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Current Status and Threats to *Lagothrix flavicauda* and Other Primates in Montane Forest of the Región Huánuco

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Abstract: We report on the current status and threats to *Lagothrix flavicauda* and other primates that inhabit montane forest of the Región Huánuco; an area that has been little explored with regard to its primate fauna and other mammals. During 618 km of transect walks in June–July 2014 and September–October 2014, we encountered 47 groups of five primate species, the most common being *Alouatta seniculus* (15 groups) and *Lagothrix flavicauda* (13 groups). We also observed four groups of *Aotus* sp. in the Miraflores census site. *Lagothrix flavicauda* was seen only in the microbasin of the Río Chontayacu, and *Ateles chamek* in the upper Río Huallaga. The primates were living in patches of primary and remnant forest surrounded by farmland and pasture except in Chontayacu, where the forest is still dense and extensive. Of the three species with complete counts, group sizes were largest for *L. flavicauda* (mean 13.6 ± 7.8 , $n = 5$) and smallest for *A. seniculus* (mean 5 ± 3.5 , $n = 11$). Population densities were highest for *L. flavicauda* (20.8 ind./km²) and lowest for *Sapajus macrocephalus* (2.7 ind./km²). Deforestation for agriculture and cattle ranching and hunting are the major threats to the survival of these primates. *Sapajus macrocephalus* and *Cebus yuracus* were the most affected by these threats, particularly in the Río Chinchao microbasin,

Key Words: Primates, Andean montane forest, *Lagothrix flavicauda*, threats

Introduction

There are still areas in the Peruvian Amazon where we have little or no information concerning the primate communities occurring there. They are mostly forested areas present in the north and east, near the borders with Ecuador and Brazil, respectively, and premontane and montane forests (500–2800 m) of the Cajamarca, Huánuco, Junín and Ayacucho regions. These regions are remote and difficult to reach, so that information about primates there is scarce and mostly limited to the Peruvian yellow-tailed woolly monkey (*Lagothrix flavicauda*) and the Andean night monkey (*Aotus miconax*). *Lagothrix flavicauda*, one of the world's 25 most endangered primates (Mittermeier *et al.* 2012), is endemic and lives in cloud forest. There have been some studies of its behavior and feeding (Leo Luna 1980, 1982, 1984; Cornejo 2008), geographical distribution (Shanee *et al.* 2008; Shanee 2011), and activity budget and behavior patterns (Shanee and Shanee 2011a), but very little is known about the use of forest strata and home range. The presence of *L. flavicauda* in the premontane and montane forests of the Región Huánuco

was unknown until 2005. Till then it was believed that it was restricted to the cloud forests of the regions of San Martín, La Libertad and Amazonas (Shanee *et al.* 2008). Aquino (2006) observed a group near the village of Tingo de Uchiza in the Región Huánuco during a wildlife inventory in the Provincia de Tocache, between the Río Chontayacu and the limit with the Provincia de Tocache, Región San Martín. Shanee (2011) considered that its range included the montane forests from the limits of the Provincia de Tocache (Región San Martín) south to probably the Río Magdalena in the Región Huánuco, but Aquino and Ramos (2010) suspected that their distribution would extend further south to include the premontane and montane forests surrounding the ríos Monzon, Patuy Rondos and Chinchao, including Carpish near Tingo María and Pampamarca near the limit with the Región Pasco. For our study area, a few reports indicated the presence of *L. flavicauda*, the red howler (*Alouatta seniculus*), and *Aotus miconax* in premontane forests of the Región Huánuco, but there was no information on their population density, geographic distribution, group size, and food resources and the floristic composition of the forests where they live. The lack of information

regarding these aspects motivated us to carry out this study, the main purpose of which was to determine the current status of *L. flavicauda* and other primates and their habitats, and assess the threats facing the wildlife and the forests there, predictably from agricultural expansion, cattle ranching and floriculture. We hoped to determine the geographic distribution, abundance and population density, and group sizes of *L. flavicauda* and other primates in the south of the Región Huánuco. Here we present the results of a survey conducted between June–July and September–October, 2014, in three sectors of montane forest of the Región Huánuco. The results will be used to recommend areas for the conservation of primates and other wildlife, and to promote environmental education, especially in the villages surrounding the study area.

Methods

Study area

The Región Huánuco is in central Peruvian Amazonia. The forests of this region, including the premontane and montane forest, are being cut down for agriculture, timber extraction, cattle ranching and floriculture. There is some subsistence hunting, and monkeys, particularly *Cebus yuracus* and *Sapajus macrocephalus*, are shot as crop-raiders, when they enter maize plantations to eat the unripe corn called “choclo.” We identified three sectors for the surveys, each with two census sites (Fig. 1). Table 1 gives their geographic coordinates and elevation, and indicates the extent of human disturbance. The sampling sectors were as follows.

The microbasin of the Río Chontayacu, including the forest of the Río Bardales near the village of Cocalito on the left bank, and the Río Yanajanca on the right bank. At both census sites the forests were moderately disturbed, mainly due to timber extraction and subsistence hunting. Deforestation for agriculture is increasing with the construction of the Uchiza-Huacrachuco road.

The microbasin of the Río Chinchao, including the forests of the villages of San Pedro de Carpish and Ñaupamarca, on each bank of the Río Chinchao. This sector is dominated by remnant forest patches, and is being deforested for agriculture and floriculture.

The upper basin of the Río Huallaga, on the right bank; the forests surrounding the villages of Miraflores and Santa Ana. The forests along both sides of the Río Alto Huallaga are

extensively deforested for cattle ranching and the construction of a hydroelectric dam.

Transect censuses

For transect censuses we used the paths and trails of the loggers, farmers and hunters. Each transect was walked two or three times. The censuses were conducted from 07:00 to 16:00 h. Two teams of two observers walked simultaneously along two different transects, with an average speed of 0.5 km/h. Each time a primate group was detected, the recorded the following information: group size (when possible); perpendicular distance from the transect of the first individual seen; height (in the forest stratum); activity at the moment of detection; presence of juveniles and infants; and vegetation type. Censuses were conducted on the transects in both directions (inbound and outbound). Taking into account the physiographic characteristics of the montane forest, we walked 618 km—267 km in the microbasin of the Río Chontayacu, 131 km in the microbasin of the Río Chinchao, and 220 km in the upper basin of the Río Huallaga; equivalent to 876 census hours (Table 2).

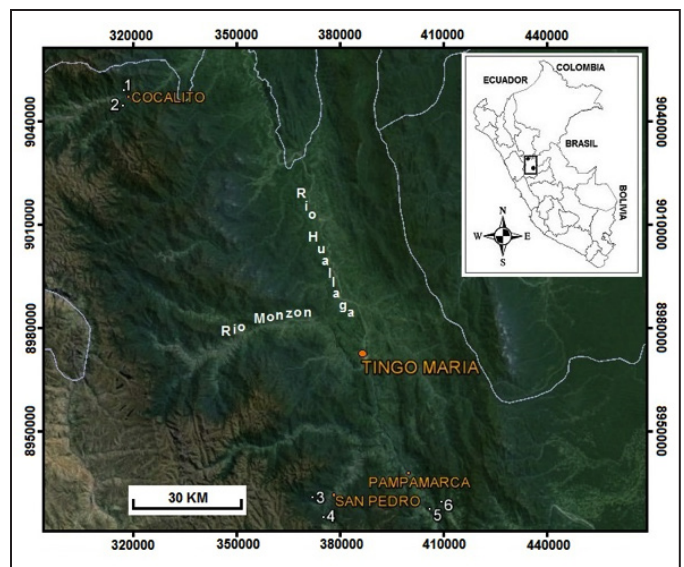


Figure 1. Location of sampling sectors and census sites in the montane forest of the Región Huánuco. Río Chontayacu microbasin (sites 1 and 2), Río Chinchao microbasin (sites 3 and 4), and Río Alto Huallaga (sites 5 and 6).

Table 1. Census sites in the montane forest of the Región Huánuco.

Sampling sectors	Census sites*	Coordinates (UTM)	Altitude (m.a.s.l.)	Degree of human disturbance
Río Chontayacu microbasin	Bardales (1)	320373/9048536	1495	Moderate
	Yanajanca (2)	317857/9042750	1620	Moderate
Río Chinchao microbasin	Ñaupamarca (3)	379516/8930750	1883	Very high
	Carpish (4)	381695/8929094	2418	Very high
Río Alto Huallaga	Miraflores (5)	510182/8929316	1862	High
	Santa Ana (6)	413452/8929274	1496	High

*Numbers in parenthesis correspond to the points in Figure 1.

Floristic composition of the montane forests

In the Chontayacu sector, we demarcated a strip of 20×1 m (coordinates: 315472/9048057; elevation: 1480 m) and a plot of 50×10 m (coordinates: 331061/ 9051625; elevation: 1051 m). In the Chinchao sector we demarcated two strips, one of 50×1 m (coordinates: 381376/8929884; elevation: 2369 m) and the other of 30×1 m (coordinates: 381287/8930057; elevation: 2231 m). The botanical samples were prepared for the herbarium following the methodology of Judd *et al.* (1999). They were identified in the Herbario Amazonense (AMAZ) of the Universidad Nacional de la Amazonía Peruana and Museo de Historia Natural of the Universidad Nacional Mayor de San Marcos, with the help of the keys of Spichiger *et al.* (1989, 1990), Gentry (1993), Vásquez (1997), Ribeiro *et al.* (1999), and others. The botanical specimens were deposited in the herbarium of the Instituto de Investigaciones de la Amazonía Peruana (IIAP).

Data analysis

Group size was determined on fully counted groups, excluding dependent infants. Each time we contacted the primates, we counted the number of individuals and, when possible, also the adults (males and females), juveniles and infants. Due to the small number of sightings (<30) for *L. flavicauda* and other species, we used the formula suggested by Burnham *et al.* (1980) for calculation of densities: $D = N / 2dL$, where *D* is the density (groups/km²), *N* the number of sightings, *L* the accumulated transect length, and *d* the mean perpendicular distance to the transect. Except for *C. yuracus* and *S. macrocephalus*, the population density was then obtained by multiplying *D* by mean group size. For *C. yuracus* and *S. macrocephalus*, we considered the highest group sizes counted, which were 11 and 9, respectively. To obtain relative abundances, we calculated the number of sightings per

10 km of transect walked. Sightings and density calculations for *A. seniculus*, *C. yuracus* and *S. macrocephalus* are based on the total 618 km of transect. Calculation for *L. flavicauda* and *A. chamek*; are based on 267 km and 220 km, respectively, because *L. flavicauda* does not occur in the forest of the upper Río Huallaga, and was not confirmed to occur in Capish and Ñaupamarca (sector of the Río Chinchao microbasin), while *A. chamek* apparently does not occur in the microbasins of Chontayacu and Chinchao. Why these species are absent from these areas is unknown.

Results

Forty-seven groups of five primate species were observed during the survey. We also encountered four groups of *Aotus* sp. (probably a new species) in forests surrounding the village of Miraflores, on the right bank of the Río Huallaga when we were not surveying. The range of this species probably extends south to the montane forests of the Región Pasco. Most commonly seen were *A. seniculus* (*n* = 15) and *L. flavicauda* (*n* = 13); the fewest sightings were of the tufted capuchin *S. macrocephalus* (Table 3).

Of the five species recorded during the census, *L. flavicauda* (Fig. 2) was observed only in the Bardales and Yanajanca sites around the village of Cocalito in the Río Chontayacu microbasin, and *A. chamek* (Fig. 3) was seen only in Miraflores and Santa Ana sites located in the upper Río Huallaga basin. *Alouatta seniculus* was the only species observed in all census sites. *Cebus yuracus* and *S. macrocephalus* were not observed in Carpish and Ñaupamarca (Sector Chinchao), although people affirmed that both occur there and are pests raiding corn and other crops. They also told us that *L. flavicauda* occurs in this sector and is seen most frequently from December to February, coinciding with the production

Table 2. Distance traveled and census hours by census site in the sampling sectors.

Sampling sectors	Census sites	Transect length (km)	Effort – time censused (hours)
Río Chontayacu microbasin	Bardales	116	179
	Yanajanca	151	231
Río Chinchao microbasin	Ñaupamarca	62	87
	Carpish	69	107
Río Alto Huallaga	Miraflores	151	185
	Santa Ana	69	87
Total		618	876

Table 3. Primate species and numbers of groups registered in the sampling sectors.

Species	Sampling sectors			Total
	Chontayacu	Chinchao	Alto Huallaga	
<i>Lagothrix flavicauda</i>	13			13
<i>Ateles chamek</i>			8	8
<i>Alouatta seniculus</i>	6	5	4	15
<i>Sapajus macrocephalus</i>	2		3	5
<i>Cebus yuracus</i>	4		2	6
Total	25	5	17	47

of wild fruits, particularly *Cecropia* sp. “tacones.” People at Carpish described it accurately and a short expedition should be carried out to confirm or discard this possibility. For now we consider the Río Alto Huallaga as the limit of their geographic distribution southward, but it will be important still to

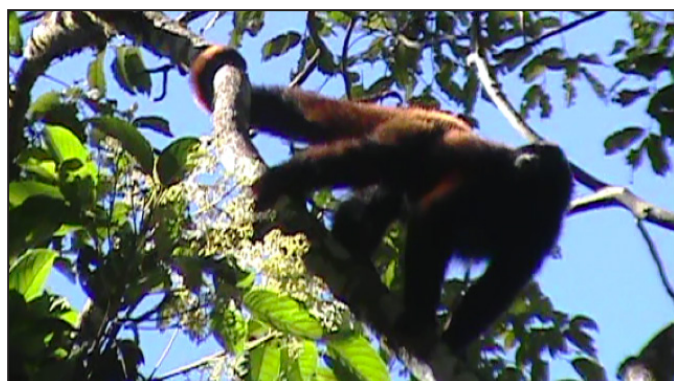


Figure 2. Adult Peruvian yellow-tailed woolly monkey (*Lagothrix flavicauda*) in the Yanajanca census site, sector Chontayacu.

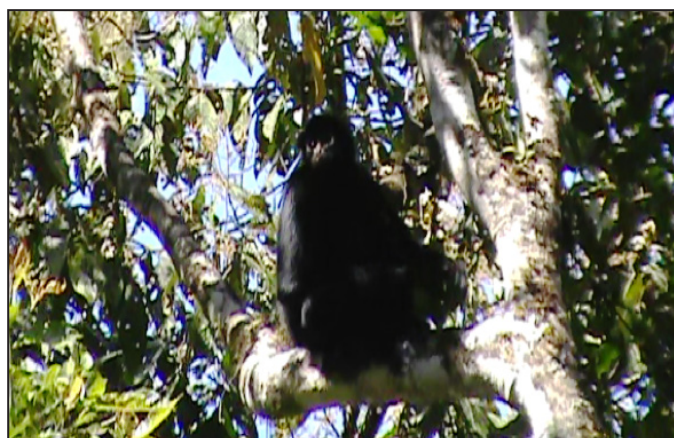


Figure 3. Adult black-faced black spider monkey *Ateles chamek* in Santa Ana, Sector Río Alto Huallaga.

explore the microbasins of the ríos Magdalena and Monzón to confirm or discard the presence of this species in this part of the Región Huánuco.

With regard to *L. flavicauda*, eight of the 13 registered groups were observed in the Yanajanca forest (right bank of Río Chontayacu), the others in the Bardales forests on the left bank of this river near to the village of Cocalito (Table 4). In Yanajanca, we also saw an adult female, who we followed for two hours hoping to find the other members of her group. She did not contact a group during this time, however, so she may have been dispersing. She did not show any behavior indicating she was lost; on the contrary, she just foraged and rested. We observed others groups at elevations of 1572 m to 2045 m along with *A. seniculus*, *S. macrocephalus* and *C. yuracus*.

Dependent infants were observed in some groups of the five recorded species. There were one to four infants in most of the *L. flavicauda* groups (Table 4). Infants were on the mother's back, except in two cases where they were nestled between the mother's neck and chest. This would indicate that the reproductive season of *L. flavicauda* and the other primates that inhabit these montane forests would be from January to April. Juveniles observed would correspond to births of the previous year.

Alouatta seniculus was the only species registered in Carpish, in the Río Chinchao microbasin. Groups were seen in patches of primary and residual forests there. In Miraflores and Santa Ana (Río Alto Huallaga), the primates were inhabiting patches of primary forest on the steep and rugged slopes. In Yanajanca and Bardales (Río Chontayacu), however, *L. flavicauda* and other primates were found in relatively dense and extensive primary forests.

The variation in group size in the three species with complete counts is similar to those recorded for these species in other parts of the Peruvian Amazon with physiography varying from montane (*L. flavicauda*) to sub-montane (*A. chamek* and *A. seniculus*) (Table 5). We were unable to determine

Table 4. Groups of *Lagothrix flavicauda* observed in the Río Chontayacu microbasin.

Groups	Size	Census sites	River bank	Coordinates (UTM)	Altitude (m.a.s.l.)	Observations
1	>3	Yanajanca	Right	317853/9042935	1572	
2	6	Yanajanca	Right	317966/9043238	1682	+1 infant
3	>12	Yanajanca	Right	318004/9043342	1705	+2 infants
4	>8	Yanajanca	Right	317850/9042934	1575	+1 infant
5	13	Yanajanca	Right	317951/9043170	1661	+2 infants
6	>8	Yanajanca	Right	317852/9042932	1572	+1 infant
7	23	Yanajanca	Right	317874/9042994	1579	+4 infants
8	6	Yanajanca	Right	317176/9043791	2045	
9	>6	Bardales	Left	320302/9048832	1673	
10	>7	Bardales	Left	320993/9048710	1823	
11	20	Bardales	Left	321174/9048894	1760	+3 infants
12	>1	Bardales	Left	321265/9049032	1781	
13	>5	Bardales	Left	321268/9049036	1783	+2 infants

the average group size for *C. yuracus* and *S. macrocephalus* because they were so skittish, persecuted as they are for their crop raiding. The primates in Bardales, near to the village of Cocalito, suffer from subsistence hunting. In forests near the road (2 to 3 km), groups of *L. flavicauda* and *A. seniculus* were small and fearful. In more distant forests (3 km or more from the road), groups were larger and easier to observe. In Yanajanca, all groups seen were quite tame and tolerant of humans watching them. Dependent infants were not considered in the group-size count, but as many as three infants were observed in some *L. flavicauda* groups there. The number of sightings and the population densities were higher for *L. flavicauda* and *A. chamek*, than for the other species, notably *S. macrocephalus* with only 0.08 groups/10 km and 2.7 indiv./km² (Table 6).

In the microbasin of the Río Chontayacu, between Cocalito and San Antonio de Padua, the floristic composition was composed of trees of 18–25 m height, with some emergents up to 30 m, and with trunk diameters at breast height largely in the classes of 10 to < 20 m (36.7 %) and 20 to < 30 m (5.0 %). There, the most representative life forms were trees and shrubs, along with epiphytic plants, mainly mosses, on the stems. We recorded 75 species (Table 7); of which, *Pseudolmedia macrophylla* (Moraceae), *Himatanthus sucuuba* (Apocynaceae) and *Nealchornea yapurensis* (Euphorbiaceae) were the most representative of the middle stratum and canopy, while the understorey was populated mainly by *Cyathea* sp. (Cyatheaceae). Notable among the epiphytes and hemiepiphytes were *Lomariopsis latipinna* (Lomariopsidaceae) and *Columnea* sp. (Gesneriaceae), and among the lianas *Arrabidaea* sp. (Bignoniaceae) and *Ficus pertusa* (Moraceae).

In Carpish, the vegetation was composed of trees 15 m tall, with some emergents up to 20 m. Trunks and branches were laden with epiphytes. In contrast to Chontayacu, we recorded only 35 species, indicating the extent of disturbance in these forests (Table 7). *Ferreyranthus excelsus* (Asteraceae), *Cavendishia punctata* (Ericaceae) and *Podocarpus oleifolius* (Podocarpaceae) are among the most representative species of the middle stratum and canopy, while in the understorey there are many *Baccharis* sp. (Asteraceae), *Diplazium* sp. (Dryopteridaceae), *Gaultheria* sp. (Ericaceae) and *Miconia* sp. (Melastomataceae). Among the epiphytes and hemiepiphytes were *Stenospermation killipii* (Araceae), *Pitcairnia* sp., *Tillandsia* sp. (Bromeliaceae) and *Epidendrum* sp. (Orchidaceae), and among lianas and climbing plants *Clusia minor*, *Clusia* sp. 1 (Clusiaceae), *Dioscorea* sp. (Dioscoreaceae) and *Manettia* sp. (Rubiaceae).

Deforestation is the main threat to the survival of primates and other wildlife in the areas we surveyed. The forest is cut for agriculture and cattle ranching, most extensively in the Alto Huallaga and Chinchao sectors (Figs. 4 and 5), currently less so in Chontayacu, but deforestation will undoubtedly increase in the near future with the improvement of the Uchiza-Huacrachuco road. Deforestation is also related to illegal commercial logging in the microbasin of the Río Chontayacu (Fig. 6). Forest burning is another threat. Fires are used by the Andean people to improve the quality of the pasture and soil, and to reduce costs in the maintenance of good pasture for the cattle. Wildfires affect not only the shrubby thickets and pasture, but also the primary forest.

In the study area there are two types of hunting: (1) to reduce crop raiding and (2) for subsistence. People shoot

Table 5. Group sizes of primates encountered during transect surveys.

Species	Group size		Number of groups		Group size range in other areas
	Mean $\pm$ SD	Range	Total	With complete group count	
<i>Lagothrix flavicauda</i>	13.6 $\pm$ 7.8	6–23	13	5	3–19 ^a
<i>Ateles chamek</i>	10 $\pm$ 6.2	3–15	8	2	8–17 ^b
<i>Alouatta seniculus</i>	5 $\pm$ 1.9	3–9	15	11	4–8 ^b
<i>Sapajus macrocephalus</i>		>11	5		7–11 ^b
<i>Cebus yuracus</i>		>9	6		6–13 ^b

^a La Esperanza: Shanee and Shanee (2011).

^b Urubamba and Tambo: Aquino *et al.* (2013).

Table 6. Sightings rates and population density estimates for the study area.

Species	Mean detection distance [m]	Total length of transect walks [km]	# of sightings/10 km of transect walk	Population density	
				Groups/km ²	Ind./km ²
<i>Lagothrix flavicauda</i>	16	267	0.5	1.53	20.8
<i>Ateles chamek</i>	12	220	0.36	1.5	13.5
<i>Alouatta seniculus</i>	12	618	0.24	1	5
<i>Sapajus macrocephalus</i>	14	618	0.08	0.3	3.3
<i>Cebus yuracus</i>	10	618	0.1	0.5	4.5

Table 7. Floristic composition of Chontayacu and San Pedro de Carpish montane forest.

Family	Species	Habit*	Montane forest (ind./plot)	
			Chontayacu	San Pedro de Carpish
Anacardiaceae	<i>Astronium</i> sp. 1	T	1	
	<i>Mauria ferruginea</i>	T		1
	<i>Tapirira guianensis</i>	T	1	
Apocynaceae	<i>Himatanthus sucuuba</i>	T	3	
Araceae	<i>Monstera</i> sp. 1	H He	1	
	<i>Philodendron</i> sp. 1	H He	1	
	<i>Philodendron</i> sp. 2	H He	1	
	<i>Stenospermation amomifolium</i>	H He	1	
	<i>Stenospermation killipii</i>	H He		1
Arecaceae	<i>Ceroxylon</i> sp. 1	De	1	
Araliaceae	<i>Oreopanax</i> sp. 1	Sh		1
Asteraceae	<i>Ageratina</i> sp. 1	Sh		1
	<i>Baccharis</i> sp. 1	Sh	1	2
	<i>Baccharis trinervis</i>	Sh		1
	<i>Chromolaena laevigata</i>	Sh	1	
	<i>Ferreyranthus excelsus</i>	Sh		4
	<i>Munnozia hastifolia</i>	Sh	2	
	<i>Schistocarpha eupatorioides</i>	H		1
	<i>Vernonanthura patens</i>	Sh	2	
	<i>Vernonia</i> sp. 1	Sh	1	
Begoniaceae	<i>Begonia bracteosa</i>	H		1
	<i>Begonia parviflora</i>	Sh		1
	<i>Arrabidaea</i> sp. 1	L	1	
Bromeliaceae	<i>Guzmania</i> sp. 1	H Ep	1	
	<i>Pitcairnia</i> sp. 1	H Ep		2
	<i>Tillandsia</i> sp. 1	H Ep		1
Burseraceae	<i>Dacryodes</i> sp. 1	T	1	
	<i>Protium altsonii</i>	T	1	
	<i>Tetragastris panamensis</i>	T	2	
Cecropiaceae	<i>Cecropia sciadophylla</i>	T	1	
	<i>Coussapoa</i> sp. 1	T	1	
	<i>Pourouma bicolor</i>	T	1	
Chloranthaceae	<i>Hedyosmum</i> sp. 1	Sh		1
Chrysobalanaceae	<i>Licania</i> sp. 1	T	1	
Clusiaceae	<i>Chrysochlamys ulei</i>	T	1	
	<i>Clusia minor</i>	L		1
	<i>Clusia</i> sp. 1	L		1
	<i>Marila</i> sp. 1	Sh	1	
Commelinaceae	<i>Dichorisandra ulei</i>	H	1	
Cyatheaceae	<i>Cyathea</i> sp. 1	De	3	
Cyclanthaceae	<i>Asplundia</i> sp. 1	H He	1	
	<i>Cyclanthus bipartitus</i>	H	1	
Cyperaceae	<i>Oxycaryum cubense</i>	H	1	
Dioscoreaceae	<i>Dioscorea</i> sp. 1	Cp		1

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Table 7. continued

Family	Species	Habit*	Montane forest (ind./plot)	
			Chontayacu	San Pedro de Carpish
Dryopteridaceae	<i>Cyclodium meniscioides</i>	H Ep	1	
	<i>Diplazium</i> sp. 1	H		2
Ericaceae	<i>Cavendishia punctata</i>	Sh		3
	<i>Gaultheria</i> sp. 1	Sh		2
Euphorbiaceae	<i>Croton</i> sp. 1	T	1	
	<i>Hevea guianensis</i>	T	1	
	<i>Hyeronima oblonga</i>	T	1	
	<i>Mabea occidentalis</i>	T	2	
	<i>Nealchornea yapurensis</i>	T	3	
	<i>Sapium glandulosum</i>	T	1	
Fabaceae	<i>Dussia</i> sp. 1	T	1	
Flacourtiaceae	<i>Casearia arborea</i>	Sh	1	
	<i>Casearia commersoniana</i>	Sh	2	
Gesneriaceae	<i>Columnnea</i> sp. 1	H Ep	2	
Lauraceae	<i>Nectandra</i> sp. 1	T		1
	<i>Nectandra</i> sp. 2	T		1
	<i>Pleurothyrium</i> sp. 1	T	1	
Lecythidaceae	<i>Eschweilera bracteosa</i>	T	1	
Liliaceae	<i>Bomarea</i> sp. 1	H		1
Lomariopsidaceae	<i>Elaphoglossum</i> sp. 1	H		1
	<i>Lomariopsis latipinna</i>	H He	2	
Marantaceae	<i>Ischnosiphon gracilis</i>	H	1	
	<i>Monotagma juruanum</i>	H	1	
Melastomataceae	<i>Aciotis</i> sp. 1	Sh		1
	<i>Miconia</i> sp. 1	H	1	
	<i>Miconia</i> sp. 2	H		2
	<i>Miconia</i> sp. 3	H		2
	<i>Tibouchina longifolia</i>	Sh	1	
	<i>Tibouchina</i> sp. 1	Sh		1
Moraceae	<i>Batocarpus orinocensis</i>	T	1	
	<i>Brosimum lactescens</i>	T	1	
	<i>Clarisia racemosa</i>	T	1	
	<i>Ficus pertusa</i>	L He	1	
	<i>Pseudolmedia laevigata</i>	T	1	
	<i>Pseudolmedia macrophylla</i>	T	5	
Myricaceae	<i>Morella pubescens</i>	Lt		1
Myristicaceae	<i>Virola</i> sp. 1	T	1	
Myrsinaceae	<i>Cybianthus</i> sp. 1	Sh		1
	<i>Myrsine manglilla</i> cf.	Sh	2	
Myrtaceae	<i>Calyptanthus</i> sp. 1	Sh	1	
	<i>Myrcia fallax</i>	Sh	1	
Nyctaginaceae	<i>Neea divaricata</i>	Sh	1	
Olacaceae	<i>Minuartia guianensis</i>	T	1	
Orchidaceae	<i>Epidendrum</i> sp. 1	H Ep		1

table continued on next page

Table 7. *continued*

Family	Species	Habit*	Montane forest (ind./plot)	
			Chontayacu	San Pedro de Carpish
Piperaceae	<i>Peperomia</i> sp. 1	H Ep		1
	<i>Piper</i> sp. 1	Sh		1
	<i>Piper</i> sp. 2	Sh	1	
Podocarpaceae	<i>Podocarpus oleifolius</i>	T		2
Polygonaceae	<i>Triplaris setosa</i>	Lt	1	
Polypodiaceae	<i>Campyloneurum</i> sp. 1	H	1	
Rubiaceae	<i>Elaeagia</i> sp. 1	T	1	
	<i>Faramea</i> sp. 1	Lt		1
	<i>Ladenbergia oblongifolia</i>	T	1	
	<i>Manettia</i> sp. 1	L		1
	<i>Psychotria buchtienii</i>	Sh	1	
Sapotaceae	<i>Chrysophyllum</i> sp. 1	T	2	
	<i>Pouteria ambelaniifolia</i>	T	1	
	<i>Pouteria torta</i>	T	1	
Selaginellaceae	<i>Selaginella geniculata</i>	H	1	
	<i>Selaginella haematodes</i>	H	1	
Solanaceae	<i>Trianaea</i> sp. 1	Sh		1
Sterculiaceae	<i>Theobroma subincanum</i>	T	1	
Violaceae	<i>Leonia glycycarpa</i>	T	2	
	<i>Leonia</i> sp. 1	T	1	
Vochysiaceae	<i>Qualea paraensis</i>	T	1	
	<i>Vochysia</i> sp. 1	T	1	

*T = Tree; Sh = Shrub; De = Dendriform (basal branching); S = Suffrutescent (somewhat shrubby, or shrubby at the base); H = Herb; L = Liana, Cp = Climbing plant; Lt = Small tree; H Ep. = Epiphyte herb; H He = Hemiepiphyte herb; and L He = Hemiepiphyte liana.



Figure 4. Deforestation for cattle pasture in the Santa Ana census site, sector Alto Huallaga.



Figure 5. Deforestation for agricultural land in Carpish census site, sector Chinchao.



Figure 6. Illegal logging in Cocalito near the Bardales census site, Sector Chontayacu.

capuchin monkeys, *S. macrocephalus* and *C. yuracus*, because of their crop raiding in Chinchao and Alto Huallaga. Only subsistence hunting was recorded in the Río Chontayacu microbasin, occupied by transients and loggers.

Discussion

The diversity of primates recorded in the Miraflores and Santa Ana montane forests in the Río Alto Huallaga was much higher than in the other census sites, including the pre-montane and montane forests of the San Martín, Huánuco, and Amazonas regions surveyed by Shanee *et al.* (2013). We observed *S. macrocephalus* and *C. yuracus* at elevations of 1600–1880 m, and Butchart *et al.* (1995) found *S. macrocephalus* in the Cordillera de Colán at 2350 m; records above the maximum elevation indicated by Emmons and Feer (1990) for this species (to 1500 m).

According to Shanee (2011) the southern limit of the range of *L. flavicauda* in Huánuco would probably be the Santa Martha or Magdalena river valleys or the intervening highlands. We suspect that their distribution could reach up to the premontane and montane forests of the left bank of the upper basin of the Río Huallaga. Their absence during our surveys in Carpish and Ñaupamarca does not rule out this possibility; first, because the descriptions of the pelage by two people interviewed in Carpish coincide clearly with the phenotypic characteristics of this primate, and second, because in the past there was no geographical or ecological barriers that might prevent their occurrence between the upper basin of the Río Huallaga and the Río Chontayacu.

In Carpish and Ñaupamarca, *A. seniculus* was found inhabiting patches of primary forest present on the rugged hillsides, where agriculture or cattle ranching are impossible, and in remnant forest patches, degraded by the extraction of timber trees. These patches are isolated by fields and pasture, which the howlers have to cross when moving from one patch to another, exposing themselves to dogs and wild carnivores

such as the tayra (*Eira barbara*), which is common in high forest and cloud forest. In Miraflores and Santa Ana, the primary forest is much more extensive compared to Ñaupamarca and Carpish, where the forests are more patchy and isolated, separated by large expanses of open pasture, probably limiting the movements of primates, particularly during the summer when the insolation is intense in the open fields. Although for now our perception is that the primates are doing well in these primary forest patches, the medium-term prospects are not good, with the inevitable erosion of forest cover due to the burning practiced by the settlers, whose justification is the need to improve pasture quality and to lower costs in the maintenance and expansion of pasture for their cattle. In Bardales and Yanajanca in the Río Chontayacu microbasin, primary forest is continuous and present on both sides of the river from Cocalito downstream to San Antonio de Padua, where *L. flavicauda* and other primates were most abundant. Until the end of 2012, deforestation in this part of Chontayacu did not surpass one kilometer from the river edge, but with the building of the Uchiza-Huacrachuco road deforestation is increasing due to logging for valuable hardwoods and expanding agriculture and cattle ranching. Prospects for the future are not good, and the creation of a conservation area and, simultaneously, the promotion of ecotourism to benefit local communities, is essential to protect this significant population of *L. flavicauda*.

Group sizes (range and mean) of *L. flavicauda* recorded in this study are similar to those obtained for La Esperanza (Shanee and Shanee 2011b) and the Río Abiseo National Park (Leo Luna 1982). Group sizes were smaller than those reported for the Bosque de Protección Alto Mayo, where the groups were relatively large (17 to 20 individuals) (DeLuycker 2007), but larger than those obtained for the Area de Conservación Privada Abra Patricia – Alto Nieva (average 5.53 individuals; range 2–7) (Cornejo 2007). Group sizes of other species, particularly of *A. chamek* and *A. seniculus*, were very close to those reported for the Río Urubamba – Río Tambo interfluvium, particularly those recorded in premontane forest (Aquino *et al.* 2013).

The population density of *L. flavicauda* estimated in the Chontayacu sector was very similar to that reported by Leo Luna (1982, 1987) for the Río Abiseo National Park, who used the traditional method of line transect surveys, and also similar to the density found by Shanee and Shanee (2011a) at La Esperanza. It was higher than the density estimated for the Area de Conservación Privada Abra Patricia – Alto Nieva (Cornejo 2007), which would indicate that in Chontayacu populations of *L. flavicauda* are still healthy. In the case of *A. chamek*, population density was higher than that reported for the interfluvium of the ríos Urubamba and Tambo, where montane forest is predominant (Aquino *et al.* 2013). In this regard, Shanee (2009) concluded that spider monkey densities tend to drop with increasing elevation, but our results indicate the opposite. These populations are not hunted, and it is possible that the higher population density in Huánuco comes from crowding in the forest patches.

The Andean people in these regions are farmers and cattle ranchers and, except for *S. macrocephalus* and *C. yuracus*, in general the primates are not heavily hunted. This could explain the large groups, and shows that these primates can survive in disturbed habitats when there is little hunting. The most critical problem is the forest loss occasioned by deforestation, most intense in the Chinchao sector, where the red howler groups live in small patches of remaining forest, while in other sectors there is still primary forest, particularly in the basins of the ríos Yanajanca and Bardales in the Chontayacu sector, which must be evaluated as ideal for the creation of a conservation area and an ecotourism business to ensure the survival of *L. flavicauda* and its forests.

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