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Current Status of *Ateles belzebuth* in Montane Forests of the Peruvian Amazon

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Abstract: The white–bellied spider monkey, *Ateles belzebuth*, is one of the seven species that inhabits both lowland and montane forests in the Peruvian Amazon. The lowland populations are locally extinct over a large part of the species range there, but there is very little information on the montane forest populations other than records of some groups in a few localities. The lack of information motivated us to conduct this study to determine the current status of these spider monkeys and identify the threats to their populations. Transect censuses were carried out in November 2016, February 2017 and May–July 2017. In 786 km of transects walked, we observed 44 groups of five primate species, the most common being *A. belzebuth* and *Cebus yuracus* (both with 13 groups). Most of the *A. belzebuth* groups were observed in Las Hamacas (six groups) and La Meseta (four groups) belonging to the Área de Conservación Privada Los Chilchos. Of the four species for which we obtained complete group counts, the largest groups were those of *A. belzebuth* (average 16 ± 6.1, n = 5) and the smallest of *Alouatta seniculus* (average 4.8 ± 1.2). The highest relative abundance was for *A. belzebuth* (2.56 individuals/10 km) and lowest for *A. seniculus* (0.53 individuals/10 km). South of the Río Marañón, the distribution of *A. belzebuth* is restricted to the montane forests of the regions of Amazonas, San Martín, La Libertad, and part of Huánuco to the Río Monzón, but it is locally extinct between the ríos Tocache and Monzón. Logging, hunting and deforestation for agriculture and cattle ranching were found to be the main threats to the survival of *A. belzebuth* and other primates in the areas we surveyed.

Key words: Primates, Andean montane forest, *Ateles belzebuth*, abundance, threats

Introduction

Seven species of primates are known to inhabit the montane forests of the Peruvian Amazon. Most studies have focused, however, on just three: the Peruvian yellow–tailed woolly monkey *Lagothrix flavicauda* (see Leo Luna 1980, 1982, 1984, 1987; Butchart *et al*. 1995; Barrios *et al*. 2003; Cornejo 2007; Shanee *et al*. 2007a, 2008; Shanee 2011, 2014; Shanee and Shanee 2011); the Andean night monkey, *Aotus miconax* (see Cornejo *et al*. 2008; Shanee *et al*. 2013a, 2015); and the Río Mayo titi, *Plecturocebus* (formerly *Callicebus*) *oenanthe* (see De Luycker 2006; Vermeer and Tello 2015), all endemic to the northeastern Amazon in Peru. There is practically no information about the abundance and current status of the remaining species that also live in lowland forests there.

In the case of the white–bellied spider monkey, *Ateles belzebuth*, categorized as Endangered (EN) on the IUCN Red List (IUCN 2017), the only information available for the montane forests is records of their presence in the Cordillera de Colán (Mittermeier *et al*. 1975), Laguna de Los Cóndores and Chilchos (Barrios *et al*. 2003), Santa Rosa (Shanee *et al*. 2007b), and Yambrasbamba, Copallin and Paujil (Shanee *et al*. 2013b).

Of the primates inhabiting the Amazonian forests of Peru, the atelids, and especially *A. belzebuth*, are the most susceptible to hunting and habitat alteration as was shown in a recent

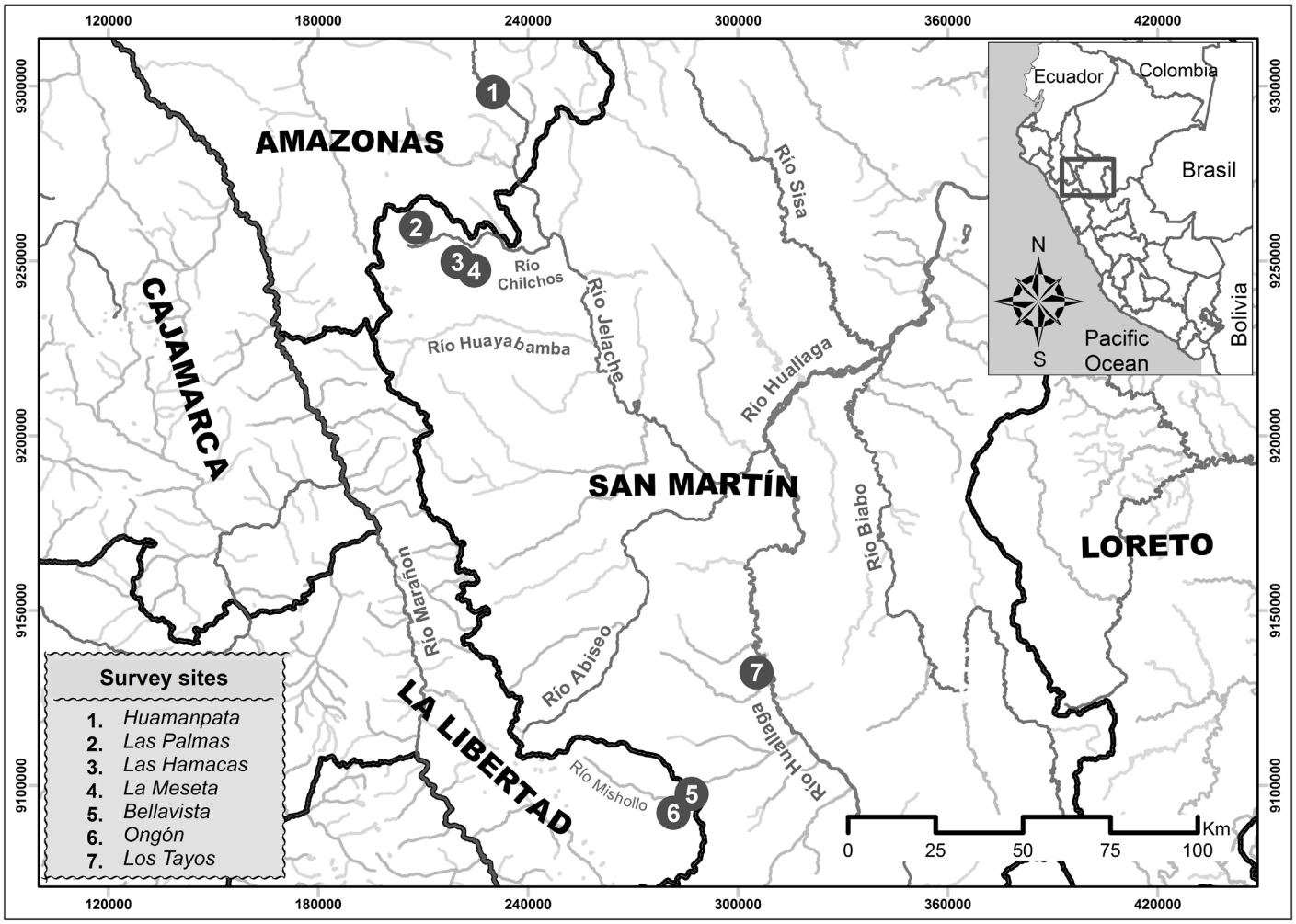

Figure 1. Location of the survey sites in the study area for the census of *A. belzebuth* and other primates.

study in lowland forests of the northeastern Peruvian Amazon of Peru by Aquino *et al*. (2016a). The consequences can be local extirpation. Unlike the lowland forest, where hunting is the main threat to primates and other mammals, in montane forest, *A. belzebuth* and other primates are mainly exposed to the reduction and loss of habitats by accelerated deforestation for agriculture, cattle ranching and extraction of forest resources (wood, leaves, lianas, and resins, among others). The absence of information on the populations of this species and other primates in montane forests motivated us to conduct this study, the objectives of which were to determine the abundance of *A. belzebuth* in montane forests, to obtain a better understanding of its geographic distribution, and to identify human activities that constitute threats to its survival and that of other primates such as *L. flavicauda*. To achieve these objectives, transect censuses were conducted in November 2016, February 2017 and May–July 2017 in forests in the regions of Amazonas, La Libertad and San Martín.

Methods

Study area

The study area was in the regions of Amazonas, La Libertad and San Martín, on the Amazonian side of the Eastern Cordillera, about 1000 m above sea level. They are broadly influenced by the Amazon with regard to climate and biodiversity. Young and León (1999) refer to these forests as Eastern montane forest. With the exception of Los Chilchos, formed by the microbasins of the ríos Tingo, Chilchos and Lejía and Los Tayos in the basin of the Río Huallaga, the forests are subject to intense deforestation for agriculture, cattle ranching, and the extraction of forest resources, and are predominantly highly disturbed, secondary and residual. Fragments or patches of primary forest are found in the rugged reliefs where agriculture or cattle ranching is impossible. Unlike in the lowland Amazon, hunting is occasional and primarily for subsistence and the sale of infants and skins. For the census, seven survey sites were defined in four sectors and three regions (Fig. 1). The geographic coordinates, altitude and level of human disturbance are given in Table 1. The transport of field materials and foods from the communities to the survey sites was mostly by mule (Fig. 2), the only means of transport in montane forests due to the absence of roads. The sectors and survey sites were as follows:

Región Amazonas

The microbasin of the Río Huamanpata, patches of residual forest on the left bank of this river. The forest patches

Table 1. Sectors and survey sites in montane forest of the study area.

Región	Sector	Survey sites	Coordinates	Altitude (m.a.s.l.)	Human disturbance
Amazonas	Río Huamanpata microbasin	1. Huamanpata	229969/9298176	2145	Very high
	Río Chilchos microbasin	2. Las Palmas	208010/9259586	2062	High
	Río Blanco microbasin	3. Las Hamacas	219830/9249703	1770	Low
	Río Lejía microbasin	4. La Meseta	224600/9247235	1857	Low
La Libertad	Río Mishollo microbasin	5. Bellavista	286772/ 9097574	1226	High
	Río Cajas microbasin	6. Ongón	281580/ 9092141	1348	High
San Martín	Río Huallaga basin	7. Los Tayos	305340/9132304	1072	Moderate

have suffered considerable disturbance and the trees do not exceed 20 m in height due to illegal commercial logging. Large mammals are practically absent because of hunting by the logging teams.

The microbasin of the Río Chilchos, the forests surrounding Fundo Las Palmas, located on the left bank of the river. There, agriculture and cattle ranching are present but on a small scale, while fragments of primary forest are still relatively extensive, but disturbed by timber extraction and the existence of trails of farmers and ranchers. However, large mammals are still present, among them *L. flavicauda*.

The microbasin of the Río Blanco, the forests of Las Hamacas, located on the right bank of the river. These primary forests are part of the Área de Conservación Privada Los Chilchos and belong to the community of Leymebamaba. No disturbance was noticed at this survey site, so the wildlife and primates are relatively abundant, including *A. belzebuth.*

The microbasin of the Río Lejía, the forests of La Meseta, on the right bank of the river. Most of these forests belong to the Área de Conservación Privada Los Chilchos. There is agriculture and cattle ranching, but on a small scale and close to the limits of the conservation area. Here, as in the rest of the area of Los Chilchos, deforestation and hunting is prohibited, so large mammals are still present, among them *A. belzebuth.*

Figure 2. Mules with their respective loads traveling from Leymebamba to the area of Los Chilchos, Región Amazonas. June, 2017.

Región La Libertad

The microbasin of the Río Mishollo, the forests bordering the community of Bellavista, near the border with the Región San Martín. There are patches of essentially primary residual forest, ranging in size from 6 to 20 km^2. Large mammals can be seen, including *L. flavicauda.*

The microbasin of the Río Cajas, the forests near the community of Ongón. There are agricultural crops and pasture on both banks of the river. Quite extensive residual forests are located 2 km from the right bank, where there are still large mammals, including primates such as *L. flavicauda*.

Región San Martín

The Río Huallaga basin, the forests bordering the cave of Los Tayos, in front of the community of Balsayacu and approximately 15 km from the border of the Parque Nacional Río Abiseo. The forests of this part of the Huallaga are concessioned for logging, but large areas of primary forest still exist, where wildlife is relatively abundant.

Transect censuses

Three to five trails were set up in each survey site. The trail lengths ranged from 2.5 to 3.0 km depending on the relief. On some occasions we also used the already existing trails made by farmers, ranchers and villagers. Each of the trails were walked 2 to 3 times in intercalated form. The censuses were conducted on the transect in both directions (inbound and outbound) from 07:00 to 16:00 h. Two teams consisting of an investigator and a field assistant were simultaneously mobilized along the trails and walked at an average speed of 0.5 km/hour. The following data were recorded in field notebooks each time a group of *A. belzebuth* or another primate was sighted: time, species, group size (a complete

Table 2. Distance (km) walked and survey hours per survey site in the study area.

Región	Sector	Survey sites	Distance walked (km)	Effort (hours of census)
Amazonas	Río Huamanpata microbasin	1. Huamanpata	198	225
	Río Chilchos microbasin	2. Las Palmas	113	160
	Río Blanco microbasin	3. Las Hamacas	110	180
	Río Lejía microbasin	4. La Meseta	59	83
La Libertad	Río Mishollo microbasin	5. Bellavista	54	97
	Rio Cajas microbasin	6. Ongón	94	175
San Martín	Río Huallaga basin	7. Los Tayos	158	256
Total			786	1116

count when possible), perpendicular distance from the trail to the first individual observed, height (in the vertical stratum of the forest), activity at the time of detection, presence of juveniles and infants, and type of vegetation. We also collected data related to the level of disturbance of the forest and the anthropic activities. In all, we walked 786 km of transect equivalent to 1116 census hours; of this total, 480 km corresponded to the montane forests of Región Amazonas and the rest to the regions of La Libertad and San Martín (Table 2).

Interviews

Interviews were conducted in communities surrounding the survey sites. We also talked to people in Ocol and Omia in the Región Amazonas, in Pelejo a settlement on the left bank of the Río Tocache in the Región San Martín, and Cocalito and Olla, both settlements along the Río Chontayacu in the Región Huánuco. These interviews were aimed at confirming or discounting the presence of *A. belzebuth* in forests adjacent to the aforementioned communities in order to determine their geographical distribution in montane forests and the current status of their populations. The interviews also served to clarify the confusion arising from the use of names such as "maquizapa negro" and "maquizapa cenizo," particularly in the Región Amazonas, where people have mistakenly argued for the existence of two species of *Ateles*. To facilitate the identification, the interviewees were shown photographs of *A. belzebuth* specimens with varying patterns of pelage coloring and also *A. chamek* to indicate which of them was present in the forests of their communities. For the geographic distribution, we also considered interviews conducted in previous studies, in particular in the communities of Balsapuerto and Canoa Puerto, settlements on the Río Cachiyacu, tributary of the Río Huallaga in the Región San Martín, and Santa Rosa in the Río Saramiriza, tributary of the Río Marañón in the Región Loreto.

Identification of threats

Activities which constitute threats were registered during the censuses and interviews. Other activities related to deforestation besides agriculture, such as logging and road construction were also investigated. The opportunity to search for primate pets and other evidence such as skins and skulls suggesting hunting was taken during visits to communities, in particular in Huamanpata, Ocol and Omia, sites with fewer primates.

Data analysis

The number of groups of *A. belzebuth* and other primates recorded during the censuses (less than 14) was insufficient to calculate population density. For this reason, we used only relative abundance, the number of individuals sighted per 10 km of transect walked. The relative abundance is based on the total distance walked in the study area, except for *L. flavicauda* and *Sapajus macrocephalus*, for which the survey distance used, was 628 km and 306 km, respectively. In the case of *L. flavicauda*, we excluded the surveys in Los Tayos, where the trails were between 950 and 1200 m above sea level below the elevational limits of its distribution. With respect to *S. macrocephalus*, the survey sites in the Región Amazonas were excluded because they are not part of their geographic distribution.

The mean group size for *A. belzebuth* and other primates was determined from groups with complete counts. Every time we found a group, we tried to count all the individuals and, when possible, their sex and age: adults (females and males), juveniles and infants. Dependent infants were not considered in determining the average group size.

Results

Registered groups of A. belzebuth

We saw 13 different groups during the censuses. Of these, most were found between the Hamacas and La Meseta sites, both belonging to the Área de Conservación Privada Los Chilchos in the Región Amazonas. Others were seen in Los Tayos in the Región San Martín and Bellavista in the Región La Libertad (Table 3). We obtained no sightings or records in the other survey sites.

Table 3. Groups of *A. belzebuth* and other primates recorded during surveys in the study area.

Región	Survey sites	Species					Total
		A. belzebuth	*L. flavicauda*	*A. seniculus*	*S. macrocephalus*	*C. yuracus*	
Amazonas	1. Huamanpata						
	2. Las Palmas		1	1		1	3
	3. Las Hamacas	6		3		2	11
	4. La Meseta	4		2		3	9
La Libertad	5. Bellavista	1	2		1	3	7
	6. Ongón		3			1	4
San Martín	7. Los Tayos	2		3	2	3	10
Total		13	6	9	3	13	44

Table 4. Group size and range of *A. belzebuth* and other primates observed in the study area. Mean size estimates were obtained from complete group counts.

Species	Range	Mean size±SD	Total groups	Groups with complete counts	Groups size range in other areas
Ateles belzebuth	10–26	16±6.1	13	5	6–18[a]
Lagothrix flavicauda	7–15	10.5±3.4	6	4	12–15[b]
Alouatta seniculus	3–6	4.8±1.2	9	6	2–5[b]
Sapajus macrocephalus	>12		3		>5[b]
Cebus yuracus	11–22	14.7±4.9	13	4	10–15[b]

[a] Northeast Peruvian Amazon: Aquino *et al*. (2016a).

[b] Montane forest of Huánuco: Aquino *et al*. (2017).

Table 5. Relative abundance of *A. belzebuth* and other primates for the study area.

Species	Total length of transect walked (km)	# of sightings/10 km of transect		
		Groups/10 km	Individuals/10 km	Other areas
Ateles belzebuth	786	0.16	2.56	0.3–0.7[a]
Lagothrix flavicauda	628	0.1	1.05	1.6[b]
Alouatta seniculus	786	0.11	0.53	0.2[b]
Sapajus macrocephalus	306	0.1	1.2	0.3[b]

Group size and range

Group sizes of *A. belzebuth* ranged from 10 to 26 individuals, with an average of 16 (Table 4). It is very probable that some of the groups recorded between Las Hamacas and La Meseta were composed of more than 32 individuals, because there were incomplete counts up to 25 individuals, and it was possible to see movements of branches that indicated the presence of more individuals than we were able to count. This was not the case in the other two survey sites where we saw them, in particular Bellavista, where the incomplete count of the only group observed very close to the San Martín border was five individuals, although there were probably more due to branch movements, but which would not have exceeded nine individuals.

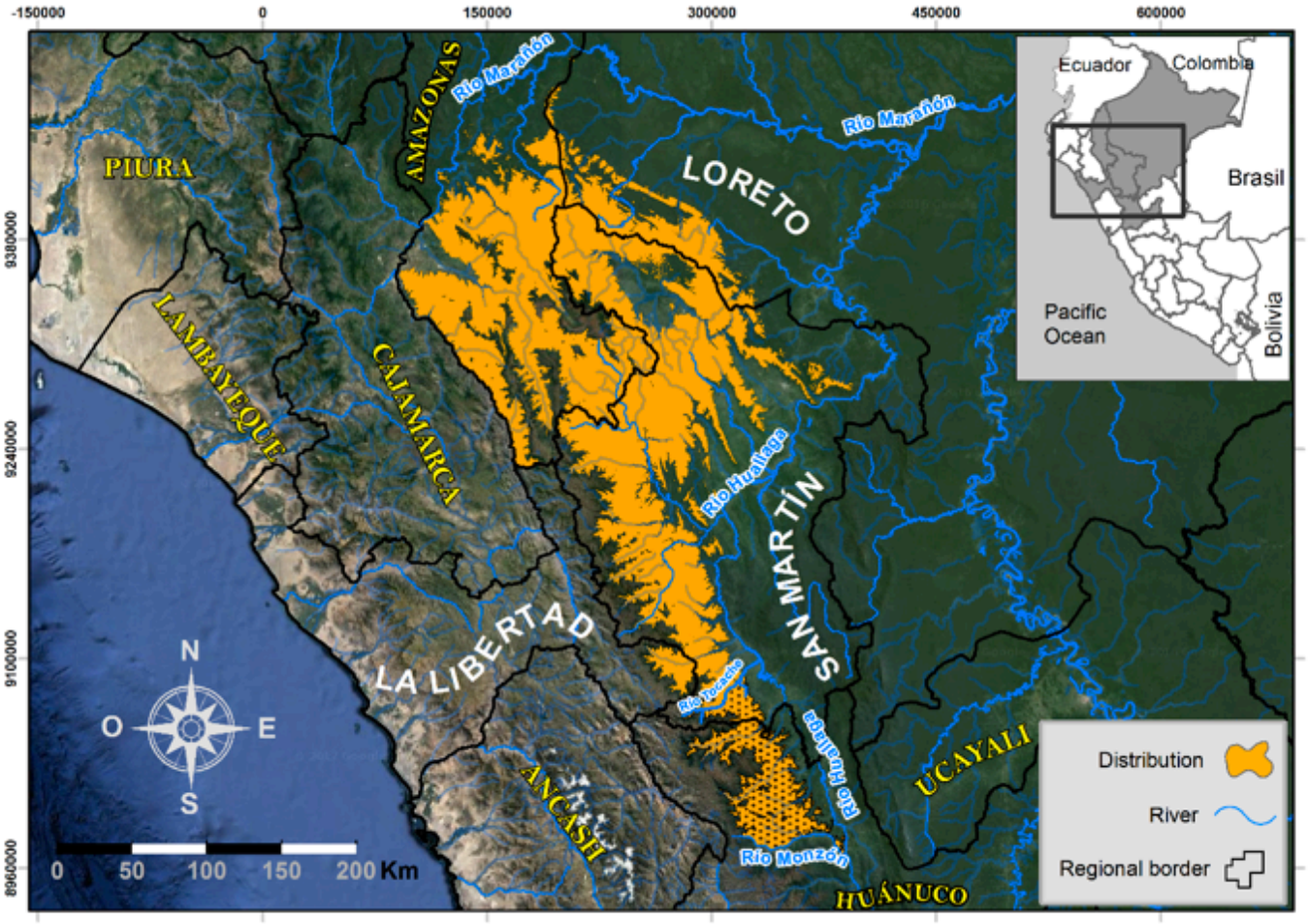

Figure 3. Distribution of *A. belzebuth* to the south of the Río Marañón. Orange without points indicates the surviving population, and orange with spots, the locally extinct population.

Relative abundance

The most abundant of the primates in any of the areas we surveyed was *A. belzebuth* and the lowest was for *A. seniculus* (Table 5). We must admit, however, that the high abundance estimated for *A. belzebuth* does not reflect the reality for the entire area, since 77% of the groups were registered in the area of Los Chilchos, in particular in the Área de Conservation Privada Los Chilchos, while in the other sites, including the Área de Conservación Ambiental Cuenca del Río Huamanpata, we obtained no records at all.

Geographic distribution south of the Río Marañón

With the exception of the small enclave between the Río Huallaga and Caucho Grande to the west and the Río Samiria to the east; the geographic distribution south of the Río Marañón comprises only the montane forests on the western side of Río Huallaga, from the Río Marañón in the north to the montane forests on the left bank of the Río Monzón in the south (Fig. 3). However, it is evidently locally extinct in the area between the Río Tocache in San Martín and Río Monzón in Huánuco. The only reference to its existence in this part of its range is information provided by one of the interviewees in the community of Cocalito, who reported having observed a group of approximately seven individuals on the right bank of the Río Chontayacu at the beginning of 2010, but he had not seen them there since then.

Variation in pelage coloration

Unlike the populations of *A. belzebuth* in the lowland forests of the northeastern Peruvian Amazon that are characterized by their blackish pelage on the dorsal surface of the trunk and the anterior limbs, and yellow-creamy color on the ventral side of both parts of the body, those in montane forest vary in the coloring pattern of the pelage, particularly on the head, chest and limbs. In some groups we have observed individuals with the transverse band on the forehead a mostly orange color, and the chest with blackish hairs (Fig. 4), whereas in other groups, the transverse band is absent or there is simply a vestige only slightly perceptible at some distance, while the pelage on the outer and inner side of the thighs and legs are dark gray and orange, respectively (Fig. 5).

Threats and current status

With the exception of Las Hamacas and La Meseta belonging to the Área de Conservación Privada Los Chilchos in the Región Amazonas and Los Tayos in the Región San

Figure 4. Adult *A. belzebuth* with the orange transverse band and blackish chest, observed at Las Hamacas, Los Chilchos. July, 2017.

Martín, the results obtained for the other survey sites indicate that *A. belzebuth* and other primates, among them *L. flavicauda*, are scarce or absent. This is due, among other factors, to intense deforestation for agriculture, cattle ranching and timber extraction, besides hunting for food, for skins (handicrafts), and for infant pets.

In the case of Huamanpata in the Área de Conservación Ambiental Cuenca del Río Huamanpata, the absence of primates and other components of the larger fauna is mainly due to the indiscriminate hunting associated with illegal logging, activities that have intensified over the last decade. Up to 2006, it was still possible to see primates, in particular *A. belzebuth* and *L. flavicauda*, commonly known to the interviewees as "maquizapa negro" and "genebra," respectively. This is not the case of Las Palmas in Los Chilchos, where hunting is not allowed. There the absence of *A. belzebuth* could be related to logging for the construction of corrals and other purposes, although in recent years this activity has declined drastically because most of the chakras and grasslands have been abandoned by their owners.

In Bellavista that belongs to the Región La Libertad, scarce populations of *A. belzebuth* and *L. flavicauda* are living in patches of residual and primary forest, present more than 4 km away from both banks of the Río Mishollo but, as far as we could discern, they are vulnerable to ongoing

Figure 5. Adult *A. belzebuth* without the transverse band and with the pelage of dark gray thighs and orange legs, observed at La Meseta, Área de Conservación Privada Los Chilchos. July, 2017.

deforestation, which is affecting the larger fauna including these primates. Unlike Bellavista, in Ongón there was no record of *A. belzebuth*, perhaps because these fragments of forests close to the community are extremely disturbed by the extraction of timber for the construction of corrals and for other purposes. To the south of the Río Cajas, up to 4 km from the river bank, however, there is primary forest where *A. belzebuth* could be persisting, along with other primates.

Finally, in Omia and Ocol, in the Región Amazonas, the interviewees told us that until 2007, *A. belzebuth* and *L. flavicauda* were still frequently observed in forest patches belonging to their communities, but today are already difficult to find, indicating that they are declining and heading for local extinction, even in the Área de Conservación Privada Bosque de Palmeras of the Comunidad Campesina Taulia Monopampa, created in September 2012, the same that is adjacent to the Área de Conservación Ambiental Cuenca del Río Huamanpata. With regard to Pelejo, a settlement on the left bank of the Río Tocache, the interviewees told us that spider monkeys could be found only between 10 and 15 km to the north, indicating the existence of a small population between the ríos Mishollo and Tocache.

Records of other primates

During our surveys, we observed 31 groups of four species besides *A. belzebuth*. Twenty-three groups were seen in Los Chilchos, including the Área de Conservación Privada Los Chilchos (Las Hamacas and La Meseta) (Table 3). Of the four species, the most frequently seen was the Marañón white-fronted capuchin *Cebus yuracus* (13 groups). The large-headed capuchin *Sapajus macrocephalus* was seen the least (just three groups), twice in Los Tayos and once in Bellavista. We saw no diurnal primates at Huamanpata in the Área de Conservación Ambiental Cuenca del Río Huamanpata, only *A. miconax*. We obtained no records of *L. flavicauda* in Las Hamacas and La Meseta in the Área de Conservación Privada Los Chilchos, and the only group we saw was at Las Palmas, outside the conservation area. The largest groups we recorded were those of *C. yuracus* (average size 14.7 individuals), followed by *L. flavicauda* with groups averaging 10.5 individuals (Table 4). The Colombian red howler *A. seniculus* groups were small with an average of 4.8 individuals. We were unable to obtain any complete group counts for *S. macrocephalus*. They were noticeably shy and skittish, probably because of hunting.

Discussion

The distribution of *A. belzebuth* to the south of the Río Marañón determined in this study contrasts with Emmons and Feer (1990), who suggested the ranged only north of the Río Marañón, with *A. chamek* (then considered a subspecies of *A. paniscus*) occurring to the south. It also contrasts with Aquino *et al*. (2013) who indicated the Río Mishollo as the boundary to the south, although reporting that they do occur in the area between the ríos Mishollo and Tocache. In this case, *A. belzebuth* would be sharing the habitat with *A. chamek*. We are convinced that there was an error in considering the presence of *A. chamek* in these montane forests. In some places such as Huamanpata, Ocol, Limabamba, San Martín and Rodríguez de Mendoza in the Región Amazonas, Tingo de Uchiza in San Martín, and Cocalito in Huánuco, the people generally call *A. belzebuth* that has the pelage of the dorsum, including the head, a deep black, with the ventral surface, in particular the chest, blackish, "maquizapa negro." We are, therefore, able to maintain that only *A. belzebuth*, with variable pelage coloration, inhabits these forests.

Among the species recorded in this study, *S. macrocephalus* was the only one that was not observed in any of the sites we surveyed in the Región Amazonas. Mittermeier *et al*. (1975) and Shanee *et al*. (2013b) also failed to observe this primate there, so we are convinced that these forests are not within their geographic range, and that they occur only in the north of the Región Amazonas, as shown by Butchart *et al*. (1995), who observed eight groups during their exploration in the Cordillera Colán.

Lagothrix flavicauda was not recorded in Los Tayos, where surveys were conducted at elevations of 950 m to 1,200 m. This indicates that they range only above 1200 m. The lowest elevation that we have recorded was 1,248 m at Hoja Grande in San Martín (R. Aquino, pers. obs.). Allgas *et al*. (2014), however, recorded a group in Tingo de Uchiza at 1084 m.

The range and average size of *A. belzebuth* groups observed in the study area (Table 4) was higher than those reported for the Río Pucacuro (Aquino *et al.* 2000) and the Río Samiria (Aquino and Bodmer 2006), where they are heavily hunted. Group sizes were also larger than those recorded between Curaray-Nashiño and Curaray-Arabela, where human disturbance is low (Aquino *et al*. 2013) and in the northeastern forests of the Peruvian Amazon that have moderate to low human disturbance (Aquino *et al*. 2016a).

The group sizes of *L. flavicauda* were close to those reported for the Río Abiseo (Leo Luna 1982), La Esperanza (Shanee and Shanee 2011), Chontayacu-Miraflores (Aquino *et al*. 2015) and Huánuco (Aquino *et al.* 2016b). They were lower, however, than those reported by DeLuycker (2007) for the Bosque de Protección Alto Mayo, with groups from 10 to more than 25 individuals, but higher than in the Área de Conservación Privada Abra Patricia-Alto Nieva, where Cornejo (2007) reported an average group size estimated at 5.53, with a range of 2 to 7 individuals.

The average group size of *A. seniculus*, estimated from six groups counted in this study, was lower than that recorded in the sub-Andean forests of Colombia (Morales-Jiménez 2002), where groups fluctuated from 2 to 9, and an average of 6 individuals. It was also lower than that reported for Miraflores (Aquino *et al*. 2015), where groups of more nine were observed. However, it is similar to those reported for San Martín and Huánuco by Aquino *et al*. (2017), where groups ranged from 2 to 5, with an average of 4 and 3, respectively. Finally, the range and average group size of *C. yuracus* was

higher than those reported for San Martín, but similar to Huánuco (Aquino *et al*. 2017), where groups were seen of more than 15.

The relative abundance of *A. belzebuth* estimated for the study area was lower than was obtained in the Curaray-Nashiño and Curaray-Arabela surveys by Aquino *et al*. (2013) and for the forests of northeastern Peru with low and moderate human disturbance, but was higher than reported for the Río Pucacuro (Aquino *et al.* 2000) and Río Samiria (Aquino and Bodmer 2006), both areas that are heavily hunted. The relative abundance estimated for *L. flavicauda* was, likewise, lower than that reported by Aquino *et al*. (2015) for Yanajanca-Cocalito in Huánuco 0.5 groups/10 km and 6.8 individuals/10 km as well as the montane forests of Huánuco with a estimated at 1.8 individuals/10 km.

The estimated relative abundances for *S. macrocephalus* and *C. yuracus* were higher than those reported for Chontayacu-Miraflores (Aquino *et al*. 2015) and montane forests of San Martín and Huánuco (Aquino *et al.* 2017), sites where the remaining forests are essentially primary and well-preserved, but hunting pressure is apparently very high.

In montane forests, interspecific associations of primates seem to be uncommon. The few mixed groups so far observed were between *A. belzebuth* and *A. seniculus* in Las Hamacas (this study), *L. flavicauda* and *A. seniculus* in Yanajanca (Aquino *et al*. 2015) and in the valley of Los Chilchos (H. Dignum, pers. comm.), and between *A. belzebuth* and *L. flavicauda* in forests adjacent to the Santa Rosa community where Shanee *et al*. (2007b) observed a mixed group of eight *L. flavicauda* and a female *A. belzebuth*. The rarity of mixed groups between these two species would indicate competition for habitat and food resources. No records were obtained of *L. flavicauda* at Las Hamacas and La Meseta where most of the groups of *A. belzebuth* were observed. This coincides with the findings of Barrios *et al*. (2003) and H. Dignum (pers. comm.), but not with Del Carmen and Jimenez (2008), who reported *L. flavicauda* in the Río Blanco, near Las Hamacas, which would indicate the existence of a small number of individuals, similar to Las Palmas where we recorded just one group of nine, including two infants.

The low abundance recorded in the study area for *A. belzebuth* and for all other species has much to do with the quality and extent of the forest. While some sites such as the Área de Conservación Privada Los Chilchos are in a good state of conservation, others evidence very high disturbance, as is the case for the Área de Conservación Ambiental Cuenca del Río Huamanpata, the Área de Conservación Privada Palmeras de la Comunidad Campesina Taulia Monopampa (which includes Ocol), and forests near Omia, where *A. belzebuth* and *L. flavicauda* are already locally extinct. In other survey sites, such as Bellavista, *A. belzebuth* is evidently very reduced in numbers, and the same is true for the Concesión de Conservación Alto Huayabamaba in San Martín that delimits the area of Los Chilchos and where only one group of approximately 10 individuals was observed in 164 km walked (P. Perez, pers. comm.). These results are a clear indication that the populations of this primate are in a critical situation in at least part of the species' range in the montane forests, demonstrating the need evaluate the threats at the sites where they were recorded, even more than two decades ago such as the Cordillera de Colán (Butchart *et al*. 1995).

With the exception of the Área de Conservación Privada Los Chilchos, the predominance of small groups and the low relative abundance of primates for most of the species recorded in this study is mainly associated with habitat loss from deforestation for agriculture, cattle ranching, logging and the exploitation of forest resources; but also has much to do with hunting, as is the case of Huamanpata, where they have practically exterminated the larger fauna, including primates. According to Estrada *et al*. (2017), both activities are considered by IUCN as the main threats to all primates and are responsible for 36% of the Neotropical species being threatened. Because of their large size and, as is the case for all atelines, relatively slow reproductive rates, *A. belzebuth* and *L. flavicauda* are particularly vulnerable to fragmentation and degradation of their forests and to hunting.

Habitat loss due to intense deforestation for the abovementioned purposes is undoubtedly the most critical problem for primates and other components of wildlife inhabiting the montane forests, thus coinciding with those sustained by Shanee (2011) for primates living in Amazonas, La Libertad, Huánuco and San Martín. However, there are still quite large fragments of residual forests that are essentially primary in the headwaters and upper reaches of the Río Mishollo in La Libertad and San Martín and the ríos Tingo, Lejía and Huayabamba in the Región Amazonas. In these forests, there are still populations of *A. belzebuth* and other primates such as *L. flavicauda* and *A. seniculus* similar to those reported for the forests of the ríos Chontayacu and Yanajanca microbasins in Huánuco (Aquino *et al.* 2015), Shunté and Tingo de Uchiza between the microbasins of the ríos Tocache and Crisnejas in San Martín (Aquino *et al*. 2017). Fortunately, these forests are being considered important for their conservation and ecotourism, particularly in the area of Chilchos where the Área de Conservación Privada Los Chilchos is located (our survey sites of Las Hamacas and La Meseta) and we observed the majority of the groups of *A. belzebuth* and other primates. We cannot say the same of the Área de Conservación Ambiental Cuenca del Río Huamanpata, which is practically abandoned by both regional and provincial authorities; extreme disturbance of forest fragments and the absence of primates and other components of wildlife are evidence of what has been happening in this conservation area.

With regard to hunting, it was most prevalent at Huamanpata, where it was linked to illegal logging. The interviewees told us that the illegal loggers employed hunters to supply bushmeat for continuous periods of more than 12 years, indicating the attrition of primate populations resulting in the gutting of the forest resources and the extirpation of the large mammals, among them *A. belzebuth* and *L. flavicauda*, species recorded there at the end of 2005 during the diagnosis of wild fauna for the Ecological Ecosystem Zonification (ZEE)

of the Región Amazonas (Aquino 2010). Another survey site where there is subsistence hunting is Los Tayos, where the logging is increasing in a forest concession where hunting is customary.

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