACIONAL SANTA ROSA

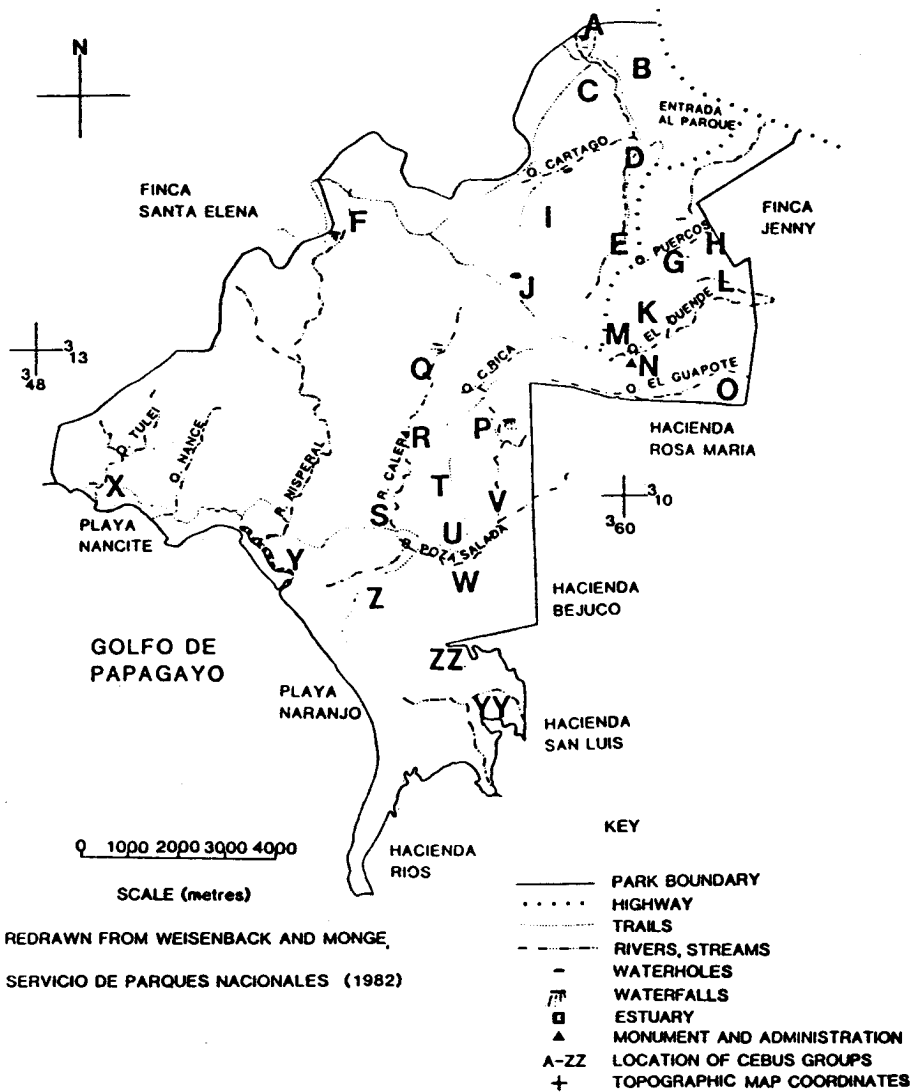


Figure 1. Distribution of *Cebus capucinus* groups in Santa Rosa National Park, Cos-Rica.

PARQUE NACIONAL SANTA ROSA

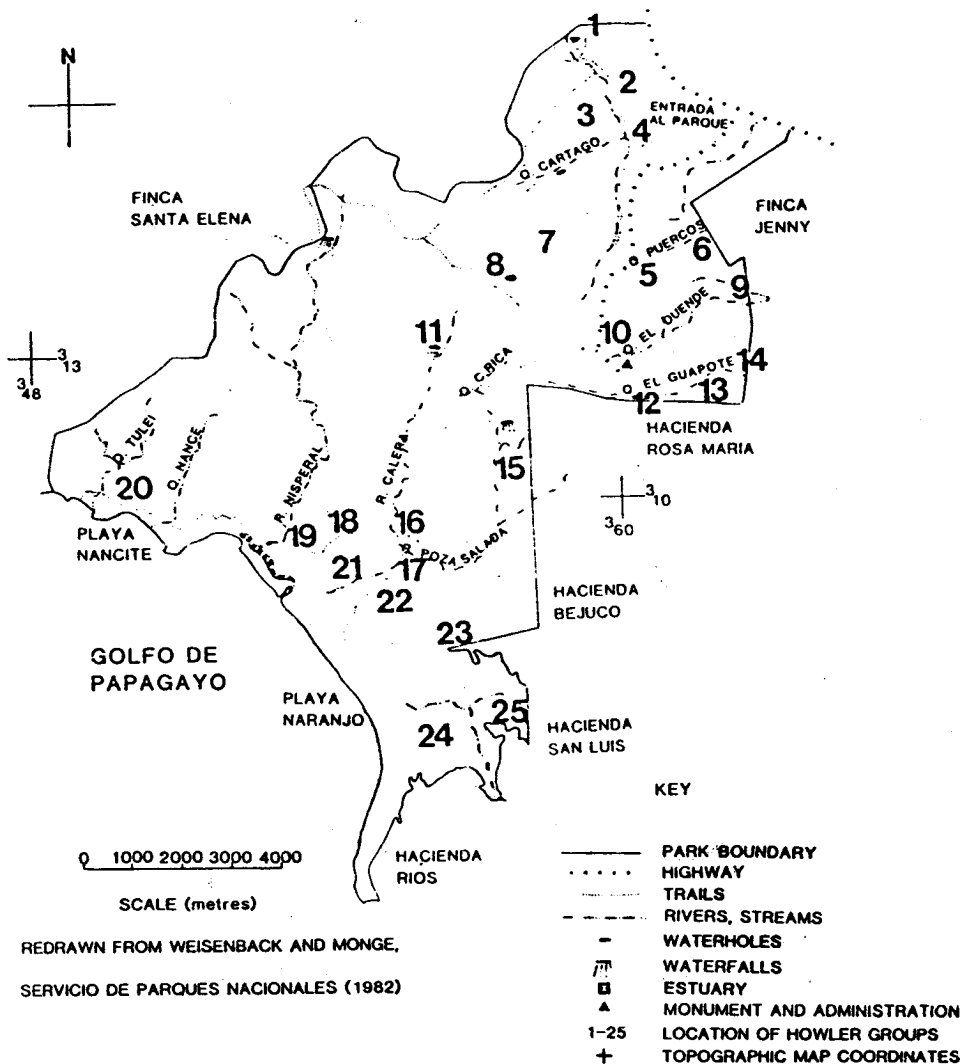


Figure 2. Distribution of *Alouatta palliata* groups in Santa Rosa National Park, Costa Rica.