

New Range Limits of the Sun-tailed Monkey, *Cercopithecus solatus*, in Central Gabon

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Abstract: *Cercopithecus solatus* is a recently discovered monkey endemic to Gabon, present in parts of the Lopé National Park and the *Forêt des Abeilles* in the center of the country. It is listed as Vulnerable on the IUCN Red List (2010) due to its restricted extent of occurrence and continuing decline in population caused by high hunting pressure. All known field observations of this species are compiled here. Data collected since 1999 show that *C. solatus* occurs further to the south, east, and west than was previously known, and that its extent of occurrence almost certainly includes three national parks, rather than one.

Key Words: Gabon, Sun-tailed monkey, *Cercopithecus solatus*, distribution, protected areas, Red List

Introduction

Cercopithecus solatus was first described in 1988 (Harrison 1988), following sightings in 1984 in the *Forêt des Abeilles*, a large block of what was then mostly undisturbed primary forest in Central Gabon, north of the Ogooué River. *Cercopithecus solatus* is a member of the *lhoesti* super-species, and characterized by a bright yellow-orange on the distal half of its tail (Harrison 1988). The range of *C. solatus* is thought to be among the smallest of any African primate (Brugière and Gautier 1999). It was originally believed to be endemic to the *Forêt des Abeilles* forest block, but was later found in the contiguous Lopé Reserve to the west (White and Mackanga-Missandzou 1995). *Cercopithecus solatus* is threatened by hunting (Brugière and Gautier 1999), and being semi-terrestrial is sensitive to ground snares. Commercial hunting is likely to become a growing threat (Brugière and Gautier 1999), and could lead to population declines (IUCN 2010). Due to its restricted distribution, and the hunting pressure on the population, *C. solatus* is listed as Vulnerable on

the IUCN Red List (IUCN 2010). It is also on Appendix II of CITES (CITES 2010), and was declared a fully protected species by the Gabonese government in 1994 (Brugière and Gautier 1999).

The range and habitat requirements of *C. solatus* have been further clarified since its original description in 1988 from the *Forêt des Abeilles*. In 1992, hunter surveys in 102 villages in the predicted range of *C. solatus* found that hunters did not encounter the species north of the Ogooué River nor west of the Offoué River. The species was not found south of the village of Popa, even though there was no obvious southern barrier (Gautier *et al.* 1992). In 1994, however, *C. solatus* was encountered in the center of the Lopé Reserve, west of the Offoué River (White and Mackanga-Missandzou 1995), providing the first sighting of the species in a protected area. Finally, surveys have shown that the density of *C. solatus* declines at higher elevations (Brugière *et al.* 1998), suggesting that the southern limit of the distribution may be limited by mountainous terrain—specifically by the lower density of the understorey (Brugière and Gautier, 1999).

In the last ten years, wildlife and bushmeat studies have been carried out in Central Gabon, both in and outside of protected areas. Many of these studies recorded sightings of *C. solatus*, either alive in the forest or as components of hunter catches. A collation of this data is presented here, which increases our understanding of the distribution of this species.

Methods

We contacted researchers working in Gabon, and asked them for any presence/absence information for *C. solatus*. We accepted presence/absence data from studies that used faunal transect surveys (visual and camera-trapping) inside and outside of protected areas, and from village bushmeat surveys and village interviews, as well as opportunistic sightings from experienced field researchers. Data on presence/absence of *C. solatus* were compiled (Table 1), and combined with data from the literature to create an updated range map (Fig. 1).

Results

We have listed (Table 1) and mapped (Fig. 1) all sightings and bushmeat records from the literature and from unpublished work since 1999.

Sightings in and around Lopé National Park (Location Number (LN) 39–41, 61, Table 1)

In August 1995, a group of about 12 *C. solatus* were clearly seen by Kate Abernethy in trees next to the road in the SOFORGA logging concession. The observers (4) were on foot, and the monkeys travelled for several minutes in low vegetation near to the road. At one point an adult male walked several metres along a large branch in full view and was clearly identifiable, with the blue coloration of the scrotum easily visible. They were observed with 10×42 binoculars at a range of about 20 m. In 1993, on the road from Offoue to Booue, at the north-eastern border of the Lopé reserve, Lee White observed a group of 4 or 5 *C. solatus* on the ground crossing the road. The group was in clear view for 5 minutes,

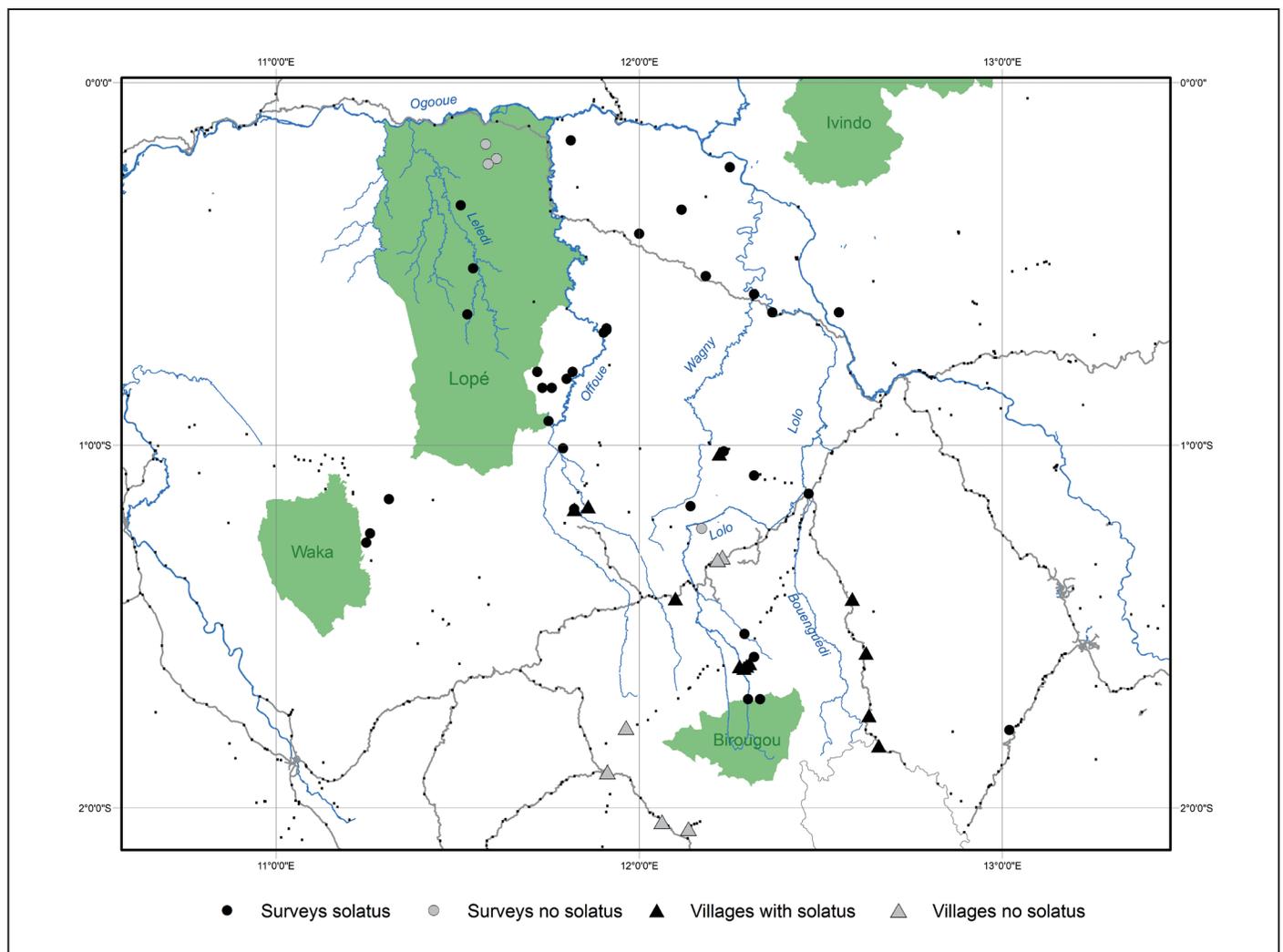


Figure 1. Known distribution of *Cercopithecus solatus*, including published data to 1999, subsequent field sightings, village interviews and village hunting information collected from 1984–2006. Small black dots = villages, blue lines = major rivers, black lines = major roads, green shading = national parks.

about 30 m from the vehicle. In 1994, Lee White met a hunter in Iwatsi village (close to the meeting-point of the Offoue and Onoy rivers) who had just arrived with an adult male sun-tailed guenon that he had shot. From 1989 to 2004, Kate Abernethy and Lee White carried out weekly transect surveys in the forest surrounding the Station d'Etudes des Gorilles et

Chimpanzés, in the north of the Lopé reserve. No *C. solatus* were encountered during that time.

Sightings around the Makande study site (LN 29–38, Table 1)

A research camp (Makande), jointly run by the Institute for Tropical Ecological Research in Gabon (IRET) and the

Table 1. Published and new sightings of *Cercopithecus solatus* in Gabon.

LN	Paper/ researcher	Date of sighting	Site coordinates (lat/long)	Method	Site Description	Additional information
Specific sightings or specimens:						
1	Gautier <i>et al.</i> 1992	20/12/1984	12°07'E 0°21'S	Hunter interviews on where wild- caught living and dead monkeys were found	Maki	Male Juvenile: 2.7 kg Collector: M. Harrison
2	Gautier <i>et al.</i> 1992	18/06/1985	12°19'E 0°35'S		La Wagny	Female Infant (2): 1.5 kg Collector: Moysan
3	Gautier <i>et al.</i> 1992	14/06/1986	2°11'E 0°32'S		La wonbou	Male Infant (1): 0.7 kg Collector: Moysan/J.N. Loireau
4	Gautier <i>et al.</i> 1992	19/06/1986	12°07'E 0°21'S		Maki	Female Infant (2): 1.8 kg Collector: Moysan/J.N. Loireau
5	Gautier <i>et al.</i> 1992	20/05/1986	12°07'E 0°21'S		Maki	Male Subadult: 4.4 kg Collector: Moysan/J.N. Loireau
6	Gautier <i>et al.</i> 1992	11/04/1986	12°07'E 0°21'S		Maki	Female Juvenile: 2.6 kg Collector: J.N. Loireau
7	Gautier <i>et al.</i> 1992	18/05/1986	12°28'E 01°08'S		Koulamoutou	Male Infant (1): 0.6 kg Collector: Moysan/J.N. Loireau/ Feist
8	Gautier <i>et al.</i> 1992	23/02/1989	12°19'E 0°35'S		La Wagny	Female Infant (1): 0.7 kg Collector: J.P. Gautier
9	Gautier <i>et al.</i> 1992	04/03/1989	12°28'E 0°08'S		Koulamoutou	Male Infant (1): 0.5 kg Collector: J.P. Gautier
10	Gautier <i>et al.</i> 1992	08/03/1984	12°15'E 0°14'S	Dead monkeys collected; specimens kept in the British Museum of Natural History, London, Uk 020 7498 4533; Museum National d'Histoire Naturelle, Paris, France; Biological Station of Paimpoint, Rennes University, France	Bali River	Male Adult. Collector: M. Harrison
11	Gautier <i>et al.</i> 1992	30/03/1984	12°15'E 00°14'S		Bali River	Male Adult Collector: M. Harrison
12	Gautier <i>et al.</i> 1992	23/12/1984	12°00'E 00°25'S		Mbiga	Female Adult Collector: M. Harrison
13	Gautier <i>et al.</i> 1992	25/01/1986	12°22'E 00°38'S		Mite. Mik.	Male Adult: 6.7 kg Collector: J. P. Gautier
14	Gautier <i>et al.</i> 1992	25/01/1986	12°22'E 00°38'S		Mite. Mik.	Female Adult: 4.2 kg Collector: J.P. Gautier
15	Gautier <i>et al.</i> 1992	25/01/1986	12°22'E 00°38'S		Mite. Mik.	Male Juvenile: 1.7 kg Collector: J.P. Gautier
16	Gautier <i>et al.</i> 1992	10/03/1986	12°11'E 00°32'S		La Wonbou	Female Adult Collector: J.N. Loireau
17	Gautier <i>et al.</i> 1992	02/04/1986	12°11'E 00°32'S		La Wonbou	Male Adult: 8.7 kg Collector: J.N. Loireau
18	Gautier <i>et al.</i> 1992	13/04/1986	12°11'E 00°32'S		La Wonbou	Female Adult: 3.5 kg Collector: J.N. Loireau
19	Gautier <i>et al.</i> 1992	28/02/1989	12°19'E 00°35'S		La Wagny	Female Adult: 3.5 kg Collector: J.P. Gautier
20	Gautier <i>et al.</i> 1992	04/03/1989	12°14'E 01°01'S		Mogabo 1	Male Juvenile: 2.8 kg Collector: J.P. Gautier
21	Gautier <i>et al.</i> 1992	06/03/1989	12°19'E 01°05'S		Moukoumou	Male Adult: 5.8 kg Collector: J.P. Gautier
22	Gautier <i>et al.</i> 1992	06/02/1989	12°19'E 01°05'S		Moukoumou	Male Adult. Collector: J.P. Gautier
23	Gautier <i>et al.</i> 1992	22/02/1989	12°19'E 01°35'S		La Wagny	Male Sub Adult Collector: J.P. Gautier
24	Gautier <i>et al.</i> 1992	24/02/1989	12°19'E 01°35'S		La Wagny	Female Sub Adult Collector: J.P. Gautier
25	Gautier <i>et al.</i> 1992	24/02/1989	12°19'E 01°35'S	La Wagny	Male Sub Adult Collector: J.P. Gautier	

LN	Paper/ researcher	Date of sighting	Site coordinates (lat/long)	Method	Site Description	Additional information
26	White and Mackanga 1995	18/09/1994	11°32'34"E 00°30'44"S	Explorations of the reserve	In the Lopé Reserve	At least four individuals, including juveniles
27	White and Mackanga 1995	18/09/1994	11°32'34"E 00°30'44"S	Explorations of the reserve	In the Lopé Reserve	At least four individuals, including juveniles
28	White and Mackanga 1995	12/1994	11°20'E 01°42'S	Explorations of the reserve	In the Lopé Reserve	1 male adult, associated movement suggested presence of a group
29	Brugière <i>et al.</i> 1998	12/1996–09/1997	11°43'10"E 00°47'50"S	Line transect survey	13.8 km from the left bank of the Offoue River, close to the eastern border of the Lopé Reserve	Altitude: 450–550 m Coordinates given in Brugière <i>et al.</i> (1998)
30	Brugière <i>et al.</i> 1998	12/1996–09/1997	11°49'E 00°47'50"S		Left bank of the Offoue River, close to the eastern border of the Lopé Reserve	Altitude: <450 m Coordinates estimated from map provided by Brugière <i>et al.</i> (1998)
31	Brugière <i>et al.</i> 1998	12/1996–09/1997	11°45'32"E 0°50'30"S		8.7 km from the left bank of the Offoue River, close to the eastern border of the Lopé Reserve	Altitude: 450–550 m Coordinates given in Brugière <i>et al.</i> (1998)
32	Brugière <i>et al.</i> 1998	12/1996–09/1997	11°44'E 00°50'30"S		Left bank of the Offoue River, close to the eastern border of the Lopé Reserve	Altitude: 450–550m Coordinates estimated from map provided by Brugière <i>et al.</i> (1998)
33	Brugière <i>et al.</i> 1998	12/1996–09/1997	11°45'E 00°56'S	Chance observation	Left bank of the Offoue River, close to the eastern border of the Lopé Reserve	Altitude: <450 m Coordinates estimated from map provided by Brugière <i>et al.</i> (1998)
34	Brugière <i>et al.</i> 1998	12/1996–09/1997	11°45'E 00°56'S		Left bank of the Offoue River, close to the eastern border of the Lopé Reserve	Altitude: <450 m Coordinates estimated from map provided by Brugière <i>et al.</i> (1998)
35	Brugière <i>et al.</i> 1998	12/1996–09/1997	11°48'E 00°49'S		Very close to the left bank of the Offoue River, close to the eastern border of the Lopé Reserve	Altitude: <450 m Coordinates estimated from map provided by Brugière <i>et al.</i> (1998)
36	Brugière and Gautier 1999	1996?	11°54'35"E 00°40'39"S	Population density estimate along two line transects	Makande Field Research Station	
37	This study, FM	1993	11°54'36"E 00°40'55"S	Field sightings	Makande study area	
38	This study, FM	1993	00°41'22"S 11°54'08"E	Field sightings	Makande study area	
39	This study, LW	1993	00°09'34"S 11°48'42"E	Field sightings	The road from Offoue to Booue	Group of 4–5 individuals
40	This study, LW	1994		Field sightings	Village: Iwatsi.	1 male adult shot. Village location at the point where the Ofoue and Onoy rivers converge.
41	This study, KA	1995	11°30'30"SE 0°20'25"S	Field sightings	SOFORGA logging concession east of Leledi River	Group of >12 individuals including a large adult male
42	This study, MF	1999–2001	00°38'20"S 11°34'06 E	Observations during the 'megatransect'		
43	This study, MF	1999–2001	01°08'54"S 11°18'40"E	Observations during the 'megatransect'		
44	This study, MF	1999–2001	01°14'34"S 11°15'32"E	Observations during the 'megatransect'		
45	This study, MF	1999–2001	01°16'06"S 11°14'55E	Observations during the 'megatransect'		
46	This study, MS	2000		Hunting study	Village: Banyati	1 individual killed
47	This study, OSGP	21/07/2001	Very near to 01°08'42"S 11°46'48"E	Observed during herpetological field survey	Eastern flank of Mount Iboundji	At least 3 in a tree, clearly observed. Altitude: <i>ca.</i> 550 m

LN	Paper/ researcher	Date of sighting	Site coordinates (lat/long)	Method	Site Description	Additional information
48	This study, NB	June 2003	12°58'57.612"E 01°46'52.778"S	Field sighting during mandrill tracking	Lékédi Park. Hilltop overlooking the canopy of the rainforest, closed canopy forest with some forest-savannah mosaic	Group counted 4 adults and 3 sub-adults/infants
49	This study, MP	March–June 2004		Hunting study	Village: Mbegho	10 individuals killed in 45 days. Villagers say that <i>solatus</i> some- times raids plantations
50	This study, MP	March–June 2004		Hunting study	Village: Rongassa	1 individual (shot by a hunter on 4 June) in 90 days
51	This study, JJT	2004	12°17'24"E 01°31'12"S	Field sighting	Roadside, Popa village	335 m altitude single adult in tree
52	This study, PH	2005	12°08'29"E 01°10'04"S	Camera trapping stud- ies: 8 cameras over 50 km ² , for 48 days	A logging concession area south of Mount Mimongo	A mountain range between Mount Iboundji and Mbégbo. Seven images of <i>C. solatus</i> (see Fig. 4)
53	This study, YM	August 2006	Between the vil- lages of Ngoungou 01°31'59"S 12°19'09"E) and Popa (01°36'04"S 12°18'14"E)	Field study to collect duiker faeces for genetic study	<i>C. solatus</i> seen in a Mora- ceae tree	
54	This study, YM	2006	12°18'15"E 01°42'12"S	Field sightings	Birougou National Park (northern section)	
55	This study, JJT	2006	12°18'13" E 01°42'25"S	Field sightings	Birougou National Park (northern section)	

Village interviews:

56	Gautier <i>et al.</i> 1992	1992		Hunter interviews in 102 villages to determine presence/ absence, and estimate distribution		
57	This study, OSGP	2001	01°10'32"S 11°49'16"E	Village and hunter interviews	Villages: Boussimbi vil- lage, alt. 485 m	Said to be common on Mount Iboundji; groups often venture into village plantations. The species is well known by the villagers of Boussimbi
58	This study, MP	March–June 2004		Hunting study	Villages: Imeno-Plateau, Mbeghou, Rongassa	Abundant in Mbeghou, present in Imeno-Plateau and Rongassa. Local names given for species
59	This study, JJT	2004–2005		Village and hunter interviews	Villages: Léméngué, Koumbi, Siono and Grand Village	Species is said to be present, although uncommonly seen, and always in small groups
60	This study, JJT	2004–2005		Village and hunter interviews	Villages: Popa, Mambadi, Iwatsi, Missimba	Species is well known and was at once recognized on the poster and on digital pictures. Said to be locally common. Highest densi- ties occur in the hills between Lolo and Bouenguïdi rivers

Surveys where *C. solatus* were not encountered:

61	This study, KA, LJTW	1989–1994		SEGC Study area	Ecological field research area in Lopé National Park	LJTW PhD thesis
62	This study, JJT	2004–2005		Village interviews	Villages: Moudouma, Itsiba, Mbigou and Le- vinda villages, west of the Onoye River	Species not thought to be present Hunters did not recognise the species, and did not have a name for it
63	This study, LC	2005–2007		Hunting returns and village interviews over 2 year study (Coad 2007)	Villages: Kouagna, Dibouka, up to the Lolo River	Species not thought to be present Villagers knew the monkey by a local name 'Mbaya', and said that it did not occur in these villages, but was present in villages closer to Iboundji
64	This study, PH	2005–2007		Camera trapping stud- ies: 15 cameras over 30 km ² for 54 days	Southern bank of the Lolo River	No <i>C. solatus</i> images obtained

University of Rennes, hosted studies from 1992 to 1997 on the east side of the Offoué River. Much of the published literature on the species comes from this site or nearby.

Sightings during the “Megatranssect expedition” (LN 41–45, Table 1)

The “Megatranssect expedition” was a foot journey carried out between 1999 and 2001 by Mike Fay, from the northern Republic of Congo to the coast of Gabon. The trajectory passed through some of the most untouched forests remaining in Central Africa, and all wildlife and human sign was recorded along the way. Sun-tailed guenons were sighted on several occasions in October 2000, either in the Lopé Reserve (now Lopé National Park) or just to its southwestern border and at the limit of the Waka National Park (Fig. 1).

Sightings around Mount Iboundji (LN 47, 57, Table 1)

In the afternoons of 21 and 23 September 2001, Olivier Pauwels obtained good sightings of a group of 6–7 *C. solatus* feeding on a fruiting tree on the eastern slopes of Mount Iboundji (Offoué-Onoy Department, Ogooué-Lolo Province), in open forest, at an altitude of about 550 m. Using binoculars, he was able to identify the typical coloration of the species, and he approached the group until he was 60 m away. The species is well known by the villagers of Boussimbi, at the foot of the mountain (01°10'32"S, 11°49'16"E, altitude 485 m). They reported that *C. solatus* was common on the mount, and that groups often ventured into the village plantations.

Sightings around the Lekédi Sanctuary (LN 48, Table 1)

On 26 June 2003, Nicholas Bout radio-tracked a group of mandrills (*Mandrillus sphinx*) in the Lékédi Sanctuary. To search for the radio-collar signal he was positioned on a hill-top overlooking the canopy of the rainforest (approximately 01°47'05"S, 13°01'10"E). The position at the height of the canopy provided an unobstructed view of the forest. About 15 m from Bout, a slender and dark monkey, with a golden tail appeared and presented its profile on a large bare branch, offering a perfect view and was identifiable as *C. solatus*. It remained behind him for at least a minute. Seven monkeys also identified as *C. solatus* foraged in *Pentaclethra macrophylla* and *Musanga cecropioides* at 30 m above the ground in the canopy. They were not in the shadows, which allowed for good observation, and their long golden tails were clearly visible. The monkey closest to Bout suddenly rushed away and the group fled without calling. The entire group was counted—4 adults, 2 sub-adults and 1 infant. The local landscape is principally closed canopy forest with some forest-savannah mosaic, and is rich in all species of the local fauna found in southern and central Gabon, except the forest elephant (excluded from the sanctuary when it was fenced).

Village hunting returns in the Iméno Plateau and Ogooué-Lolo provinces (LN 46, 49, 50, 58, Table 1)

A study on subsistence hunting near logging concessions from 15 March to 20 June 2004 was carried out by Marielle

Puit and local assistants in the villages of Iméno-Plateau (90-day survey), Mbégho (situated half way between Koulamoutou and Baniati, Lolo-Bouenguidi Department, Ogooué-Lolo Province; 45-day survey), and Rongassa (about 15 km northeast of Koulamoutou; 90-day survey). Observations were made in the eastern distributional limits of *C. solatus*; local villagers killed 10 *C. solatus* over 45 days in Mbégho (see Fig. 2). Six were shot, and four were caught by ground snares. Villagers of Mbégho mentioned that *C. solatus* had previously raided plantations. In 90 days in Rongassa, one *C. solatus* was shot (4 June 2004). During a previous hunting study carried out in 2000, Malcolm Starkey recorded that a sun-tailed monkey was killed by hunters in Banyati. Among the villages visited, Mbégho was the only one where the species was said to be abundant. It was said to be seen only occasionally in the others. Local vernacular names noted included *bahia* (Pouvi language, Mbégho), *mbahi* (Massango language, Iméno-Plateau) and *imbonga* (Nzebi language, Rongassa).

Village interviews and sightings along the Baposso-Mbigou road (LN 51, 59, 60, 62, Table 1)

Bushmeat inquiries were led by Jean-Jacques Tanga in several villages along the roads from Baposso to Mbigou (01°53'47"S, 11°54'37"E, altitude 700 m; Boumi-Louétsi Department, Ngounié Province), Mbigou to Koulamoutou (Lolo-Bouenguidi Department, Ogooué-Lolo Province), and from Koulamoutou to Pana (Lombo-Bouenguidi Department, Ogooué-Lolo Province), i.e., the three roads respectively situated near the eastern, northern and western limits of Mount Birougou National Park (February–March 2004, July 2004, June 2005). Main localities and park delimitations are shown



Figure 2. Adult female *Cercopithecus solatus* trapped near Mbégho on 7 June 2004. It shows the typical body coloration of the species: black legs, brown-reddish back and flanks, tail distal part yellowish. It is shown here along with a common pangolin *Manis tricuspis* that was caught in the same locality by the same hunter. Photograph by M. Puit.

by Anonymous (2002). The bushmeat markets of Koula-moutou, Mbigou and Pana were visited, and hunters from all the villages along these roads were interviewed and shown a poster illustrating 88 African primates (Kingdon 2001). These interviews show that the species was unknown in the villages situated west of the Onoye River (Moudouma, Itsiba, Mbigou and Lévida), where the hunters did not recognize the species on the poster, and did not have a name to designate it. In comparison, the species was said to be present in the eastern villages (Lémengué, Koumbi, Siono and Grand Village), although uncommon, and always in small groups. In the villages in the northeast of Mount Birougou National Park, near Lolo River (Popa, Mambadi, Iwatsi, Missimba), the species was well known and was at once recognized both on the poster and on digital pictures. It was said to be locally common. In all villages where the species was recorded from Tanga's study, a single common name was given to this monkey by the Nzébi, Massango and Pouvi ethnic groups; *mbaya*, a name also used by the Massango in Iboundji area. In the villages near Lolo River, the species was well known for its habit of crop-raiding, especially manioc and bananas. It was hunted locally to reduce its impact on cultivated fields, and also as bushmeat. According to the interviews, it was most abundant in the hills between Lolo and Bouenguidi rivers. As these sightings are south of the formerly known distribution of *C. solatus*, Tanga asked the villagers to bring a specimen in order to unambiguously document its occurrence. Popa



Figure 3. Young female *Cercopithecus solatus* captured in the buffer zone of Mount Birougou National Park, southern Gabon, in June 2005. Photograph by J.-J. Tanga.

villagers brought him a juvenile female in early June 2005 (Fig. 3). It had been caught in a ground snare in the northeastern buffer area of Mount Birougou National Park, in a hilly area (altitude 600 m). In the early afternoon of 8 March 2004, Tanga observed a single adult resting on a tree branch at the forest edge along the road between Popa and Mbigou Moréné (01°31'12"S, 12°17'24"E; altitude 355 m; Lolo-Bouenguidi Department, Ogooué-Lolo Province).

Camera trap study around Mount Mimongo (LN 52, Table 1)

During wildlife surveys conducted by Philipp Henschel between 14 April 2005 and 2 June 2005, *C. solatus* was photographed in a logging concession area south of Mount Mimongo (01°10'04"S, 12°08'29"E; altitude 675 m, Lolo-Bouenguidi Department, Ogooué-Lolo Province), a mountain range between Mount Iboundji and Mbégou. Seven images of *C. solatus* were obtained from 18 remote camera traps distributed through a 50-km² study area over a 48-day trapping period (Fig. 4).

Camera trap study and hunting survey around the Lolo River (LN 63–64, Table 1)

Fifteen camera traps were deployed in a 30-km² study area over 54 days between 28 August and 21 October 2004 in an area about 10 km to the south of the southern bank of the Lolo River. No images of *C. solatus* were obtained. This indicates that the species is either absent or very rare south of the Lolo River. Lauren Coad and local field assistants conducted a hunting study from January 2004 to January 2005 in the same area in two villages, Dibouka (01°19'07"S, 12°12'54"E) and Kouagna (01°18'28"S, 12°13'45"E). Their results showed considerable hunting pressure that was highest within 5 km from the villages, but also extended up to hunting camps 12 km to the north, on the southern bank of the Lolo. During this study all hunting returns for the two villages were recorded, and no *C. solatus* were ever caught or seen. During a previous hunting study in these villages conducted by Malcolm Starkey from 2000 to 2002, no *C. solatus* were



Figure 4. *Cercopithecus solatus* photo taken using camera trapping, close to Mount Mimongo. Photo by P. Henschel.

observed or captured. Hunters from Dibouka could, however, identify *C. solatus* from Kingdon (2001) as *mbaya*, and said that it could be found around villages further south-west towards Iboundji.

Sightings between Popa and Ngoungou villages (LN 53, Table 1)

On 1 August 2006, in the forest surrounding Popa village, Yves Mihindou saw a single individual of *C. solatus* close to a group of *C. nictitans* in a *Musanga cecropioides* tree. As he approached, all the monkeys fled. This observation was made between the villages of Ngoungou (01°31'59"S, 12°19'09"E) and Popa (01°36'04"S, 12°18'14"E).

Sightings between Popa and Biroughou National Park (LN 54–55, Table 1)

In 2006, Yves Mihindou and Jean-Jacques Tanga reported separate sightings of individual sun-tailed guenons on the road from Popa to Birougou National Park, close to the northern boundary of the park.

Discussion

It is clear that the range of *C. solatus* extends further to the west, south, and east than was previously thought, and the extent of occurrence may be as great as 18,000 km² (previously the range was estimated at 11,000 to 12,000 km²; Brugière and Gautier 1999). Sightings of *C. solatus* very close to the limits of the national parks of Waka and Mount Birougou are particularly important, as the species was previously only known to occur in Lopé National Park. In addition, as both the Birougou and Lekedi areas are close to the Congolese border, it is possible that *C. solatus* may also occur in the Congolese part of the Massif du Chaillu. In that area of Congo, however, hunting pressure is considerably higher than on the Gabonese side of the border, and the single faunal survey carried out there in 2007 did not mention the species (Inkamba-Nkulu 2007). If present, the species is likely to be under considerable threat. The evidence from the Lolo area indicates that it may have been hunted to local extinction (as it occurs all around that area). The semi-terrestrial habits of the species render it vulnerable to wire snares, and when it encounters hunters with dogs it climbs and is then highly visible and vulnerable to hunters with guns.

Currently the IUCN Red List categorizes *C. solatus* as Vulnerable under the criteria B1ab(v). The criterion B concerns the geographic range, and B1 specifically the extent of occurrence, which, to qualify as Vulnerable, is considered to be less than 20,000 km². To qualify as Vulnerable under criterion B1, two further conditions (subcriteria) must apply in aspects concerning (a) a severely fragmented population or occurrence at no more than 10 locations, (b) decline in populations and range, or (c) extreme fluctuations in populations or range (see IUCN [2001] for the precise criteria). In the case of the current designation, *C. solatus* was considered to exist at no more than 10 locations (a) and is suffering from decline in

the numbers of mature individuals (b(v)) (Oates and Bearder 2008).

Oates and Bearder (2008) indicated that hunting was becoming an increasingly serious threat to *C. solatus*. Severe hunting pressure may be leading to local extinctions, and the number of mature individuals is undoubtedly decreasing. Most of the area of occurrence of the sun-tailed guenon apart from the protected areas is now under timber exploitation, with the result that the logging road network has penetrated almost all of its range. Roads provide easy access to local and commercial bushmeat hunters in the region and are strongly associated with wildlife depletion in Central Africa and in the range fragmentation of a number of species (Blake *et al.* 2008; Laurance *et al.* 2006; Minnemeyer *et al.* 2002; Stokes *et al.* 2010; Wilkie *et al.* 2000). Thus, the IUCN Red Listing status of the sun-tailed guenon should remain as Vulnerable B1ab(v), despite the increase in the size of its extent of occurrence detailed in this paper.

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Literature Cited

- Anonymous. 2002. *Les Parcs nationaux du Gabon. Stratégie pour le troisième millénaire. République Gabonaise*. National Geographic Society, Wildlife Conservation Society, Libreville. 108pp.
- Blake, S., S. Deem, S. Strindberg, F. Maisels, L. Momont, B.-I. Inogwabini, I. Douglas Hamilton, W. Karesh and M. D. Kock. 2008. Roadless wilderness area determines

- forest elephant movements in the Congo Basin. *PLoS One* 3, e3546 doi:10.1371/journal.pone.0003546.
- Brugière, D. and J.-P. Gautier. 1999. Status and conservation of the sun-tailed guenon *Cercopithecus solatus*, Gabon's endemic monkey. *Oryx* 33: 67–74.
- Brugière, D., J.-P. Gautier and S. Lahm. 1998. Additional data on the distribution of *Cercopithecus (lhoesti) solatus*. *Folia Primatol.* 69: 331–336.
- CITES. 2010. Appendices I, II and III valid from 24 June 2010, p.42. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Secretariat / UNEP, Geneva, Switzerland. Website: <<http://www.cites.org/eng/app/index.shtml>>. Accessed: 27 August 2010.
- Coad, L. M. 2007. Bushmeat Hunting in Gabon: Socio-economics and Hunter Behaviour. PhD thesis, University of Cambridge, Cambridge, and Imperial College, London, UK.
- Gautier, J.-P., F. Moysan, A. T. C. Feistner, J.-N. Loireau and R. W. Cooper. 1992. The distribution of *Cercopithecus (lhoesti) solatus*: an endemic guenon of Gabon. *Rev. Ecol.* 47: 367–381.
- Harrison, M. J. S. 1988. A new species of guenon (genus *Cercopithecus*) from Gabon. *J. Zool., Lond.* 215: 561–557.
- Inkamba-Nkulu, C., 2007. *Sondage écologique dans le massif du Chaillu*. Wildlife Conservation Society (WCS), Congo. 15pp.
- IUCN, 2001. IUCN Red List Categories and Criteria. Version 7.0. International Union for Conservation of Nature (IUCN), Species Survival Commission (SSC), Gland, Switzerland, and Cambridge, UK. Website: <<http://intranet.iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines.pdf>>. Accessed: 27 August 2010.
- Kingdon, J. 2001. *The Kingdon Field Guide to African Mammals*. Reprint of the original with corrections. Academic Press, London.
- Laurance, W. F., B. M. Croes, L. Tchignoumba, S. A. Lahm, A. Alonso, M. E. Lee, P. Campbell and C. Ondzeano. 2006. Impacts of roads and hunting on central African rainforest mammals. *Conserv. Biol.* 20: 1251–1261.
- Minnemeyer, S., T. Walker, J.-G. Collomb, L. Cotton and D. Bryant. 2002. *An Analysis of Access to Central Africa's Rainforests*. World Resources Institute, Washington, DC.
- Oates, J. F. and S. K. Bearder (assessors). 2008. *Cercopithecus solatus*. IUCN/SSC Red List of Threatened Species. International Union for Conservation of Nature (IUCN), Species Survival Commission (SSC), Gland, Switzerland, and Cambridge, UK. Website: <<http://www.iucnredlist.org/apps/redlist/details/4230/0>>. Accessed 26 August 2010.
- Stokes, E., S. Strindberg, P. Bakabana, P. W. Elkan, F. Iyenguet, B. Madzoke, G. Malanda, B. Mowawa, C. Moukoubou, F. Ouakabadio and H. Rainey. 2010. Monitoring great ape and elephant abundance at large spatial scales: measuring effectiveness of a conservation landscape. *PLoS One* 5: 1–18.
- White, L. J. T. and A. Mackanga-Missandzou. 1995. Good news for *Cercopithecus solatus*, Gabon's endemic guenon. *African Primates* 1: 6–8.
- Wilkie, D., E. Shaw, F. Rotberg, G. Morelli and P. Auzel. 2000. Roads, development, and conservation in the Congo Basin. *Conserv. Biol.* 14: 1614–1622.

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