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The Impact of Cropping on Wild Populations of *Saguinus mystax* and *Saguinus fuscicollis* in Peru

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A transect census technique was used to estimate the population densities of *Saguinus mystax* and *Saguinus fuscicollis* at two sites in Peru. Cropping of these two species had occurred five years before the census at one site and two years before at the other. The populations of *S. mystax* at both sites had recovered completely from cropping, and the relationship between *S. mystax* and *S. fuscicollis* had not been altered at one site and had been reversed in favor of *S. mystax* at the other.

Key words: ***Saguinus mystax, Saguinus fuscicollis*, cropping, transect censusing, population recovery**

INTRODUCTION

Nonhuman primates play a vital role in biomedical research, and more than 30 species, most of them wild-caught, are presently being used in biomedical testing [Anonymous, 1982]. The survival of these primate populations in the wild is of great concern in the face of this continuing demand for research, which has made significant contributions to advances in human health. One way to reduce the drain on wild populations is to establish self-sustaining captive breeding colonies. Another way is to develop sustained-yield cropping strategies for free-ranging populations. Sustained-yield (SY) or cropping is a management procedure in which a crop can be taken on a regular basis without forcing the population into decline [Caughley, 1976]. A major consideration for any cropping operation is the standing crop biomass of the available population [Field, 1979]. Since SY strategies have not yet been developed for any primate species [Anonymous, 1982] the question remains, Are primates a resource that can be managed for the benefit of the primates, the forest, other animals, and humans?

As part of the Primate Project in Peru (AMRO-3171) *Saguinus mystax* and *Saguinus fuscicollis* were cropped from Fundo Los Angeles in 1976–77 and Caserio Santa Cecilia in 1980. No subsequent cropping of these species was done at either of these sites. Here we report the results of a census during June and July, 1982, at these two sites. Our objectives were the following: (1) to determine the effects of the previous cropping at Los Angeles and Santa Cecilia on the populations of *S. mystax*

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and *S. fuscicollis*; (2) to compare the population densities of *S. mystax* and *S. fuscicollis* at the time of the 1982 census with those at the time of cropping; (3) to compare the recovery capabilities of *S. mystax* populations in areas where entire groups were removed with those in areas where only the juvenile members of the groups were removed; (4) to compare the relationship between *S. mystax* and *S. fuscicollis* in terms of relative population density before the cropping took place and at the time of the 1982 census, and determine whether or not this relationship had changed; and (5) to determine the impact of forest clearing activities, associated with the oil palm project, on the primate populations of Santa Cecilia.

MATERIALS AND METHODS

Study Sites

The geographical area and its relationship to Iquitos and the location of the two study sites are shown in Figure 1. Both study sites were located on the Rio Maniti, a southern tributary of the Amazon which discharges its waters 50 km downstream (east) of Iquitos.

Fundo Los Angeles (Fig. 1) is located approximately 45 km from the junction of the Maniti and the Amazon. Scattered hamlets occur along the Maniti, with several of them having been established as recently as one to two months before the census was begun. Fundo Los Angeles consists of three houses belonging to one family of six people. There are many small subsistence plots along the river, and the area is under heavy hunting pressure. The study area consisted primarily of forest above

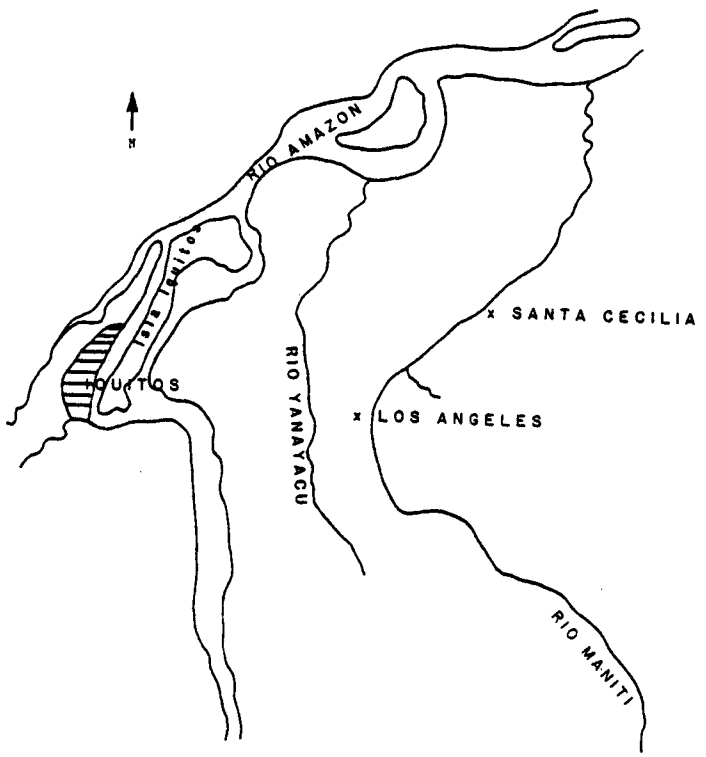

Fig. 1. The geographical location of the census areas.

flood level but was interspersed with *Mauritia* palm swamps. For a more detailed description of the forest and surrounding area, see Soini [1982].

Caserio Santa Cecilia (Fig. 1) is located 22 km from the mouth of the Maniti and is the site of Emdepalma, a project organized to raise African oil palm trees. If completed, the project will cover 210,000 ha. The project presently employs more than 70 laborers, many of whom live in the 38 houses, which make up the village of 200 people. There are presently 14 ha of forest cleared and planted with oil palm trees (Fig. 2). Clearing of other areas is occurring, including a 30-m-wide access road that traverses the eight 2-km trails that were used for censusing. Approximately one-half of the study area consisted of floodplain (Fig. 2). The rest of the area was high ground covered by a very heterogeneous forest.

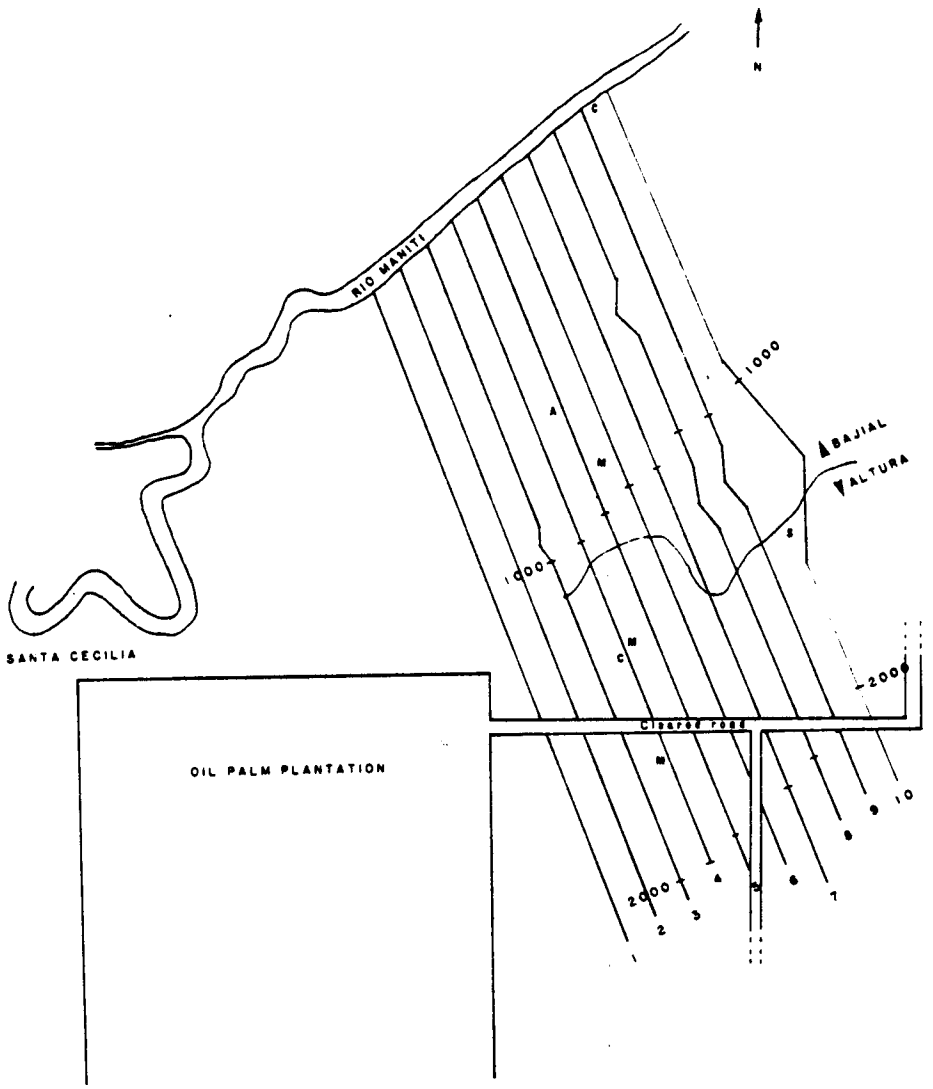

Fig. 2. Map of the Santa Cecilia census area. Distance is in meters. M, *Saguinus mystax*; C, *Cebuella pygmaea*; S, *Saimiri sciureus*; A, *Aotus trivirgatus*.

Census Techniques

We used the census techniques used by Freese et al. [1982] in Peru and Bolivia. Two groups of two observers each moved single file through the forest using existing trails or trails specifically created for censusing. This is known as "transect censusing." The area censused was calculated by multiplying the linear distance traveled by the "auditory/visual field," an estimate of the width from the observer's path that a particular primate species can be detected. For example, our auditory/visual field was 200 m; ie, we were able to detect primates within 100 m of either side of our census trail. The animals were usually first detected by their vocalizations or by sounds of their progress through the trees. These two species (*S. mystax* and *S. fuscicollis*) are particularly vocal and therefore are well suited for this type of censusing. Once the animals were detected, the observers left the trails to obtain group counts and to determine distance from the detection point.

Before any censusing was done, each trail was cleared of any obstruction and measured by pacing. The same individual (Francisco Cahuaza T.) paced all of the trails. Brightly colored plastic strips were placed at 50-m intervals, and distances were scratched into nearby trees or stakes to serve as points of reference for locating observed groups of primates. All trails were censused more than once. Repeat censuses were necessary to increase accuracy. On some days, no groups were seen; yet the very next day, as many as five or six groups might be observed on the same transect. Repeat censuses of the same transect increase the probability that whatever primates are present will be detected.

Transect censusing was done on foot and by canoe at Los Angeles and on foot at Santa Cecilia. At Los Angeles, three marked trails were created using existing hunter's trails, for a total of 16.1 km (Fig. 3). At Santa Cecilia, ten 2-km parallel trails (spaced at 100-m intervals) had been cut in July 1980. These were reopened, paced, and marked with plastic strips for our use. However, trails 1 and 2 could not be used during the 1982 census because they were underwater. Figure 2 shows the locations and individual distances of the trails which made up the total distance of 17.2 km of trails at Santa Cecilia.

A majority of the censusing was done between the hours of 0700 and 1200. On a few days, censusing began as early as 0600 and lasted until 1430, depending on the length of the trail being censused and the weather conditions.

RESULTS

We located most of the groups by auditory means (78%, N = 81) rather than by visual contact. Figure 4 shows the number of groups and their distances from the trail when first detected.

Los Angeles

A total of 191 km was censused during 14 days. Sixteen different groups of *S. mystax* (Fig. 3) and 11 groups of *S. fuscicollis* were estimated to occur in the 3.2-km^2 area that was censused.

The average group size for *S. mystax* was 5.9 with a range of 2–8. The average group size for *S. fuscicollis* was 7.1 with a range of 4–12. The densities for *S. mystax* and *S. fuscicollis* are presented in Table I. This cropping site had recovered to at least the 1976–77 density levels. In fact, there were actually more *S. mystax* individuals per km^2 in 1982 than in 1976–77.

During the first downriver census (6,000 m), seven groups of *S. mystax*, one group of *S. fuscicollis*, two mixed groups of *S. mystax* and *S. fuscicollis*, and ten groups of *Cebuella pygmaea* were located. On the first upriver census (5,000 m), two groups of *S. fuscicollis*, two mixed groups of *S. mystax* and *S. fuscicollis*, five *Cebuella*

pygmaea groups, and one group of *Saimiri sciureus* were located. On the second downriver census (6,000 m), one *S. mystax* group, one *S. fuscicollis* group, and five mixed *S. mystax* and *S. fuscicollis* groups were located. During the second upriver census (2,000 m), only one *Cebuella pygmaea* was found.

The majority of group detections during river censuses were by auditory means only. We seldom saw any individuals. Weather conditions or the fact that the groups were in other parts of their home ranges away from the river may account for the different results of the river censuses.

Santa Cecilia

A total of 85 km was censused during nine days. Three groups of *S. mystax* and two groups of *S. fuscicollis* were estimated to occur in the 1.7-km^2 area that was censused (Fig. 2). All three groups of *S. mystax* were seen on the same day by the same observer team.

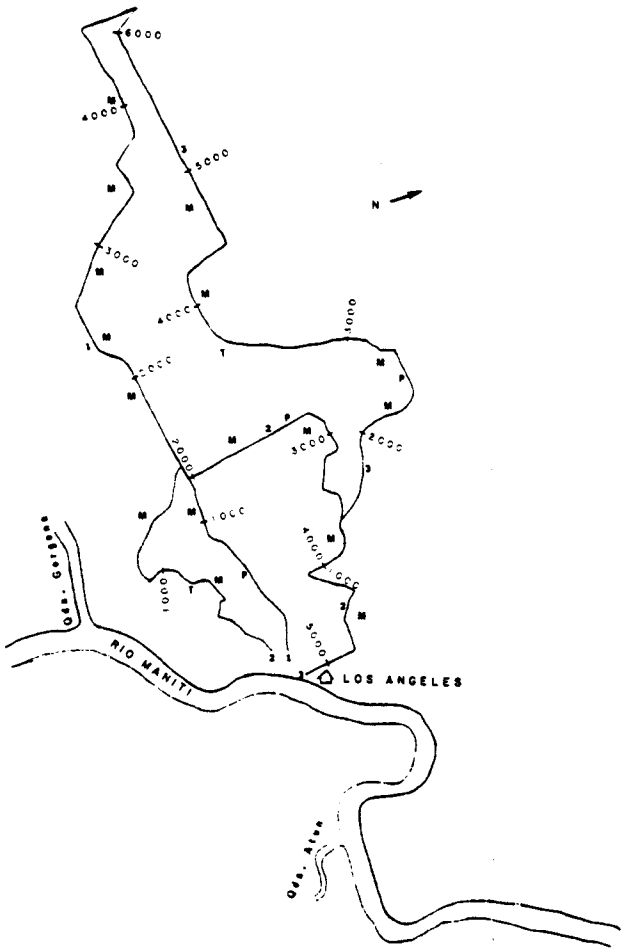

Fig. 3. Map of Los Angeles census area. Distance is in meters. M, *Saguinus mystax*; P, *Pithecia* sp.; T, *Callicebus torquatus*.

The average group size for *S. mystax* was 5.4 with a range of 2–10. The average group size for *S. fuscicollis* was 9.0 with a range of 5–13. The densities for *S. mystax* and *S. fuscicollis* are presented in Table I. For this site, populations of both *S. mystax* and *S. fuscicollis* had completely recovered to precropping levels in only two years. And, just as at Los Angeles, there were more *S. mystax* individuals per square kilometer postcropping than precropping.

Hunting was intensive at both Los Angeles and Santa Cecilia and no *Alouatta*, *Ateles*, or *Cebus* were seen or heard at either site. Other primate species observed at Los Angeles were *Pithecia* sp. and *Callicebus torquatus*. At Santa Cecilia *Aotus trivirgatus* and *Saimiri sciureus* were observed.

The number of animals removed from Los Angeles in 1976–77 and from Santa Cecilia in 1980 was substantial. A total of 186 *S. mystax* [Soini, 1981a] and 27 *S. fuscicollis* [Soini, 1981b] were removed from Los angeles and 365 *S. mystax* and 186 *S. fuscicollis* were removed from Santa Cecilia [Tapia, 1980].

DISCUSSION

The primary reason we were able to use 100 m as our auditory field was the fact that the vocalizations of these two species are unique and can be easily heard over 100 m. Thorington [1972] suggested that tamarin vocalizations might be useful for locating and censusing them. Our detection distance would have been much smaller had we been limited to visual rather than auditory and visual means. We feel comfortable with the 200-m detection field; we arrived at this distance (based on actual distances in the field, Fig. 4) before doing the density calculations.

Our population estimates for *S. mystax* and *S. fuscicollis* are within recorded group size and densities (Table II). The results of Ramirez (in press) are of particular

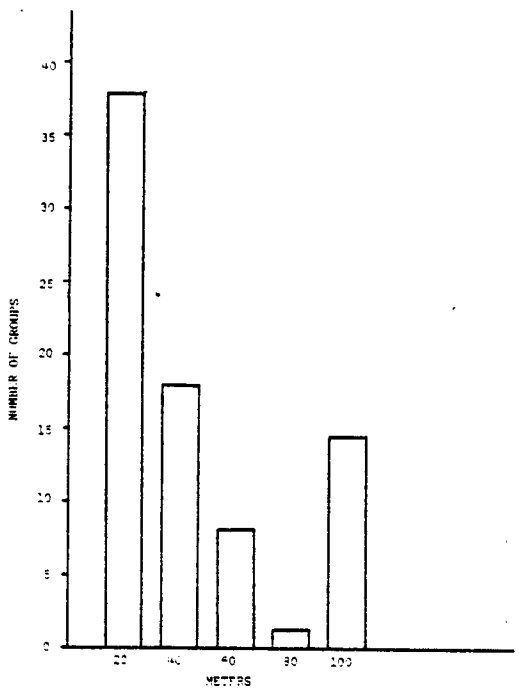

Fig. 4. The distance from the census trail that groups were detected.

interest because she reported pre- and postcropping densities of *S. mystax* for another area of Peru. Her population of *S. mystax* had not completely recovered three years after cropping.

Cropping of *S. mystax* and *S. fuscicollis* at Los Angeles and Santa Cecilia had little or no detrimental effect on wild populations of *S. mystax*. Obviously the cropping in 1976–77 and 1980 occurred over a much larger area than was censused during this study. But the fact that more *S. mystax* than *S. fuscicollis* were removed did not have any apparent negative effect on the recovery capabilities of *S. mystax*. In fact, the data suggest that *S. mystax* have actually benefited from the cropping. Even though many more *S. mystax* than *S. fuscicollis* were removed, the present proportion of *S. mystax* to *S. fuscicollis* favors *S. mystax*, both in terms of groups/km^2 and individuals/km^2 (Table I). In fact, the relationship has been reversed at Los Angeles, there being 6.5 more *S. fuscicollis*/km^2 than *S. mystax* in 1976–77 and 5.4 more *S. mystax*/km^2 than *S. fuscicollis* in 1982. In other words, *S. mystax* have fully recovered to precropping numbers, while *S. fuscicollis* may have actually decreased, despite the fact that almost seven times as many *S. mystax* were removed. Possibly the presence of *S. mystax* at a certain population density is critical for *S. fuscicollis* to return to precropping population size, and the *S. fuscicollis* populations in those areas where *S. mystax* were cropped lag slightly behind the *S. mystax* population in recovery.

The method of cropping (removing entire groups or releasing the alpha pair) apparently made no difference in the recovery ability of *S. mystax*. There was no detectable difference in the present population densities owing to the two different removal techniques. In fact, the *S. mystax* postcropping population densities at both sites has surpassed the precropping densities (Table I).

It is likely that in any area that is cropped, animals from the surrounding regions or from those groups that escape cropping provide the individuals that migrate into the vacated habitats. Very possibly, mortality decreases in the surrounding areas, and/or a greater number of breeding females produce infants which survive to reproductive age in those locations where *S. mystax* are cropped. Ramirez [in press] found that immigration played only a minor role and that increased reproductivity and decreased infant mortality were the main factors in the recovery of a cropped population of *S. mystax*.

Primate densities are normally reported as number of groups or individuals per km^2. Unfortunately, this procedure probably results in a less-than-accurate picture of the true situation. At both Los Angeles and Santa Cecilia, it was clear that the habitat varied greatly from one area to another along the transects just as it did throughout the forest. In reality, there were areas where the group and individual

TABLE I. A Comparison of Pre- and Postcropping Densities

	Saguinus mystax		*Saguinus fuscicollis*	
Year	Groups/km^2	Individuals/km^2	Groups/km^2	Individuals/km^2
Los Angeles				
1976–77	5.0[a]	21.5[a]	4.7[b]	28.0[b]
1982	5.0	29.5	3.4	24.1
Santa Cecilia				
1980[c]	1.5	8.0	1.5	10.5
1982	1.8	9.7	1.2	10.8

[a]Soini [1981a].
[b]Soini [1981b].
[c]Tapia [1980].

TABLE II. Group and Individual Densities of *Saguinus mystax* and *Saguinus fuscicollis* in Peru, Bolivia, and Colombia

Species	Group size	Group density (per km^2)	Individual density (per km^2)	Reference
S. mystax	2–6	5–7	—	Castro and Soini [1977]
S. mystax[a]	-	6.3	32.1	Ramirez [in press]
S. mystax[b]	-	4.7	24.1	Ramirez [in press]
S. fuscicollis	1–9	0.8–4.9	4.8–22.9	Freese et al. [1977, 1982]
S. fuscicollis	2–10	4–5	—	Castro and Soini [1977]
S. fuscicollis	4–11	—	—	Neville et al. [1976]
S. fuscicollis	-	4.7	26	Ramirez [in press]
S. fuscicollis	5–20	—	—	Hernandez-Camacho and Cooper [1976]
S. fuscicollis	9	—	—	Pook and Pook [1982]

[a]Precropping densities on the Rio Yarapa in Peru.
[b]Postcropping densities on the Rio Yarapa in Peru.

densities were much higher or lower than the average figure given above. For example, the density along trail 2 at Los Angeles was 7.8 groups/km^2 and 46.0 individuals/km^2, whereas the density along the first 2,000 m of trail 2 was 10.0 groups/km^2 and 59.0 individuals/km^2. The habitat clearly affects population density.

Another example of habitat impact on population density is clearly demonstrated in a comparison of the densities at the two sites. Both *S. mystax* and *S. fuscicollis* are present at much lower densities at Santa Cecilia than at Los Angeles (Table I). Both sites are disturbed to a similar degree. However, more than one-half of the censused forest at Santa Cecilia was "bajial" (swamp forest); ie, water is present during most of the year (Fig. 2). Comparatively, the forest at Los Angeles is mostly "altura" (high forest, no standing water) or "aguajal" (flooded during only part of the year and characterized by palm trees). Thus, the tree species are very different at the two sites as well as between the different forest types at each site. These tree species differences and the different kinds of plant material they provide as potential food for the primates likely account for the very different population densities at the two sites.

It is clear from these data that the censused populations of *S. mystax* and *S. fuscicollis* were able to recover from cropping. Apparently, these primates can support cropping on a regular basis, at least at the level experienced here. The length of time needed to recover from cropping probably depends on the characteristics of each site, but three to five years is indicated.

CONCLUSIONS

1. The cropping at both sites has had little negative effect on the populations of *S. mystax*, which have returned to or surpassed precropping levels.

2. There was no detectable difference between the recovery capabilities of those areas where the entire group was removed and those areas where only the juveniles were removed.

3. The cropping of *S. mystax* may have had a slight negative impact on the population density of *S. fuscicollis* or at least on the recovery capabilities of *S. fuscicollis*.

4. Forest clearing at its present levels has had no apparent impact on the tamarin population in the censused area at Santa Cecilia.

5. The only other primates seen at either site were *Pithecia*, *Callicebus*, *Saimiri*, and *Aotus*.

6. Regular cropping of *S. mystax* can be established at various sites. Sustained-yield cropping of a scale conducted at Los Angeles and Santa Cecilia can occur every three years contingent on further monitoring.

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