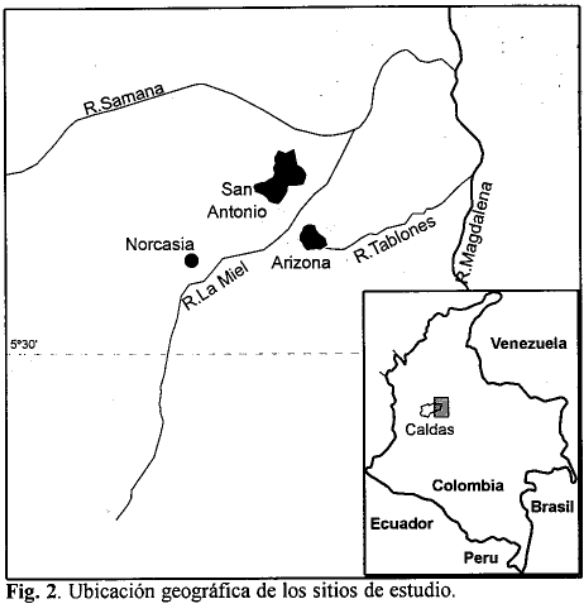

Fig. 2. Ubicación geográfica de los sitios de estudio.

de corredores que los comunican con fragmentos más pequeños facilitando el intercambio de individuos de *S. leucopus* entre poblaciones (factor fundamental en el mantenimiento de la variabilidad genética de la especie) parecen ser suficientemente adecuadas para sostener las poblaciones encontradas.

Lo anteriormente mencionado se complementa con el estudio de fotointerpretación del Municipio de La Dorada y nororiente del Municipio de Samaná, donde no existen otros fragmentos de igual tamaño y con las mismas condiciones, razón importante, a escala municipal, para conservar estos bosques. La existencia de poblaciones de otros mamíferos como *Ateles belzebuth brunneus*, *Cebus albifrons*, *Agouti paca*, *Dasyprocta* spp., *Felis* spp. (tigrillo), *Eira barbara*, *Atelocynus* cf. *microtis* entre otros, requiere de acciones de conservación urgentes como la ampliación de los parches de bosque y de los corredores de migración, además disminuir la presión ejercida por actividades humanas como la deforestación, la caza y la minería que actualmente ejercen gran presión sobre los últimos fragmentos de bosque encontrados en esta zona. El Valle del Magdalena es una zona de gran importancia biogeográfica, en él se encuentra localizado el refugio pleistocénico del Carare, actualmente no existen zonas protegidas y la presión ejercida por las actividades humanas reducen aceleradamente a un tamaño crítico los últimos fragmentos de bosque existentes, provocando a mediano plazo la extirpación de especies y para el peor de los casos la extinción de especies endémicas como *S. leucopus*.

Finalmente hay que destacar que es urgente realizar un análisis detallado sobre lo que permanece del área original de distribución de *S. leucopus* y a partir de la teoría de la fragmentacíon establecer más acertadamente la viabilidad de los fragmentos de bosque y de las poblaciones de *S. leucopus* que en ellos aún subsisten.

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Referencias

Andrade, G. I. 1990. Colombia: Megadiversidad o megaextinción? *Revista Ecologia* 5:4 - 10.

Emmons, L. H. y Feer, F. 1990. *Neotropical Rainforest Mammals. A Field Guide*. University of Chicago Press, Chicago.

Hernández-Camacho, J. y Cooper, R. W. 1976. The non-human primates of Colombia. In: *Neotropical Primates: Field Studies and Conservation*, R. W. Thorington, Jr. y P. G. Heltne (eds.), pp.35-69. National Academy of Sciences, Washington, D. C.

Hernández-Camacho, J. y Defler, T. 1983. Algunos aspectos de la conservación de primates no humanos en Colombia. In: *La Primatología en Latinoamérica*. C. Saavedra, R. A. Mittermeier y I. B. Santos (eds.), pp.67-97. World Wildlife Fund, Washington, D. C.

Rylands, A. B., Mittermeier, R. A. y Rodríguez-Luna, E. 1995. A species list for the New World primates (Platyrrhini): distribution by country, endemism, and conservation status according to the Mace-Lande system. *Neotropical Primates* 3(supl.): 113-160.

Some Observations on Primates in Paraguay

Although anecdotal recordings of primates in Paraguay have dated as far back as 80 years (Bertoni, 1914), the study of primate ecology and conservation was barely initiated fifteen years ago within this country. Most synecological studies were done by Jody Stallings (1984), who did an extensive amount of work in the Chaco. In 1982, Stallings and Mittermeier added a fifth species, the black-tailed marmoset (*Callithrix melanura*), to the country's nonhuman primate assemblage. Similar to the ranges of the night monkey (*Aotus azarae*) and dusky titi (*Callicebus moloch*), *Callithrix* is restricted to the Chaco (Stallings *et al.*, 1989), the region lying

west of the Paraguay River. While studying hunting patterns of Ache Indians, Hill and Hawkes (1983) collected data on brown capuchins (*Cebus apella*), the only Paraguayan primate restricted to the more tropical orient (east of the Paraguay River). The southern black howler monkey (*Alouatta caraya*) is the fifth species, common to both biomes of Paraguay.

The primary objective of the study described here was to obtain baseline information on the status and abundance of the five primate species in Paraguay subsequent to the earlier work of Stallings and others in the 1980's. Field work was carried out during 1989/1990. Anecdotal information on distribution, ecology, and behavior is included in the species accounts.

Methods

Data were collected from August 1989 to August 1990 using three methods: 1) walking along transects or through areas of varying extent to log recordings of primate groups seen; 2) interviewing locals and biologists familiar with the primates occurring within their geographic area; 3) driving along road transects of varying lengths to log recordings of wild primates seen. More surveys were done in the morning and during daylight hours than during the night; nocturnal surveys may have been unnecessary, as the only nocturnal species (*Aotus*) was detected during the day.

Departamento Boqueron, Paraguay (Chaco) was surveyed from September 1989 - August 1990. The I'guasu region (Paraná, Brazil and Misiones, Argentina) was surveyed in late January/early February 1990. The Curuguaty region of Departamento Canindeyu, Paraguay (Orient) was surveyed in early May 1990. The northern Paraguayan Chaco and southeastern Santa Cruz, Bolivia were surveyed in early July 1990.

Figure 1 shows the localities and regions mentioned in the text. New localities were identified by overlaying a reduction of Figure 1 onto the maps in Redford and Eisenberg (1992). Range increases comprised those localities beyond the previously documented distributions within the Chaco, as determined by the enclosed polygon of known localities.

Habitats

Habitats have been described elsewhere (e.g., Stallings *et al.*, 1989), but a brief description is provided as follows. The lower Chaco is primarily a vast palm savannah; historically a large body of water, and certain areas are still seasonally inundated. There is a cline from the middle Chaco to the upper Chaco: a low degree of stratification, dense and thorny foliage, and low canopy height in the middle Chaco to more stratified vegetation, a greater abundance of broadleaf species, and a higher canopy in the upper Chaco (Brooks, 1992).

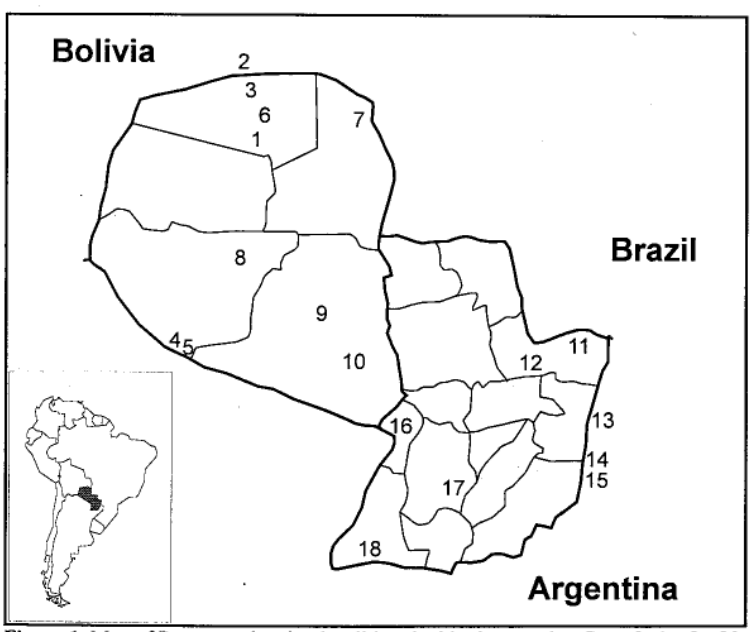

Figure 1. Map of Paraguay showing localities cited in the text. 1 - Cerro León; 2 - 30 Km South of Cerro San Miguel/Pt. 6; 3 - Est. San José; 4 - Est. Madregadta; 5 - Est. Ferrér; 6 - Agua Dulce; 7 - Bahía Negra; 8 - Northeastern Boquerón; 9 - Ruta trans-Chaco and Río Monte Lindo; 10 - Lower palm Chaco; 11 - M'baracayú Region; 12 - Curuguatí; 13 - I'taipu Dam; 14 - Paraná, Brasíl; 15 - Misiones, Argentina; 16 - Outskirts of Asuncíon; 17 - Y'bicuí National Park; 18 - South of Pilar.

The Orient is more mesic and tropical than the Chaco, which harbors more xeric forest. The southwestern Orient is more typical of a seasonally inundated area. Near the Río Paraná, eastern Paraguay and adjacent Brazil and Argentina are extensions of what once formed the vast, continuous tract of South Atlantic rain forest. There are reports that woolly spider monkeys (*Brachyteles*) inhabited this area 25 years ago (K. Benirschke, pers. comm.). Further west in the interior of the Paraguayan Orient, wet and dry seasons are more defined than in the rain forest adjacent to the Paraná river basin.

Black-tailed Marmoset (*Callithrix melanura*)

Stallings and Mittermeier (1982) first described the occurrence of this species in Paraguay. Marmosets were reported to be rare in the Defensores del Chaco National Park, not occurring south of Cerro Leon (southern park boundary),

and increasing in abundance north of Agua Dulce (northern park boundary) (S. González, pers. comm.). *Callithrix* occurs in sympatry with *Callicebus* and *Aotus* at Estancia San José (Sr. Insua, pers. comm.), which is further north, along the Bolivian border. Reports indicate that population densities increase towards the Bahia Negra region, immediately west of the Río Paraguay, which comprises the southwestern Pantanal. Most likely, this species dispersed westward into the Chaco along tributaries of the Río Paraguay. Although these reports are not necessarily bona-fide they provide an idea of the distribution of this species, which is naturally restricted to the northeastern portion of the Chaco.

Night Monkey (*Aotus azarae*)

This species inhabits areas in the lower palm savannah (P. Scharf, pers. comm.). *Aotus* is relatively scarce in Departamento Boqueron, where maximum density estimates are 1 ind./15 km² (F. Colman, pers. comm.). The major threat in the central Chaco is habitat destruction for cattle ranching. Gaps between edges of fragmented forest are increasing to the point where adjacent forest plots may be too far apart for the monkeys to disperse. The absence of dispersal corridors in the dry Chaco, where riverine gallery forest is lacking, results in isolated populations. In the northern Chaco where development is less extensive, populations appear to be stable.

A group of three individuals at Estancia San José increased the known range to the north in Paraguay (Brooks, 1993). This group comprised two adults (presumably male and female) and a single juvenile, seen foraging in the morning at 0820 hrs. Diurnal foraging has been previously documented for *Aotus* (Fernandes, 1993; Wright, 1983, 1985). The sky was completely overcast when the group was observed, which may have caused them to continue foraging through the morning from the previous night. Another possible explanation may involve metabolic constraints. The group was observed in early July during the Paraguayan winter, when the average temperature is approximately 20°C. It may be more energetically efficient for the monkeys to be active during the day. Theories regarding how *Aotus* became nocturnally-active are: 1) to avoid predation by large diurnal raptors and 2) to avoid direct interspecific competition with larger cebids (Wright, 1985). In regions such as the Chaco however, where large diurnal raptors are rare, competing species of cebids are absent, and great-horned owls (*Bubo virginianus*) (a nocturnal predator large enough to predate upon *Aotus*) are present, night monkeys may shift back to diurnal foraging (Wright, 1985). In agreement with Wright's hypothesis, the largest sympatric diurnal raptor observed at Estancia San José was a savannah hawk (*Heterospizias meridionalis*), possibly not large enough to be a predator of night monkeys, although only two days were spent there and rarer species may have been undetected. The largest sympatric cebid was *Callicebus*, which would not be considered a direct competitor, being no larger than *Aotus*. Great horned owls were not encountered at Estancia San José, but one individual was heard 30 km west at Point 6.

Upon encountering the group of night monkeys, the male was about 40 m from the female and juvenile. The male fled immediately. Locomotor skills of the juvenile were not yet well-developed, and it clung to an intersection of branches where it hid for several minutes before going deeper into the forest. During the time the juvenile was hiding, the female piloerected into an arch-posture (Wright, 1978) before fleeing.

Dusky Titi (*Callicebus moloch*)

Like *Callithrix*, the range of *Callicebus* is restricted to northeastern Paraguay albeit over a larger area (see Stallings *et al.*, 1989). Using conservative sample sizes, maximum densities of familial groups were estimated at 5 groups/km² at Cerro Leon, 2.5 groups/km² south of Cerro San Miguel, and 1 group/km² at Estancia San José. Stallings *et al.* (1989) provided an estimate of 6.2 groups/km² at Agua Dulce, which is near the center of the three aforementioned areas. Regrettably, time constraints precluded an opportunity to sample Agua Dulce. Stallings *et al.* (1989) indicated that the high density of *Callicebus* at Agua Dulce was due to the more botanically diverse and higher canopied vegetation of the region. In addition, our methods of estimating density may have differed. However, if the average density of Cerro Leon, Cerro San Miguel, and Estancia San José (2.83 groups/km²) is indicative of the present density at Agua Dulce, *Callicebus* may be below minimum population levels for stability.

The presence of *Callicebus* at Point Six increases the known range of localities in Paraguay to the north (Brooks, 1993), and perhaps to the east in Bolivia (Anderson *et al.*, 1993). Duet calling as described by Robinson (1977) was heard at 1020 hrs. at Cerro Leon, 0815 hrs. south of Cerro San Miguel, and 0730 hrs. at Estancia San Jose.

Brown Capuchin (*Cebus apella*)

At a study site approximately 40 km north of Curuguaty, Canindeyu, Hill and Hawkes (1983) compared shotgun versus bow hunting of Ache indians during 165 hunting days between March and July of 1980. Shotgun hunters called for a bow when hunting *Cebus*, killing 7.8 kg total at an average rate of 0.02 kg/man-hour of hunting.

This comprised only 1% of all game taken, the lowest mammalian biomass in the diet. In contrast, bow hunters killed 484.2 kg total, at an average rate of 0.14 kg/man-hour of hunting. This comprised 25.8% of all game taken, the highest species biomass in the diet.

The species exists locally in the Y'bicui National Park, and is abundant in the M'baracayu reserve (C. Yahnke, pers. comm.). However, a survey in the Curuguaty region of Departamento Canindeyu, just 40 km south of Hill and Hawkes' (1983) study site, revealed no evidence of the occurrence of *Cebus*, a mere ten years following their study. With the presence of a major military station in the area, hunting by soldiers is a major threat to all species. Another potential threat is logging. Although the surveys took place within tracts of primary rain forest, chainsaws could be heard. Thus, forest fragmentation and disturbance likely serve equally as threats. The majority of the Orient is experiencing a tremendous surge of development due to rapidly increasing human populations.

Brief surveys in the I'guasu region of Paraná, Brazil and Misiones, Argentina revealed no trace of *Cebus* either. The construction of the I'taipu dam on the Río Paraná, 30 km north of the I'guasu River, has most likely had a serious affect on *Cebus* populations, although the Itaipu captive breeding facility has been sucessfull in breeding individuals rescued from the flood (F. Carbonar, pers. comm.).

Southern Black Howler Monkey (*Alouatta caraya*)

Although prime howler monkey habitat was found in the I'guasu region of Paraná, Brazil and Misiones, Argentina, *Alouatta* were not encountered. However, howler monkeys were found in some prohibitive neighborhoods, where hunting would not be considered a threat, outlying the capital of Asunción (D. Espinoza, pers. comm.). Thus it appears that *Alouatta* are rare in areas where extensive human 'traffic' is consistent regardless of habitat type, but can apparently survive in secondary habitat as long as the area is expansive, naturally landscaped, and with at most minor hunting pressure. The species is said to be common along the lower Río Paraná, west of Encarnación and south of Pilar (P. Scharf, pers. comm.).

Alouatta is rare in the northern Chaco, where it is infrequently encountered (S. Gonzalez, pers. comm.). A female was reported in the southern Chaco at the interchange of the Ruta-Trans Chaco and the Río Monte Lindo (R. Brooks, pers. comm.) in early February. This species probably dispersed westward via riverine gallery forest into the lower Chaco from the Orient.

Conclusions

Primates of the Paraguayan region appear to be threatened in one area or another. Depending upon the species, these major threats include a naturally restricted range, habitat development for cattle ranching, expanding human populations, and human disturbance. Hope remains with recently increased interest in species conservation in Paraguay.

Future studies are recommended in order to obtain a better understanding of the status of the Paraguayan primates and the threats to their populations, specifically involving surveys using the same methods as those employed by Stallings *et al.* (1989). Areas of particular interest include Tte. Encisco, Agua Dulce, Chovoreca, and Y'bycui.

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References

Anderson, S., Riddle, B. R, Yates, T. L. and Cook, J. A. 1993. Los mamíferos del Parque Nacional Amboro y la region de Santa Cruz de la Sierra, Bolivia. *Spec. Publ. Mus. Southwest. Biol.* 2: 1-58.

Bertoni, A. 1914. Catalogos sistemáticos de los vertebrados del Paraguay. *Desc. Fis. y Econ. Paraguay* 59: 1-83.

Brooks, D. M. 1992. Notes on group size, density, and habitat association of the pampas fox (*Duscicyon gymnocercus*) in the Paraguayan Chaco. *Mammalia* 56(2): 314-316.

Brooks, D. M. 1993. Distribution, habitat association, and factors determining assemblage composition of mammals in the Paraguayan Chaco. M.S. thesis, Texas Tech University.

Fernandes, M. E. B. 1993. New field records of night monkeys, Genus *Aotus*, in northern Brazil. *Neotropical Primates* 1(4): 6-8.

Hill, K. and Hawkes, K. 1983. Neotropical hunting among the Ache' of Eastern Paraguay. I n: *Adaptive Responses of Native Amazonians*, R. B. Hames and W. B. Vickers (eds.), pp.139-188. Academic Press, New York.

Redford, K. H. and Eisenberg, J. F. 1992. *Mammals of the Neotropics Vol. 2: The Southern Cone.* University of Chicago Press, Chicago.

Robinson, J. G. 1977. Vocal Regulation of Spacing in The Titi Monkey *Callicebus moloch.* Ph.D. dissertation, University of North Carolina.

Stallings, J. R. and Mittermeier, R. A. 1982. The black-tailed marmoset (*Callithrix argentata melanura*) recorded from Paraguay. *Am. J. Primatol.* 4(2): 159-163.

Stallings, J. R. 1984. Conservation and status of Paraguayan primates. M.A. thesis, University of Florida, Gainesville.

Stallings, J. R. 1989. Status y conservación de primates en el Paraguay. In: *La Primatología en Latinoamérica*, C. J. Saavedra, R. A. Mittermeier, and I. B. Santos (eds.), pp.133-151. World Wildlife Fund-US, Washington, D. C.

Wright, P. C. 1978. Home range, activity pattern, and agonistic encounters of a group of night monkeys (*Aotus trivirgatus*) in Peru. *Folia Primatol.* 29: 43-55.

Wright, P. C. 1985. Howling by the light of the moon: why a day monkey has become a night monkey. In: *The Encyclopaedia of Mammals,* D. R. Macdonald (ed.), pp.364-365. George Allen and Unwin, London.

Emigration of a Masked Titi Monkey (*Callicebus personatus*) from an Established Group, and the Foundation of a New Group

Introduction

The territorial behavior of primates is frequently associated with a monogamous or nuclear family pattern of social organization (Clutton-Brock and Harvey, 1977; Wittenberger and Tilson, 1980). In most cases such groups are composed of the adult pair, which is the reproductive unit, and their offspring of different ages, as is the case in titi monkeys.

The number of members in a titi monkey family varies from two, after group founding, up to six, before a group or individual separation occurs (Kinzey, 1981; Pinto *et al.*, 1993). Under normal conditions, an infant is born each year in a titi monkey family (Kinzey, 1981). As a result a subadult monkey has to leave his group every year or, after the founding a new group, within a four to five year period.

In this paper, I report on the separation of a subadult titi monkey from his family group as well as the founding of a new group. Two different models of emigration and group founding will be discussed: the gibbon- and the titi model. Finally, I will show that territorial shifting, in the sense of Easley and Kinzey (1986), is not the only way for monogamous primates to secure new territories for their offspring.

Methods and Study Site

The study site was a forest segment of about 100 ha at the Estação Experimental Lemos Maia (ESMAI), a scientific field station of the local Cocoa Cultivation Authority - CEPLAC. It is located Una, south Bahia, Brazil (15° 18' S, 39° 06' W). Details of the study site and vegetation types have been described elsewhere (Müller, 1995; Rylands, 1982).

Data were collected on the daily ranging pattern of two nuclear family groups *of Callicebus personatus melanochir.* Radio telemetry was used to accompany the groups (Müller, 1994). The first group (Group I) was observed between August 1992 and December 1992. Data on the behavior of the second group (Group II) were collected after the emigration and the founding of the new group in December 1992. The observations took place up to September 1993. Data were collected during 101 complete days by scan-sampling for ten seconds at five minutes intervals (Altmann, 1974). Measuring, mapping and calculation of the home range of Group I and II have been described by Müller (1995).

Results

At the beginning of 1992, Group I consisted of six animals: the adult pair, two subadults and two juveniles (Fig. 1). The adult male, a subadult and a juvenile subsequently disappeared, and the Group consisted of three animals when the study was begun. In December 1992, the subadult male of this group, which had a radio transmitter, emigrated. He founded a new group together with an adult female and her infant, which was called Group II. The emigration was not observed in detail, because observations were made only one day before and after the emigration of the subadult male. Before the male left his group he was evidently neither