

Extension of the Geographical Range of White-browed Titi Monkeys (*Callicebus discolor*) and Evidence for Sympatry with San Martin Titi Monkeys (*Callicebus oenanthe*)

Jan Vermeer · Julio C. Tello-Alvarado ·
Sergio Moreno-Moreno ·
Fernando Guerra-Vásquez

Received: 12 April 2010 / Accepted: 15 January 2011 / Published online: 8 April 2011
© Springer Science+Business Media, LLC 2011

Abstract White-browed titi monkeys (*Callicebus discolor*) have one of the largest distribution ranges of all titi monkey species, occurring from central Peru to southern Colombia. During a long-term study on the distribution of titi monkeys and other primates in Peru, we conducted extensive surveys in the San Martin Department of northeastern Peru. We encountered *Callicebus discolor* at the left bank of the Huallaga River, where the species most probably lives in sympatry with endemic San Martin titi monkeys (*Callicebus oenanthe*). Our study reveals an important extension of its formerly known distribution range. Massive deforestation activities in the region make studies on the habitat preferences of both species difficult, as most titi monkeys are confined to the remaining small remnants of the original forest. Urgent conservation measures are necessary to preserve the last lowland forests of San Martin.

Keywords *Callicebus discolor* · *Callicebus oenanthe* · Distribution range · San Martin Department

Introduction

Our knowledge of the taxonomy and distribution of Peruvian primates is still very limited. Most available information is based on museum specimens, and researchers

J. Vermeer (✉)
Le Conservatoire pour la Protection des Primates, La Vallée des Singes, 86700 Romagne, France
e-mail: jan.vermeer@telfort.nl

J. Vermeer · J. C. Tello-Alvarado · S. Moreno-Moreno · F. Guerra-Vásquez
Proyecto Mono Tocón, Moyobamba, Peru

J. C. Tello-Alvarado · F. Guerra-Vásquez
Facultad de Ecología, Universidad Nacional de San Martín, Tarapoto, Peru

have conducted few systematic surveys in the country. Even in areas where researchers have been present for >25 yr, such as the Manu National Park, the taxonomic identity of titi monkeys is unclear (Vermeer, *pers. obs.*).

According to recent taxonomic revisions, Peru is home to 6 species of titi monkeys: *Callicebus cupreus*, *C. caligatus*, *C. discolor*, *C. oenanthe*, *C. brunneus*, and *C. lucifer* (Aquino & Encarnacion 1994; Hershkovitz 1990; van Roosmalen *et al.* 2002). Museum specimens of *Callicebus donacophilus* in the Leiden and Paris natural history museums are reported to originate from Peru (Jentink 1892; Vermeer, *pers. obs.*), but the presence of this species has not been confirmed by observations in the field. Therefore we must assume that the species is restricted to Bolivia. One of us has observed *Callicebus aureipalatii* in the south of Peru (Vermeer, *pers. obs.*). Finally Aquino *et al.* (2008) reported the presence of a possible new taxon of *Callicebus torquatus* north of the Amazon River.

The 2 species known to live in the San Martin Department of Peru are *Callicebus discolor* and *C. oenanthe*. *Callicebus discolor* is often considered to be a species with red underparts and a large band of white hairs above the eyes (Aquino & Encarnacion 1994; Hershkovitz 1990; van Roosmalen *et al.* 2002). Isidore Geoffroy Saint-Hilaire and Deville described the species in 1848, based on monkeys Castelnau and Deville collected on the banks of the Amazon and Ucayali rivers (Geoffroy Saint-Hilaire & Deville 1848). Their first description of the new species caused considerable confusion, as they mentioned that it had some gray-whitish hairs on the forehead. However, in a subsequent and more detailed description with a colored plate, Geoffroy reported the species to have a black forehead, in some cases “grey with a vague reddish hue” (Geoffroy Saint-Hilaire 1851). Personal examination by Jan Vermeer of the type specimens, present in the Paris Natural History Museum, showed that the species has no white band above the eyes, and is identical to the earlier described *Callicebus cupreus* (von Spix 1823). Other authors had already mentioned this synonymy (Elliot 1913; Gray 1870; Schlegel 1876), but it seems to have been ignored by most recent taxonomic revisers (Hershkovitz 1990; van Roosmalen *et al.* 2002).

Although the next available name for white-browed titi monkeys would be *Callicebus leucometopus* (Cabrera 1900), we need to determine first the validity of 5 other white-browed titi monkey species that have been described before we assign this name to the monkeys in the San Martin Department. The distribution of white-browed titi monkeys probably ranges from the area between the Ucayali and Huallaga rivers in central Peru to the Putumayo River in Colombia (Defler 2004; Hershkovitz 1990), and considering the number of potential geographical barriers it is likely that there is >1 species. In the absence of a thorough examination of the situation, we will continue to call the white-browed titi monkeys of San Martin *Callicebus discolor* to minimize confusion.

Thomas (1924) described San Martin titi monkeys (*Callicebus oenanthe*) from a specimen collected at Moyobamba. Until 2007 the species was known only from very few localities, all in the Alto Mayo valley. However, our previous research showed that the actual range of the species is much larger, extending southward toward the Huayabamba River (Boveda-Penalba *et al.* 2009). Whereas *Callicebus discolor* is red with a grayish back, *C. oenanthe* is brownish, and both species are easily distinguishable.

We collected data on the distribution of *Callicebus* during a long-term research project on the distribution and taxonomy of primates in northeastern Peru. We aimed to determine the range of both *Callicebus discolor* and *Callicebus oenanthe* on the left bank of the Huallaga River.

Methods

Study Site

The San Martin Department, situated in northeastern Peru, is bordered by the Cordillera Oriental on the west and the lowland forests of the Amazon basin in the east. It is intersected in the southeast by the Huallaga River.

We commenced our research project on the distribution and taxonomy of primates in northeastern Peru with a study of the distribution of *Callicebus oenanthe*. Until the beginning of our study, this species was known only from the Alto Mayo Valley, near Moyobamba (de Luycker 2006; Rowe & Martinez 2003); therefore we started our work in that area. From there we continued in southern and eastern directions, as far as San Martin titi monkeys were observed by our team or reported by local habitants. We encountered *Callicebus discolor* near Tarapoto, and from there we moved eastward to determine the extent of its distribution on the left bank of the Huallaga River. The study area suffers severe deforestation, with only small patches of degraded forest remaining.

Survey

Between May 2007 and September 2010 we conducted 14 mo of surveys. The survey team consisted of 4 principal investigators accompanied by several field assistants. To increase the surveyed area, the team often split into 2 subteams that walked different roads to sample forest fragments randomly.

To determine the presence of titi monkeys, we applied 3 different methods that had proven to be successful during earlier surveys: listening to vocalizations, direct visual observations, and interviews with locals. Titi monkeys are discrete individuals that are difficult to find in the forest. However, in the morning they advertise their presence by very loud vocalizations that probably serve to define the boundaries of their territory. We noticed that titi monkeys occasionally also vocalize at dusk when they are traveling to their sleeping trees. These experiences with the activity rhythm of the monkeys resulted in 2 daily study periods, one at dawn and the other at dusk.

If we heard titi monkeys calling, we tried to approach them to make visual contact. If possible, we filmed and photographed them for comparison with specimens from different localities at a later stage. We conducted interviews at each locality where local people were present. For these interviews we used pictures of 15 primate species that live in Peru. We asked the interviewee to name all primates that he or she recognized, to determine his or her knowledge of the primates that live in the region and to see if he or she recognized titi monkeys. If we had not seen or heard titi monkeys, we also asked him or her to listen to a recording of the

vocalization of *Callicebus oenanthe*, to see if he or she recognized the sound. To identify the species of *Callicebus* known to the interviewees, we showed them pictures of different color-morphs of *Callicebus oenanthe*, *Callicebus discolor*, and *Callicebus cupreus*. After the interview we judged the reliability of the information supplied by comparing it with our knowledge of primate distribution in this part of Peru and with the answers of other interviewees where possible.

Results

We surveyed a total of 298 localities, some of them more than once. In case of multiple visits to the same site we registered only the successful visits. Therefore it is not possible to quantify exactly how often we surveyed each locality. At 46 localities, we heard the vocalizations of *Callicebus discolor* or observed individuals, or local inhabitants reported to us the presence of the species. With some experience it is possible to distinguish the vocalization of *Callicebus discolor* from that of *Callicebus oenanthe*; the vocalization of the former is slower and shorter.

Eleven of the localities where *Callicebus discolor* was present are on the left bank of the Huallaga River (Table I). *Callicebus discolor*, with its orange-red underparts and striking white eyebrow-line, is very different from all other primate species living in the region. The species is easily recognizable by locals, and all localities reported in this publication were judged to be reliable. We observed both *Callicebus discolor* and *C. oenanthe* between the left bank of the Mayo River and Tarapoto, and heard the vocalization of the latter species at one other locality in this zone (Fig. 1, Tables I and II). Local inhabitants also reported the presence of both species in this area (Tables I and II). We did not observe *Callicebus oenanthe*, nor was it reported in the 10 localities that we surveyed in the area east of Tarapoto.

Table I Observations or reports of *Callicebus discolor* in the study area

Locality	Interview	Vocalization	Observations	No. of groups (no. of individuals)	Altitude	Coordinates
Naranjal	+	+	+	1 (4)	183	6°09'24 S–76°14'40 W
Nuevo Paraíso	+	–	–	0	182	6°11'26 S–76°15'16 W
La Libertad (Pongo)	+	–	–	0	185	6°14'35 S–76°05'05 W
Davicillo	+	–	–	0	190	6°14'47 S–76°15'23 W
Sangamayoc	+	+	+	1 (2)	175	6°15'16 S–76°09'28 W
San Miguel	+	–	–	0	200	6°18'48 S–76°09'01 W
Pinto Recodo	+	+	+	1 (4)	304	6°21'26 S–76°37'47 W
Yarina	+	–	–	0	152	6°25'00 S–75°54'00 W
Andevuela (left bank of Mayo River)	+	–	–	0	428	6°31'37 S–76°27'15 W
Mayopampa	+	+	+	2 (2)	424	6°32'37 S–76°25'13 W
Km7 San Francisco	–	+	+	2 (7)	359	6°32'54 S–76°25'33 W
Tupac Amarú	–	+	–	0	312	6°34'43 S–76°00'37 W
Shapaja	+	+	+	1 (7)	225	6°35'08 S–76°16'40 W

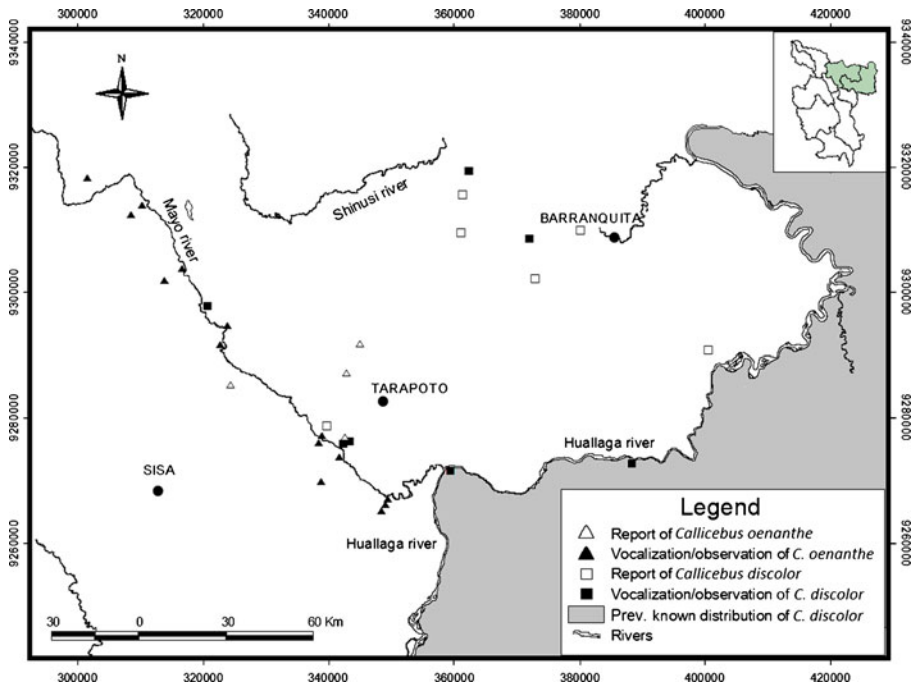


Fig. 1 Localities where *Callicebus discolor* and *Callicebus oenanthe* were observed or reported in the study area.

Discussion

The lack of knowledge of the distribution of Neotropical primates makes effective conservation measures for endangered species difficult or even impossible. Until now, *Callicebus discolor* was thought to be restricted to the right bank (east side) of the Huallaga River in Peru (Hershkovitz 1990). Our study shows that the Huallaga River is not a geographical barrier for the species, as we also observed it on the left bank. The species probably occupies the whole area between the triangle of the Huallaga and Marañon rivers and the central cordillera Cahuapanas, which would represent a huge extension of the known distribution.

Callicebus discolor lives in the area north of the confluence of the Mayo River and Huallaga River in the same forests as *Callicebus oenanthe*. We did not observe both species together, but as there are no geographical barriers between the localities where we sighted or heard both species and from where both species were reported, we can assume that they live sympatrically in this part of Peru. Sympatric *Callicebus* species have also been reported from other regions within the distributional range of the genus. *Callicebus lucifer* and *C. discolor* are known to be sympatric in northern Peru (Aquino & Encarnacion 1994). The apparent sympatry of 2 more closely related species, *Callicebus modestus* and *C. olallae*, has been reported from Bolivia (Felton *et al.* 2006; Martinez & Wallace 2007), and a potential sympatry of *Callicebus moloch* and *C. brunneus* has been reported from Brazil (Ferrari *et al.* 2000). At both localities there is a supposition that the different species hybridise (Felton *et al.* 2006; Ferrari *et al.* 2000). There is no

Table II Observations or reports of *Callicebus oenanthe* in the study area

Locality	Interview	Vocalization	Observation	No. of groups (no. of individuals)	Altitude	Coordinates
La Merced	–	+	–	0	1156	6°09'51 S–76°47'40 W
San Luis (right bank of Mayo River)	+	+	–	0	745	6°12'14 S–76°42'56 W
La Florida	–	+	–	0	1053	6°13'03 S–76°43'55 W
Aguas de Oro	+	+	+	1 (1)	526	6°17'46 S–76°39'31 W
Ponazapa	–	+	+	1 (1)	745	6°18'44 S–76°41'01 W
Pinto Recodo	+	+	–	0	287	6°22'55 S–76°35'42 W
San Antonio de Cumbaza	+	–	–	0	885	6°24'18 S–76°24'05 W
Poloponta (Shanao)	+	–	+	2 (3)	288	6°24'21 S–76°36'01 W
ACM Chorrobamba	+	–	–	0	537	6°26'48 S–76°25'16 W
San Miguel	+	–	–	0	372	6°27'46 S–76°35'20 W
Andeviela (left bank of Mayo River)	+	+	+	1 (1)	267	6°32'16 S–76°27'33 W
Mayopampa	+	–	–	0	295	6°32'23 S–76°25'25 W
Estero	–	+	+	3 (6)	409	6°32'46 S–76°27'43 W
Near San Francisco (right bank)	+	+	–	1 (3)	261	6°33'44 S–76°25'38 W
San Fernando	+	+	+	1 (4)	342	6°36'10 S–76°27'29 W
Mamonaquihua	–	+	+	5 (8)	212	6°37'40 S–76°21'43 W
Mamonaquihua	–	–	+	1 (3)	232	6°38'08 S–76°21'57 W
Mamonaquihua	–	+	+	2 (5)	223	6°38'41 S–76°22'18 W

evidence that hybridization occurs among *Callicebus oenanthe* and *C. discolor*. We have observed variation in the coloration of *Callicebus oenanthe*, but this variation occurs throughout its entire range. It has been suggested that some species are restricted to different habitats (Ferrari *et al.* 2000; Kinzey 1997; Martinez & Wallace 2007), and this might also have been the case in San Martin in the past. However, the habitat of *Callicebus* around Tarapoto is now reduced to small fragments of forest, and titi monkeys may be forced to live in habitats in which they did not evolve, and to which they are not adapted. The deforestation makes it difficult to study differences in habitat preferences between both species. If no urgent conservation measures are taken to stop the destruction of San Martins' rich natural patrimony, the opportunity to study differences in habitat preferences, and the way titi monkeys cope with living in fragments, will be lost forever.

Acknowledgments This study is part of a long-term project for the conservation of *Callicebus oenanthe*, coordinated by the Peruvian NGO Proyecto Mono Tocón and initiated by Le Conservatoire pour la Protection des Primates of the primate park La Vallée des Singes of Romagne, France. We thank Dario Lorente Hollingworth, José Tito Villacis del Castillo, César Manuel Paredes Arévalo, Carlos Enrique Zabarburú Chicana, Julio Rengifo Chávez, Paulino Rafael Altamarino, and Antonio J. Bóveda-Penalba for companionship during the study. We thank Eckhard Heymann, Rob Wallace, and an anonymous reviewer for their comments on the manuscript. We also thank Cécile Callou and Jacques Cuisin for allowing us to study the collection of the Museum Nationale d'Histoire Naturelle de Paris, and René Dekker and Hein van Grouw for access to the collection of Naturalis in Leiden. We also thank the personnel of the Naturalis Library. Financial support for the study was provided by La Vallée des Singes, the Friends of Blackpool Zoo, Primate Conservation Inc., Apenheul Primate Park, Twycross Zoo, the Zoological Society of

London, Eskilstuna Zoo, the Shaldon Wildlife Trust, Zodiac Zoos, and Bellewaerde Park. We thank DGFFS for authorization (Authorization 255-2009-AG-DGFFS-DGEFFS) to conduct this study. Our work would not have been possible without the help and hospitality of the Peruvian people, who were always friendly and happy to respond to our questions.

References

- Aquino, R., & Encarnacion, F. (1994). Primates of Peru. *Primate Report*, 40, 27–30.
- Aquino, R., Terrones, W., Comejo, F., & Heymann, E. W. (2008). Geographic distribution and possible taxonomic distinction of *Callicebus torquatus* populations in Peruvian Amazonia. *American Journal of Primatology*, 70, 1181–1186.
- Boveda-Penalba, A. J., Vermeer, J., Rodrigo, F., & Guerra-Vasquez, F. (2009). Preliminary report on the distribution of *Callicebus oenanthe* on the eastern feet of the Andes. *International Journal of Primatology*, 30, 467–480.
- Cabrera, A. (1900). Estudios sobre una colección de monos americanos. *Anales de Sociedad Espanola de Historia Natural*, 9(29), 83–85.
- Defler, T. R. (2004). *Primates of Colombia*. Bogotá: Conservacion Internacional de Colombia.
- de Luycker, A. (2006). Preliminary report and conservation status of the Rio Mayo titi monkey, *Callicebus oenanthe* Thomas, 1924, in the Alto Mayo Valley, Northeastern Peru. *Primate Conservation*, 21, 33–39.
- Elliot, D. G. (1913). *A review of the primates I*. New York: American Museum of Natural History.
- Felton, A., Felton, A. M., Wallace, R. B., & Gómez, H. (2006). Identification, behavioural observations, and notes on the distribution of the Titi monkeys *Callicebus modestus* Lönnberg, 1939 and *Callicebus olallae*, Lönnberg 1939. *Primate Conservation*, 20, 41–46.
- Ferrari, S. F., Iwanaga, S., Messias, M. R., Ramos, E. M., Ramos, P. C. S., da Cruz Neto, E., *et al.* (2000). Titi monkeys (*Callicebus* spp., Atelidae: Platyrrhini) in the Brazilian State of Rondônia. *Primates*, 41, 229–234.
- Geoffroy Saint-Hilaire, I. (1851). Description des mammifères nouveaux ou imparfaitement connus de la collection du Muséum d'Histoire naturelle 3: Famille des Singes, Supplément. *Archives du Muséum d'Histoire Naturelle*, 5, 551–555. +plate 28.
- Geoffroy Saint-Hilaire, I., & Deville, E. (1848). Note sur huit espèces nouvelles de singes américains, faisant partie des collections de MM. De Castelnau et Emilie Deville. *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences de Paris*, 27, 498.
- Gray, J. E. (1870). *Catalogue of monkeys, lemurs and fruit-eating bats in the collection of the British Museum* (pp. 54–57).
- Hershkovitz, P. (1990). Titis, New World Monkeys of the genus *Callicebus*: a preliminary taxonomic review. *Fieldiana Zoology*, 55, 1–109.
- Jentink, F. A. (1892). Catalogue systématique des mammifères (singes, carnivores, ruminants, pachydermes, sirènes et cétacés). *Muséum d'Histoire Naturelle des Pays Bas*, 11, 52–53.
- Kinzey, W. G. (1997). *New World Primates: Ecology, evolution and behavior* (p. 215).
- Martinez, J., & Wallace, R. B. (2007). Further notes on the distribution of endemic Bolivian Titi Monkeys, *Callicebus modestus* and *Callicebus olallae*. *Neotropical Primates*, 14, 47–54.
- Rowe, N., & Martinez, W. (2003). *Callicebus* sightings in Bolivia, Peru and Ecuador. *Neotropical Primates*, 11, 32–35.
- Schlegel, H. (1876). Les singes, Simia. *Muséum d'Histoire Naturelle de Pays-Bas*, 12, 230–241.
- Thomas, O. (1924). New *Callicebus*, *Conepatus*, and *Oecomys* from Peru. *Annals and Magazine of Natural History*, 9(14), 286–288.
- van Roosmalen, G. M., van Roosmalen, T., & Mittermeier, R. A. (2002). A taxonomic review of the titi monkeys, genus *Callicebus* Thomas 1903, with the description of two new species, *Callicebus bernhardi* and *Callicebus stephennashi*, from Brazilian Amazonia. *Neotropical Primates*, 10 (Supplement), 1–52.
- von Spix, J. B. (1823). *Simiarum et vespertiliarum Brasilienses species nova* (pp. 18–23).