# Habitat Utilization of Nonhuman Primates in a Forest of the Western Pando, Bolivia

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ABSTRACT. The authors carried out surveys on nine species of primates inhabiting the study area (338 ha), western Pando, Bolivia. They investigated how each of the primate species utilized four types of forest as its habitat. As a result, it was found that each species displayed its own manner of habitat utilization, and species specificities existed in the utilization of the forest.

## INTRODUCTION

Caucho trees (*Hevea brasiliensis*) and Brazil-nut trees (*Bertholletia excelsa*) occur at relatively high densities in the tropical forest of northern Bolivia. Large numbers of settlers engaged in rubber and Brazil-nut collection ('siringuero' and 'castañero') have lived in the forest since the rubber boom between the late 19th and beginning of the present century. They brought land under shifting cultivation ('chaco'), and the crop fields abandoned year by year have changed to secondary forest ('barbecho'), which extends widely showing various degrees of recovery. The natural forest also includes various types of forest, which differ in scenery.

For each species of primates occurring in northern Bolivia, the authors investigated the differences in utilization of the forest, the types of which were categorized into four and attempted to clarify the species specificities from the viewpoint of the forest utilization.

## STUDY AREA, PERIOD AND METHOD

The study area was located at Mucden (11°02′ S, 69°05′ W) about 35 km southwest of Cobija, Pando (Fig. 1). Mucden was formerly a depot point for rubber and Brazil-nuts collected in areas further inland and some families connected with the collecting services lived there. Now, however, only one family lives there by rubber collection and shifting cultivation. A driveway was built between Cobija and Mucden in December 1978.

The present study extended from 6th to 9th July, 1979 and from 12th July to 30th December, 1979.

The authors made intensive ecological surveys of *Callimico goeldii*, *Saguinus fuscicollis* and *Saguinus labiatus* over an area of 338 ha at Mucden (details reported separately). During each day of the surveys, the authors walked along the observation trails extending for 38.7 km in total, path for rubber collecting ('estrada') extending for 6.9 km and the driveway for 3.0 km, in order to plot the map locations where they encountered monkeys. They also recorded the number of monkeys encountered and attempted to identify the groups of monkeys encountered. Data collected by their field assistants, Messrs. EDILIO NACIMENTO, MAXIMILIANO FACUNDO and SATOSHI HASEGAWA, are also included in the present report.

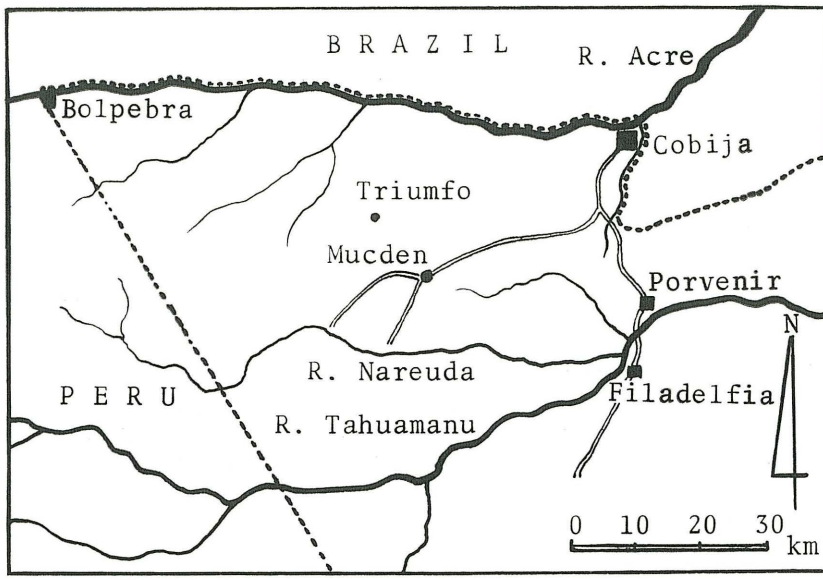


Fig. 1. Map of the study area.

## VEGETATION OF THE STUDY AREA

Roughly speaking, the secondary forest occurs at the center of the study area, while the natural forest occurs in its periphery. These two types of forest can each be categorized to two different types of vegetation, as follows:

*Monte alto*: This comprises typical Amazonian and undamaged tropical forest, where stretches of tall trees form the forest canopy with a height of about 30 m, low trees form one or two forest layers under the canopy with a height of about 10–20 m, and vines, shrubs and grass show scanty development. It is easy therefore for observers to pass through this type of forest without establishing observation trails. In the forest, which is not completely natural even though it is undamaged, paths for rubber collecting ('estradas') extend, and the undergrowth for 2–3 m around caucho trees has been cut out. Within a radius of 10–20 m of Brazil-nut trees also, the undergrowth has been cut out to collect Brazil-nuts. Rubber collection appears to shorten the life span of the caucho trees.

*Monte bajo*: This represents undamaged tropical forest. Tall trees occur at a lower density, probably due to the soil properties and drainage, and stretches of tall trees do not therefore form the forest canopy. Bamboo thickets, vines and shrubs grow thickly, so that it is difficult to pass through this type of forest unless trails are established. Although not so frequent as in the Monte alto, paths for rubber collecting and collection spots around Brazil-nut trees are established. A large patch of this type of vegetation occurs immediately northwestwards of the study area. The simple criterion for distinguishing this type of vegetation from Monte alto is that bamboos do not occur in the latter, whereas they grow thickly in Monte bajo. Due to fallen trees, a small limited area of the Monte alto is changed to Monte bajo-like vegetation. However, such vegetation is excluded here from the Monte bajo.

*Barbecho claro*: This comprises secondary forests which appeared in the abandoned crop fields of shifting cultivation or in the ruins of houses—Barbecho. Forest canopies with a height

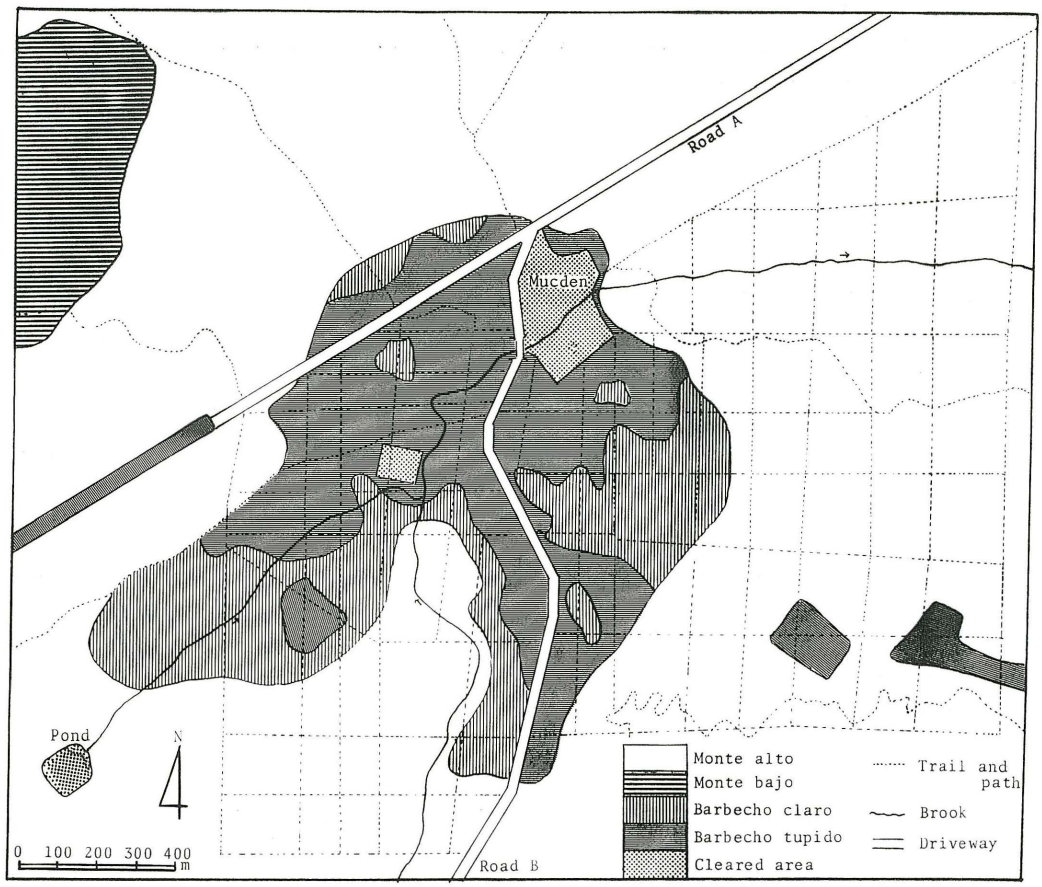


Fig. 2. Vegetation map of the study area.

of 10–20 m are formed, and therefore vines, shrubs and grass are less developed. Although not so easy as in the case of Monte alto, it is possible to pass through this type of forest without establishing trails. In addition to the above characteristics, the thickness and density of the hard-wooded trees and palm trees, and the variety of tree species make discrimination between Barbecho claro and Monte alto easy.

*Barbecho tupido*: This also comprises secondary forests which appeared as the Barbecho claro did. Forest canopies, however, are not formed completely, and therefore, bamboos, vines and grass grow rather thickly. This type of vegetation resembles Monte bajo as regards its scenery, but it is easy to distinguish between them based on the thickness of the undergrowth, the densities of *Pourouma* and *Cecropia* trees—which are pioneer species peculiar to the young secondary forest—, the densities of hard-wooded trees, etc.

As to the difference between Barbecho claro and Barbecho tupido, it can be said in principle that the former is older than the latter. However, according to the purposes of clearing (whether the land was used as a crop field by shifting cultivation only once or repeatedly, or whether the land was used as a crop field by shifting cultivation or for houses, or as pasture), the state of the land before clearing (whether it was Monte alto or Monte bajo) and many other factors, the ages of the Barbecho claro and Barbecho tupido do not necessarily cor-

respond to the years elapsed from commencement of their recovery to the present. The secondary forests occurring in the study area vary from forest of more than 50 years old to that of no more than 2–3 years old.

Figure 2 illustrates the distribution of the above four types of vegetation in the study area and its vicinity.

## RESULTS AND DISCUSSION

### Primates Inhabiting the Study Area

Nine species of ceboid monkeys and six species of callithricid monkeys occur in northern Bolivia (IZAWA & BEJARANO, 1981).

Six of these species of ceboid monkeys, i.e., *Cebus apella*, *Cebus albifrons*, *Saimiri sciureus*, *Pithecia hirsuta*, *Aotus trivirgatus* and *Callicebus moloch*, inhabit the study area. During the study period, the authors often heard vocalizations of *Alouatta seniculus* originating from the same direction, northwards of the study area, but this monkey never moved into the study area.

Three species of callitricid monkeys, i.e., *Saguinus labiatus*, *Saguinus fuscicollis* and *Callimico goeldii*[1], also inhabit the study area. *Cebuella pygmaea* occurs neither in the study area nor in its vicinity. This may be, as pointed out by IZAWA (1979b), because the study area is located in an inland area, on the watershed between the Río Acre in the north and the Río Tahuamanu in the south.

### Habitat Utilization of Primates

*Cebus apella*, *Cebus albifrons* and *Saimiri sciureus*: Each of these species of monkeys shows a strong omnivorous tendency and spends many hours of the day in foraging insects (IZAWA, 1975, 1979a; DEFLER, 1979; BALDWIN & BALDWIN, 1972; THORINGTON, 1967). Table 1 shows the relative amounts of the stomach contents of monkeys collected in the vicinity of the study area by settlers and by the authors.

During the study period, the authors encountered *C. apella* a total of 22 times, *C. albifrons* 12 times and *S. sciureus* 17 times. The places of the encounters are indicated in Figure 3. The dots and triangles on the map indicate the places of the first encounter of the day. When the

Table 1. Checklist of the stomach contents of wild-shot primates.

| | Specimens examined | Plant material | | | Insects | |
|---|---|---|---|---|---|---|
| | | Fruit | Flowers | Leaves | Ants | Insects excluding ants |
| *Cebus apella* | 8 | ++ | + | + | ++ | ++ |
| *Cebus albifrons* | 2 | ++ | + | + | + | + |
| *Saimiri sciureus* | 2 | ++ | + | − | − | ++ |
| *Pithecia hirsuta* | 2 | + | ++ | + | ++ | − |
| *Aotus trivirgatus* | 2 | ++ | − | + | + | + |
| *Callicebus moloch* | 3 | ++ | + | + | + | + |
| *Saguinus fuscicollis* | 7 | ++ | − | − | − | ++ |
| *Saguinus labiatus* | 4 | ++ | − | − | − | + |

++: Large quantity; +: small quantity; −: nil.

1) Although its taxonomic position has not been settled, the authors include this species in the Callithricidae for the purposes of the present paper.

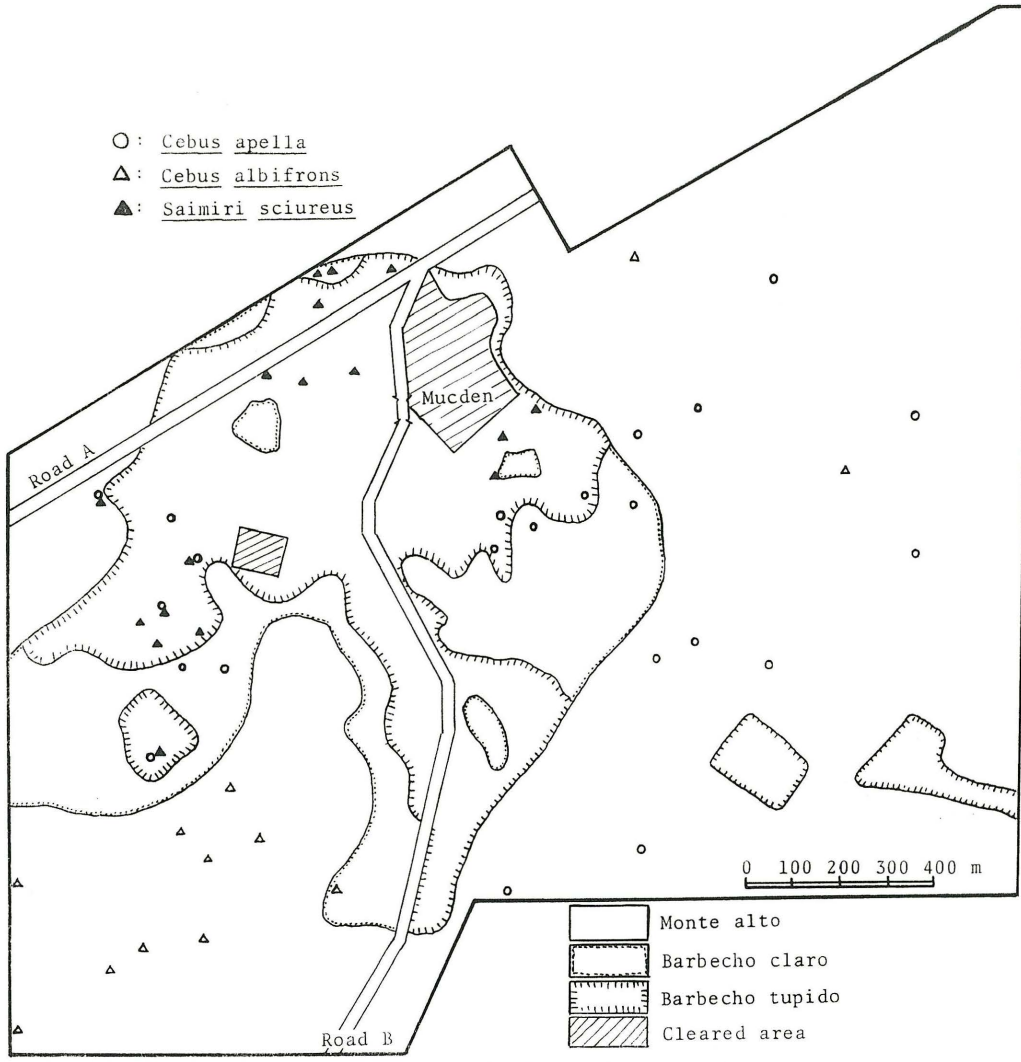


Fig. 3. Map of the encounters with *Cebus apella*, *Cebus albifrons* and *Saimiri sciureus*.

authors encountered an identical group of monkeys more than once in a day, the places of the second encounters onwards were disregarded since the movements of the group may have been affected by the first encounter with the observers.

As regards both *C. apella* and *C. albifrons*, simultaneous observations revealed that one group each was found to the east and to the west of Road B. Although it was not easy to count the number of individuals comprising a group completely, since both species feared man, the numbers of individuals in each of the groups counted by the authors were: 3.5 (1–11) individuals for the *Cebus apella* eastern group and 5.0 (2–8) for its western group, and 2.5 (1–4) individuals for the *C. albifrons* eastern group and 3.0 (2–4) for its western group. The home ranges of these four groups extend broadly to beyond the limits of the study area. The reason why the numbers of individuals in each of the groups are smaller than those in other regions (IZAWA, 1980; DEFLER, 1979) may be high hunting pressures in the study area.

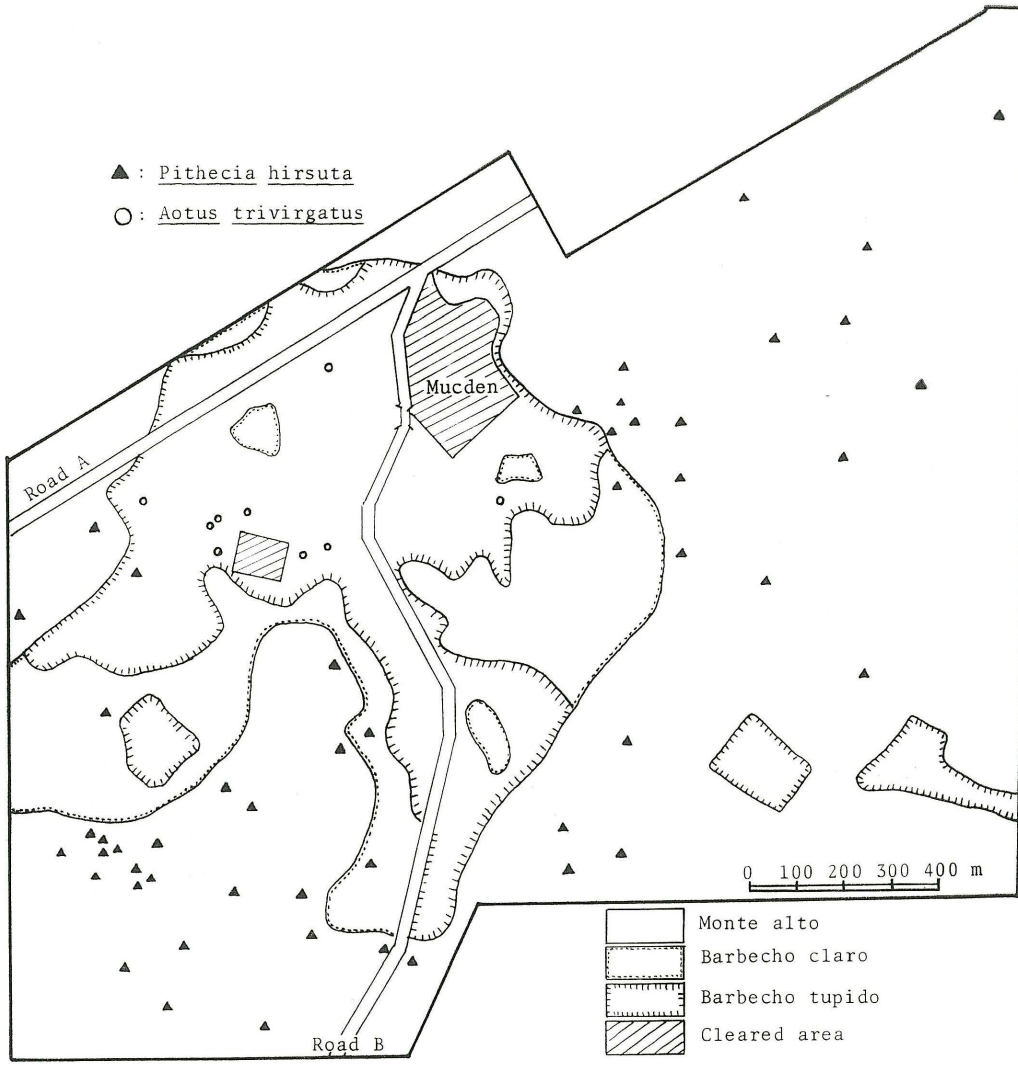


Fig. 4. Map of the encounters with *Pithecia hirsuta* and *Aotus trivirgatus*.

As for *S. sciureus*, the authors observed twice that a large group entered the study area from the west and retreated one and two days later, respectively. In the first case, they encountered the large group for three days in succession, and the individuals in the group amounted to a total of 38 at maximum. In the second case, the individuals were counted as 30 at maximum. The authors encountered another rather large group of *S. sciureus* to the north of where Road A meets Road B. The individuals in the group were counted as 14. The remaining 11 encounters were with small groups of individuals numbering 4.1 (2–9). In addition, the authors once encountered a large group of the monkeys in a large patch of Monte bajo outside the study area to the northwest. Based on the above encounters, it can be conjectured for *S. sciureus* that a large group of about 50 individuals lives in its core area located in Monte bajo to the northwest of the study area, from which smaller sub-groups separate and move in the study area from time to time.

Concerning *C. apella*, whenever the authors met the above large group of *S. sciureus*, *C. apella* always formed an interspecific association with the S. *sciureus*.

As can be seen from Figure 3, *C. apella* utilizes all of the four types of forest as its habitat.

*C. albifrons* utilizes Monte alto only, whereas *S. sciureus* utilizes Monte alto less frequently than *C. apella*, preferring to live in Barbecho tupido and probably Monte bajo.

*Pithecia hirsuta* and *Aotus trivirgatus*: Based on an investigation of the stomach contents of two individuals of *Pithecia hirsuta*, this monkey prefers to eat ants as well as fruit and flowers (Table 1). IZAWA (1975) has already described its ant-eating behavior. *A. trivirgatus* shows a strong omnivorous tendency (WRIGHT, 1978), which is supported by the results of investigations of the stomach contents of two individuals of this monkey.

During the study period, the authors encountered *P. hirsuta* a total of 51 times and *A. trivirgatus* 9 times (Fig. 4; the manner of plotting is as in Fig. 3). The home range of *P. hirsuta* is much smaller than that of the above three species of monkeys, being estimated at 25–40 ha per group. Three to four groups were found to the east of Road B and 2–3 groups to the west of it. The number of individuals in each of the groups was rather small, being 2–4. The authors encountered individuals which were thought to be solitaries. The number of individuals in a group averaged 1.9 (1–4) for the 51 encounters.

Concerning *A. trivirgatus*, which is a nocturnal monkey, neither the number of groups nor the details of their home ranges are known since no nocturnal observations were made. However, it is thought that the number of groups and their home ranges are similar to those of *P. hirsuta*. The number of individuals in a group averaged 2.1 (1–4) for the nine encounters.

As shown in Figure 4, *P. hirsuta* is a monkey which utilizes exclusively Monte alto as its habitat, whereas *A. trivirgatus* utilizes exclusively Barbecho tupido. However, because the authors were unable to make nocturnal observations on *A. trivirgatus*, it remains unknown whether or not this monkey also utilizes the other three types of vegetation. Nor can it be concluded only from the figure therefore that the monkey is an inhabitant of Barbecho tupido. In fact, one of the authors (IZAWA) has often observed the monkey in Monte alto in Colombia and Peru.

*Callicebus moloch*: This monkey also shows a strong omnivorous tendency (KINZEY, 1978), which is supported both by the results of an investigation of the stomach contents of three individuals of this monkey (Table 1) and by many direct observations. The monkey was the one most frequently encountered among all the species of ceboid monkeys observed during the study period, its encounters amounting to a total of 152 (Fig. 5; the manner of plotting is again as in Fig. 3).

Compared to *P. hirsuta*, the home range of *C. moloch* was even smaller, being estimated at 10–20 ha. Six to seven groups were found to the east of Road B and 5–6 groups to the west of it. The number of individuals in each of the groups was small, being 1–5. In both of the cases where the individuals in the group were counted as 5, the group contained a newborn baby. In all of the cases where the individuals in the group were counted as 4, the group contained one young animal which had not become completely independent of its mother. The number of individuals in a group averaged 2.5 (1–5) for the 152 encounters.

From Figure 5, it can be seen that *C. moloch* is a monkey which is dependent on Barbecho, especially Barbecho tupido. This monkey was also occasionally observed in Monte alto, but the occupied forest was always located in the vicinity of Barbecho. In all cases of observation,

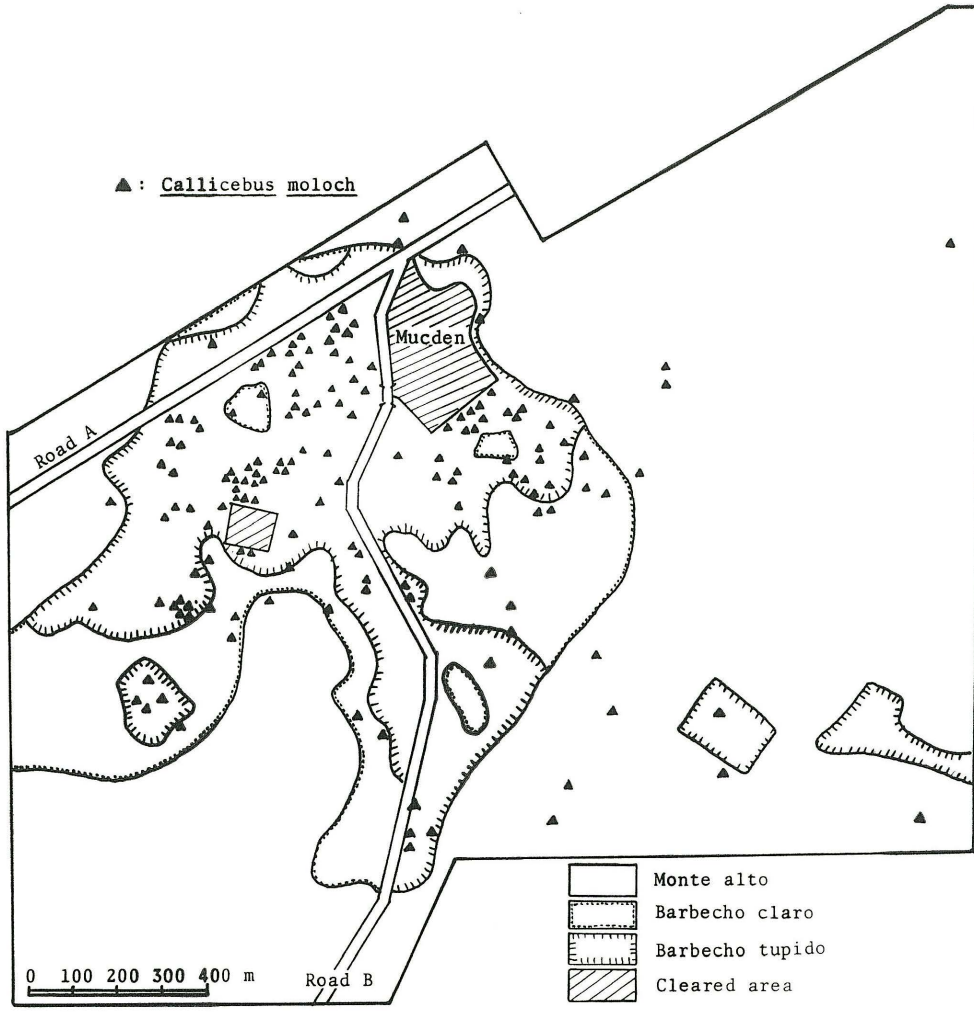


Fig. 5. Map of the encounters with *Callicebus moloch*.

the individuals of the monkey observed were considered to be members of a group which had its core area in Barbecho and had stepped out temporarily into Monte alto for foraging. Only once did the authors encounter *C. moloch* in the middle of Monte alto, in the north-eastern extremity of the study area. It is presumed that this exceptional encounter, involving only one individual, took place not because a group of the monkeys stayed there but because this individual, a young one, had become separated from its group and happened to move around. *C. moloch* is also known to occur in Monte bajo located in the northwestern part of the study area.

*Saguinus labiatus*, *Saguinus fuscicollis* and *Callimico goeldii*: Details of the food, group size and home ranges are reported separately in an article dealing with ecological surveys of the monkeys, the main purpose behind the present studies in the western Pando, Bolivia.

*S. labiatus* and *S. fuscicollis* occurred at relatively high densities in the study area and the

numbers of groups observed were about 20 and 15, respectively. The numbers of individuals in a group of these species of monkeys averaged about 5, and the size of their home ranges was 30–40 ha. Both of the monkeys fed mainly on insects and fruit.

As for *C. goeldii*, only one group inhabited the study area. The individuals of the group numbered 9 and the size of its home range was about 40 ha. This monkey also fed on insects and fruit.

Since the authors walked every day purposely to encounter these species of monkeys, the encounters with them are not plotted on maps like those for each of the ceboid monkeys. From the results of the daily surveys on foot, it can be said conclusively that (1) *C. goeldii* is dependent on Barbecho, especially Barbecho tupido, and this monkey was never observed going into Monte alto during the study period; and (2) both *S. labiatus* and *fuscicollis* utilize equally any type of vegetation. Concerning *S. labiatus*, however, it is presumed that this monkey utilizes Barbecho where *Pourouma* and *Cecropia* trees—its favorite fruit trees—occur at higher densities, whereas it utilizes Monte bajo less frequently since these trees occur at lower densities. This conclusion derives from the fact that the authors did not confirm the monkey's occurrence in a patch of Monte bajo during their two surveys outside the study area, nor could they confirm it in patches of typical Monte bajo during their surveys of the distribution of primates in the western Pando. If this conclusion is true, a difference in forest utilization must exist between *S. labiatus* and *S. fuscicollis*, since the latter utilizes any type of forest.

## CONCLUSION

Based on studies of the nine species of primates inhabiting the study area, the authors found differences in the types of forest which each of the species utilizes as its habitat—there was a tendency for forest utilization to be peculiar to each particular primate species. Besides this difference in forest types, there is also variability in vertical forest utilization among the primate species; in other words, there are differences in the actual forest layers which each of them utilizes as its habitat (TOKUDA, 1962; IZAWA, 1979b; YONEDA, 1981). According to the various combinations of forest types and forest layers, exquisite habitat segregation might be developed among primate species in Amazonian tropical forest, where many species of platyrrhine monkeys occur within the same localities. This is very important, as indicated by IZAWA (1979b) for *Callimico goeldii*, when one discusses the phylogenetic evolution of platyrrhine monkeys from the ecological viewpoint in relation to the geochronic transition of the vegetation of South America.

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