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A NEW SPECIES OF *CALLICEBUS* THOMAS, 1903 (PRIMATES, PITHECIIDAE) FROM THE STATES OF MATO GROSSO AND PARÁ, BRAZIL

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ABSTRACT

A new species of titi monkey, genus Callicebus Thomas, 1903, is described based on four individuals, one from a small tributary of the left bank of Rio Teles Pires, northern state of Mato Grosso, and three others from Largo do Souza, Rio Iriri, Pará, Brazil. The new species belongs to the Callicebus moloch species group, and the main diagnostic characteristics of the new species are the whitish forehead, sideburns and beard coloration, which are contiguous, forming a frame around the blackish face; overall body pelage coloration is pale grayish-brown agouti; hands, feet and tip of the tail whitish; belly and inner sides of fore and hind limbs uniformly orange. The pattern of pelage coloration and qualitative and quantitative skull morphology are described and compared to the other species of the Callicebus moloch group. Species of the Callicebus moloch group show great similarity in skull morphology and morphometrics, making the external morphological characters, specially the chromatic fields, the most reliable diagnostic trait to identify the species.

KEY-WORDS: *Callicebus*; New species; *Callicebus moloch* group; Brazil.

INTRODUCTION

Callicebus Thomas, 1903 comprises medium-sized platyrrhines ranging in body mass from 1 to 2 kg, distinguished by long, colorful pelage and a long and non-prehensile tail. The genus occurs exclusively in South America, east of the Andes. This distribution includes all major tropical South American biomes, such as the Amazon Rainforest, the Pantanal, the dry and semideciduous forests of Paraguayan Chaco, Atlantic Rainforest and the adjacent semideciduous forests of eastern Brazil (Hershkovitz, 1988, 1990; Van Roosmalen *et al.*, 2002).

The first taxonomic revision of the genus was performed by Elliot (1913) who recognized 22 monotypic species. However, Hershkovitz (1963) in his revision of Amazonian forms of the genus reduced the number of species, recognizing three polytypic species: (1) *C. moloch* [*C. m. moloch* (Hoffmannsegg, 1807); *C. m. donacophilus* (d'Orbigny, 1836); *C. m. hoffmannsi* (Thomas, 1908); *C. m. brunneus* (Wagner, 1842); *C. m. cupreus* (Spix, 1823); *C. m. discolor* (I. Geoffroy & Deville); *C. m. ornatus* (Gray, 1866)]; (2) *C. torquatus* [*C. t. torquatus* (Hoffmannsegg, 1807); *C. t. lugens* (Humboldt, 1811); *C. t. medemi* (Hershkovitz, 1963)]; and

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(3) *C. personatus* (É. Geoffroy, 1812) (not included in that study).

Posteriorly, Hershkovitz (1988, 1990) recognized 13 species [*C. modestus* Lönnberg, 1939, *C. donacophilus*, *C. olallae* Lönnberg, 1939, *C. oenanthe* Thomas, 1924, *C. cinerascens* (Spix, 1823), *C. hoffmannsi*, *C. moloch*, *C. brunneus*, *C. cupreus*, *C. caligatus* (Wagner, 1842), *C. dubius* Hershkovitz, 1988, *C. personatus*, and *C. torquatus*], five of them polytypical (*C. donacophilus*, *C. hoffmannsi*, *C. cupreus*, *C. personatus* and *C. torquatus*), summing up 23 nominate taxa divided in four species group (*modestus*, *donacophilus*, *moloch* and *torquatus*). Van Roosmalen *et al.* (2002) recognized all the subspecies formerly recognized by Hershkovitz as full species. These authors also described two new species for the genus (*C. stephennashi* and *C. bernhardi*). The article of Van Roosmalen *et al.* (2002) however is not a taxonomic revision in a proper way, but includes decisions and information of other taxonomical studies about the genus.

Nowadays 30 species *Callicebus* are recognized (Groves, 2005; Wallace *et al.*, 2006; Rylands & Mittermeier, 2009; Defler *et al.*, 2010) and classified into five species groups, *C. personatus*, *C. torquatus*, *C. donacophilus*, *C. cupreus* e *C. moloch* (Van Roosmalen *et al.*, 2002). The *C. moloch* group, is composed by six species (*C. moloch*, *C. cinerascens*, *C. brunneus*, *C. hoffmannsi*, *C. baptista* Lönnberg, 1939; *C. bernhardi*) distributed over the eastern portion of the Amazon biome, between the Rio Madeira to the west, the Amazon River to the north, the Rio Tocantins and Rio Araguaia to the east, and the central region of the Mato Grosso State to the south (Hershkovitz, 1988, 1990; Eisenberg & Redford, 1999; Van Roosmalen *et al.*, 2002).

In 1997 one of us (M.K.) collected a specimen of *Callicebus* from a small tributary of the right bank of Rio Teles Pires, state of Mato Grosso. Besides this specimen, two other individuals were collected from Rio Iriri, state of Pará, showing the same color pattern. When compared with *Callicebus* specimens in the collection of the Museu de Zoologia da Universidade de São Paulo (MZUSP) and others referred to in the literature they were found to belong to a hitherto unnamed form, which is described below.

MATERIALS AND METHODS

We have studied skins and skulls deposited in the mammal collection of the Museu de Zoologia da Universidade de São Paulo (MZUSP) (Appendix 1).

Five species of the *C. moloch* group (*C. moloch*, *C. cinerascens*, *C. brunneus*, *C. hoffmannsi*, *C. baptista*) and one of *C. donacophilus* group (*C. pallescens* Thomas, 1907) were included in the comparative analysis. We also examined photographs of the holotype of *C. remulus* Thomas, 1903 (collection number BMNH 1876.6.19.1, adult, female, type locality: Santarém, Pará, Brazil), now regarded as a junior synonym of *C. moloch*, to compare with the samples from Pará.

The external qualitative characters refer to the color pattern of the pelage of the head, body, hands, feet and tail. External measurements were taken from the specimen's tags as follows: (1) head and body length (HB); (2) tail length (T); (3) fore foot length (FF); (4) hind foot length (HF); and (5) ear length (E). When only total length (TL) was provided, we subtracted the recorded tail length from total length to obtain the values of the head and body length.

Skull measurements were taken with a digital caliper at the nearest hundredth of millimeter and their definitions are as follows: *greatest length of skull (GLS)*, from the anterior most point of the premaxilla to the posterior most point of the occipital region; *condilobasal length (CBL)*, from anterior most point at the margin of incisive alveoli to posterior most point of occipital condyle; *greatest breadth of braincase (GBB)*, distance between the outermost points of the lateral surface of the brain case above the squamosal root of the zygomatic arch; *zygomatic breadth (ZB)*, distance across the external sides of the zygomatic arches; *orbital breadth (OB)*, distance across the external sides the orbits; *postorbital breadth (POB)*, the least width of the skull across the postorbital constriction; *nasal breadth (NL)*, the least distance from anterior tip of the left to the anterior tip of the right nasal bone; *palatal length (PL)*, from the posterior most point of the alveolar edge of inner incisors to the anterior most point of the posterior border of the palate; *palatal breadth (PB)*, the distance across the external most points of the margin of the alveoli of the first upper molars; *breadth of foramen magnum (FOM)*, great breath of foramen magnum; *bullar length (BL)*, greatest diameter of the auditory bulla taken perpendicular to the major axis; *rostral breadth across the upper canines (RC)*, distance across the external most points of the borders of the left and right upper canines; *maxillary toothrow length (MTR)*, the least distance from the anterior most point of the border of the alveolus of the upper canine to the posterior most point of the border of the alveolus of the last molar; *mandible length (MBL)*, from the anterior most point of the mandible to the posterior

most point of the angular process; *infradental-gnatio distance (IDG)*, the length of mandibular symphysis; *coronoid process height (CPH)*, a perpendicular line to the lower border of the corpus mandibulae to the top of the coronoid process; *lower postcanine tooththrow (LTR)*, from the anterior most point of the alveolus of first lower premolar to the posterior most point of the alveolus of the last molar; *breadth across lower molars (M1B)*, breadth across the lateral most points of the alveoli of the first lower molars; *breadth across lower canines (LCB)*, breadth across the lateral most points of the alveoli of the lowers canines.

Only adult individuals, recognized by having permanent dentition and ossified spheeno-occipital suture were measured in our analysis.

Distributional data on *Callicebus* species were obtained by direct examination of specimens, from the literature (Paynter Jr. & Traylor Jr., 1991; Vanzolini, 1992; Pimenta & Silva Júnior, 2005; Gregorin, 2006) and gazetteer available on the Internet (Global Gazetteer 2.2, www.fallingrain.com/world/index.html).

RESULTS AND DISCUSSION

Callicebus vieirai sp. nov.

Holotype: MZUSP 34663 (field number PEV 747-748), skin and skull, adult male, collected by

Marília Kerr in the type locality on April 7th, 1997 during an expedition conducted by Dr. Paulo Emílio Vanzolini; left coronoid process damaged.

Paratypes: MZUSP 25441 (field number JLSilvaFº 105), skin and skull, adult female, collected in November 22nd, 1988, by J.L. Silva-Filho in the Largo do Souza, Rio Iriri, Pará, Brazil; the skull is very damaged, presenting only the nasals, the frontals, most part of parietals, part of the left orbit and a small part of the premaxilla, that support the upper left and right first incisors and the upper left second incisor; most part of the left side of the mandible is lost. MZUSP 25442 (field number JLSilvaFº 106), skin and skull, adult male collected in November 22nd, 1988, by J.L. Silva-Filho in the Largo do Souza, Rio Iriri, Pará, Brazil; the skull is partially damaged, with the left side of the facial region lost. MZUSP 25443 (field number JLSilvaFº 107), skin and skull, adult male collected in November 22nd, 1988, by J.L. Silva-Filho in the Largo do Souza, Rio Iriri, Pará, Brazil; the most part of the left side of skull is damaged, with the frontal, part of the parietal and squamosal bones, including the zygomatic arch, absent.

Type locality: Rio Renato, tributary of Rio Teles Pires (right bank), nearby the city of Cláudia, state of Mato Grosso, Brazil (11°33'00.15"S, 55°10'59.98"W; about 370 m above sea level) (Fig. 1).

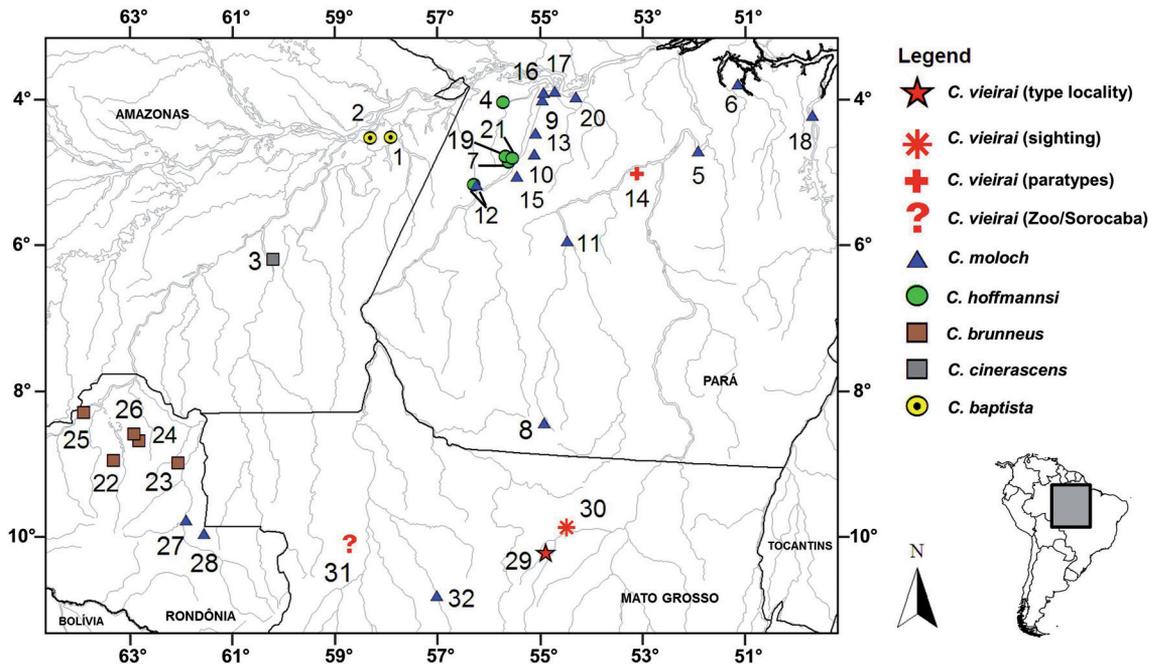


FIGURE 1: Distribution of the specimens of *Callicebus* studied. Numbered points correspond to collection localities listed in the gazetteer (see Appendix 2).

Distribution: Known from three distant localities of the Brazilian states of Mato Grosso and Pará. In the state of Mato Grosso, the species occurs in the type locality, and a nearby Ribeirão Carmelita (tributary of Rio Azul) (11°01'00.15"S, 54°28'59.99"W) where two specimens were sighted by one of us (M.K.) but were not collected. Besides, the species possibly occurs in a third locality, Juína, in the northwestern Mato Grosso, where a male and a female were seized by Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA) and further were led to the Parque Zoológico Municipal Quinzinho de Barros (Sorocaba, state of São Paulo; Rodrigo Teixeira, *pers. comm.*). However, there is not more information that indicates a more precise point in Juína region where the animals was caught. In the state of Pará, *Callicebus vieirai* occurs in Largo do Souza, Rio Iriri (04°00'S, 53°00'W), in Rio Xingu.

Habitat: The locality where the holotype was collected may be described as a tropical evergreen rainforest, composed by medium-sized trees (20 meters high, but some them emerging up to 30-35 meters) with lianas and forming a discontinuous canopy. The understory is relatively dense and well stratified, and the forest floor is thick. Along the Rio Renato and nearby igarapés there are some conspicuous specimens of moriche palm (*Mauritia flexuosa*) in swampy soil. During the collection of the holotype, another individual, possible the partner, was sighted. Six days later (April 13, 1997), another individual was vocalizing at this place on a 10 m high tree. In the nearby Ribeirão Carmelita, in April 12th, 1997, at 17:50 o'clock, two other individuals, apparently a couple, were seen in a narrow strip of forest along the river, each individual on a different bank.

Etymology: This new species is named to honor Dr. Carlos Octaviano da Cunha Vieira (1897-1958), mammalogist and Curator of the Mammal Collection at the Museu de Zoologia da Universidade de São Paulo (MZUSP), Brazil, from 1941 to 1958. During this period, the efforts of Vieira contributed to the development of the Mammal Collection of the MZUSP and he also published several scientific articles that improved the knowledge on Brazilian mammals and birds.

Diagnosis: It is a medium-sized species of the *C. moloch* group, with overall coloration pale grayish brown agouti mainly in the crown, nape, dorsum, tail and the dorsal sides of the limbs; hands, feet and tip of tail white; belly and ventral sides of limbs orangish. Clearly distinct from other members of the species group by

the white coloration present in the forehead, the crown and the beard, surrounding the dark face (Figs. 2-4, 7).

Measurements: see Table 1.

Description of holotype

External morphology and pelage (Figs. 2-4, Tables 1-3): Length of head and body smaller than length of tail,



FIGURE 2: Side view (above) and front view (bottom) of the head of the holotype of *Callicebus vieirai* (MZUSP 34663), showing the remarkable white circle around the face. Photographs by Fernando M. d'Horta.



FIGURE 3: Dorsal view of the skin of *C. vieirai* (MZUSP 34663; holotype) (left) and a male of *C. moloch* (MZUSP 10152) (right) from Itapoama, Pará, Brazil. Photographs by Mario de Vivo. Tail length modified due to process of preparation of skin.



FIGURE 4: Ventral view of the skin of *C. vieirai* (MZUSP 34663; holotype) (left) and a specimen of *C. moloch* (MZUSP 10152) from Itapoama, Pará, Brazil. Photographs by Mario de Vivo. Tail length modified due to process of preparation of skin.

TABLE 1: External and skull measurements of the holotype and paratypes of *C. vieirai*. All measurements in millimeters.

Measurements		Holotype		Paratypes		Mean
		MZUSP 34663	MZUSP 25441	MZUSP 25442	MZUSP 25443	
External	HB	348.00	305.00	300.00	300.00	313.25
	T	510.00	460.00	450.00	410.00	457.50
	FF	65.00	—	—	—	65.00
	HF	98.00	90.00	88.00	86.00	90.50
	E	35.00	30.00	29.00	30.00	31.00
	W (g)	955.00	—	—	—	955.00
Skull	GLS	64.77	—	—	60.16	62
	CBL	52.37	—	—	47.29	49.83
	GBB	38.96	—	34.03	36.62	36.54
	ZB	42.46	—	38.27	—	40.37
	OB	36.49	—	—	—	36.49
	POB	29.79	—	29.75	—	29.77
	NL	6.72	—	—	6.79	6.76
	PL	21.21	—	—	17.77	19.49
	FOM	9.66	—	8.53	8.40	8.86
	BL	18.28	—	16.9	17.35	17.51
	RC	14.32	—	—	12.99	13.66
	PB	20.28	—	—	19.76	20.02
	MTR	17.94	—	17.93	17.63	17.83
	MBL	43.11	39.91	38.14	40.89	40.71
	IDG	11.71	11.22	9.89	11.90	11.17
	CPH	37.2	33.53	32.52	34.35	34.69
	LTR	19.67	17.12	19.42	19.22	19.44
MIB	18.72	—	19.38	18.79	18.96	
LCB	10.07	10.43	9.91	9.48	9.82	

which is 60% of total length of the specimen. Forehead, sideburns and beard white, surrounding the blackish pigmented face; some white vibrissae present in the face around mouth and nostrils; between face and forehead there is a very narrow stripe of vibrissae with larger blackish bands alternating to narrower white bands. Crown and nape indistinct, pale grayish agouti, lighter than the dorsum, and showing shorter hairs (1 cm). Dorsum and flanks pale grayish-brown agouti with longer hairs (5 cm). Coloration of proximal outer surface of fore and hind limbs is indistinct from that of dorsum and flanks, but becomes gradually lighter and whitish on the distal portions; hands and feet (cheiridia) are whitish. Venter and inner sides of fore and hind limbs uniformly orangish, hairs not banded. Base of tail darker than dorsum, but in the middle region the pattern become similar to the dorsum, and the tip of tail is whitish. Face, ventral side of hands and feet, ears and genitals blackish.

Skull (Fig. 5, Tables 1, 2 and 4): the skull has an overall similarity to that others *C. moloch* group species. The squamosal portion of the zygomatic arch, in lateral view, is wide on the anterior region, becoming narrow towards to posterior region. The pterygoid has

a small hamular process and the lateral lamina is well developed. The posteromedian palatine spine is absent. The pterygoid fossa is Ω -shaped and its anterior border is slightly convex. The supraorbital crests are well developed. The frontal bone is depressed behind the supraorbital ridges. The frontal sinus in the glabella is slightly inflated. One infraorbital foramen on the left and two on right side. Auditory bulla comparatively large, the first third is flattened and the other two thirds bilobated and more inflated. The jugular foramen is reniform, with the right one showing a small septum. The foramen hypoglossal is rounded, smaller than the jugular foramen and localized very next each other. The lambdoidal suture does not rise towards the sagittal suture, remaining in a nearly horizontal plane. Mandibular body relatively high. The coronoid process long, hook-like shaped and extending above the condilar process.

Variation

External morphology and pelage (Fig. 6, Tables 1, 2 and 3): In the holotype (Fig. 2), the white frame present in the forehead is wide and evident,

TABLE 2: External measurements (in millimeters) and body mass (in grams) of *C. vietrai*, *C. moloch*, *C. hoffmannsi*, *C. brunneus*, *C. cinerascens* and *C. baptista*. Legends: M = mean; SD = standard deviation; R = range; and N = number of specimens.

	<i>C. vietrai</i>		<i>C. moloch</i>		<i>C. hoffmannsi</i>		<i>C. brunneus</i>		<i>C. cinerascens</i>		<i>C. baptista</i>	
	males	females	males	females	males	females	males	females	males	females	males	females
HB	M	316.00	305	340.44	333.63	321.00	351.43	302.05	301.25	330.00	366.67	312.50
	SD	27.71	—	54.80	49.85	27.70	40.34	3.54	6.29	—	68.61	19.44
	R	300.00-348.00	—	255.00-510.00	205.00-480.00	275.00-350.00	300.00-410.00	300.00-305.00	295.00-310.00	—	320.00-500.00	289.00-345.00
	N	3	1	32	40	5	7	2	4	1	6	2
T	M	456.67	460.00	430.53	420.15	440.00	454.38	420.00	408.75	480.00	455.00	406.00
	SD	50.33	—	37.27	43.04	34.46	38.95	0.00	19.31	—	43.24	5.66
	R	410.00-510.00	—	350.00-510.00	300.00-495.00	385.00-480.00	395.00-520.00	420	380.00-420.00	—	390.00-510.00	402.00-410.00
	N	3	1	32	40	5	8	2	4	1	6	2
FF	M	65.00	—	66.00	—	—	—	60.00	55.00	—	—	—
	SD	—	—	—	—	—	—	—	—	—	—	—
	R	—	—	—	—	—	—	—	—	—	—	—
	N	1	—	1	—	—	—	1	1	—	—	—
HF	M	91.00	90.00	90.61	88.00	93.33	96.88	87.50	88.75	90.00	88.33	87.50
	SD	6.00	—	6.17	7.04	5.77	11.53	3.54	4.79	—	7.53	10.61
	R	86.00-98.00	—	75.00-100.00	60.00-100.00	90.00-100.00	80.00-120.00	85.00-90.00	85.00-95.00	—	80.00-100.00	80.00-95.00
	N	3	1	28	36	3	8	2	4	1	6	2
E	M	31.33	30.00	23.90	26.00	—	—	30.50	28.25	34.00	33.83	—
	SD	3.21	—	5.82	7.78	—	—	2.12	6.24	—	8.01	—
	R	29.00-35.00	—	20.00-35.00	20.00-35.00	—	—	29.00-32.00	19.00-32.00	—	30.00-50.00	—
	N	3	1	9	5	—	—	2	4	1	6	—
W	M	955.00	—	1016.67	825.00	—	—	—	850.00	—	—	—
	SD	—	—	175.59	176.78	—	—	—	—	—	—	—
	R	—	—	850.00-1200.00	700.00-950.00	—	—	—	—	—	—	—
	N	1	—	3	2	—	—	—	1	1	—	—

TABLE 3: Comparisons of the chromatic fields of the pelage between *C. vieirai*, *C. moloch*, *C. hoffmannsi*, *C. brunneus*, *C. cinerascens*, *C. baptista* and *C. pallescens*.

Chromatic Fields	<i>C. vieirai</i>	<i>C. moloch</i>	<i>C. baptista</i>	<i>C. cinerascens</i>	<i>C. brunneus</i>	<i>C. hoffmannsi</i>	<i>C. pallescens</i>
Crown	pale grayish agouti	grayish agouti	blackish to grayish agouti	grayish agouti	yellowish-brown agouti	grayish agouti	pale grayish agouti or orangish agouti
Forehead	white or whitish agouti	grayish agouti	blackish to grayish agouti	grayish agouti	blackish	grayish agouti	pale grayish agouti or orangish agouti
Sideburns	white	orange	dark reddish brown	grayish agouti	blackish to dark reddish-brown agouti	yellowish	buffy to orangish agouti
Dorsum	pale grayish-brown to pale brown agouti	grayish to pale brown agouti	blackish to grayish agouti	reddish brown agouti	dark reddish-brown agouti	grayish agouti	buffy to orangish agouti
Flanks	pale grayish-brown agouti	grayish to pale brown agouti	blackish to grayish agouti	grayish agouti	dark reddish-brown agouti	grayish agouti	buffy to orangish agouti
Neck, chest and belly	pale yellowish to pale orangish	orange	dark reddish brown	grayish agouti	dark brownish	yellowish	buffy to orangish agouti
Hands and feet	withish agouti	buffy	blackish to grayish agouti	grayish agouti	blackish	grayish agouti	pale buffy to orangish agouti
Limbs (outer)	pale grayish agouti	buffy or grayish to pale brown agouti	blackish to grayish agouti	grayish agouti	dark reddish-brown agouti	grayish agouti	buffy to orangish agouti
Limbs (inner)	pale yellowish	orange	dark reddish brown	grayish agouti	blackish to dark reddish-brown agouti	yellowish	orangish to brownish orange
Tail	grayish (basis); blackish (middle); whitish (tip)	grayish (basis); blackish (middle); buffy (tip)	blackish to blackish agouti	grayish agouti	dark reddish-brown agouti; pale brownish tip	dark grayish agouti	buffy mixed with blackish

whereas in specimens from Rio Iriri it is narrow and less evident (Fig. 6). The grayish-brown agouti coloration of the dorsum is darker in the paratypes, especially in MZUSP 25441. Inner side of fore limbs is slightly more orangish in MZUSP 25441 and whitish in MZUSP 25442. Hands and feet are grayish in MZUSP 25441 and MZUSP 25442. Chest and venter slightly more orangish in MZUSP 22441 and MZUSP 22443.

Skull (Tables 1, 2 and 4): the upper border of orbits of all paratypes is less salient than the holotype. In MZUSP 25443 the infraorbital foramen is proportionally larger. The squamosal portion of the zygomatic arch in MZUSP 22442, in lateral view, is narrower. In MZUSP 25443 the hypoglossal foramen is not visible while in MZUSP 25442 it is and it is also closer to the occipital condyle than to the jugular foramen, which is piriform in this specimen. The posterior portion of the auditory bulla is more inflated in MZUSP 22442 and slightly narrower in MZUSP 22443. The anterior border of pterygoid fossa is slightly concave in MZUSP 22443.

Comparisons

The species of the *C. moloch* group are distributed around the area of occurrence of *C. vieirai*. Another species, *C. pallescens*, of the *C. donacophilus* group is distributed south to *C. vieirai* and has a similar coloration pattern.

C. vieirai is readily distinguished from *C. moloch* by the white beard and sideburns, the whitish agouti hands, feet and outer side of limbs, light orange throat, chest and belly, while in *C. moloch* the beard and sideburns are orange, the throat, chest and belly are dark orange, the hands and feet are buffy, and outer side of limbs are buffy or grayish to pale brown agouti (Figs. 3 and 4).

C. vieirai is distinguished from *C. cinerascens* by the pale grayish-brown agouti coloration of dorsum, and crown, sideburns, beard, hands and feet are white or whitish, while *C. cinerascens* shows reddish brown agouti coloration in dorsum, and crown, sideburns, beard, hands and feet are grayish agouti.

C. vieirai is distinguished from *C. baptista* by white or whitish agouti forehead, white

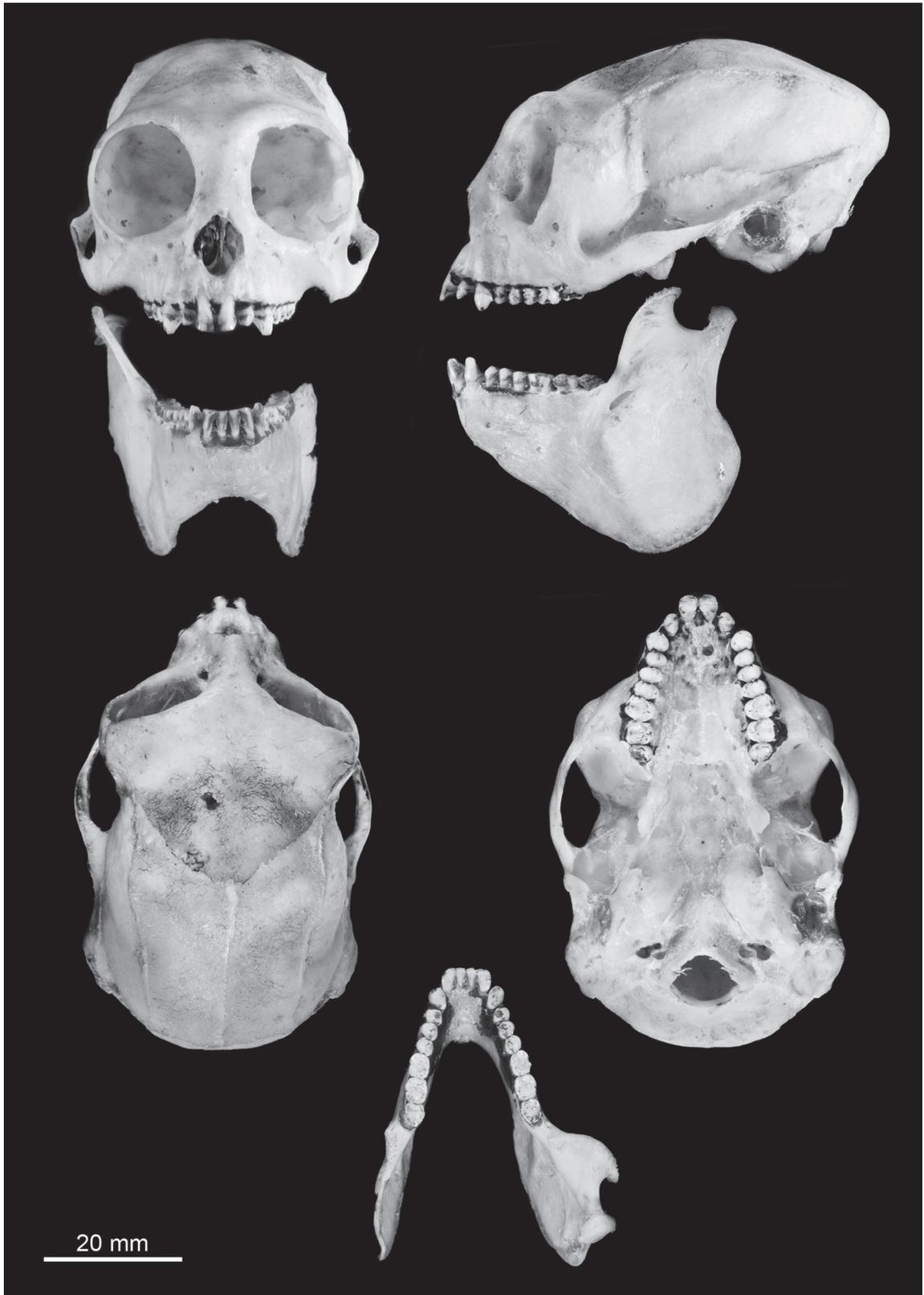


FIGURE 5: Skull of the adult male holotype of *C. vieirai* (MZUSP 34663). The left coronoid process is damaged. Photographs by Marcus Vinícius Brandão.

TABLE 4: Skull measurements of *C. vieirai*, *C. moloch*, *C. hoffmannsi*, *C. brunneus*, *C. cinerascens*, *C. baptista* and *C. pallascens*. Legends: M = mean; SD = standard deviation; R = range; and N = number of specimens. All measurements in millimeters.

	<i>C. vieirai</i>		<i>C. baptista</i>		<i>C. brunneus</i>		<i>C. moloch</i>		<i>C. hoffmannsi</i>		<i>C. cinerascens</i>		<i>C. pallascens</i>	
	males	females	males	females	males	females	males	females	males	females	males	females	males	unknown sex
GLS														
M	62.47	60.61	60.16	60.61	60.99	59.49	61.99	61.01	61.9	62.22	63.67	62.48	59.78	
SD	3.26	1.13	0.73	1.13	1.56	1.83	1.48	1.36	1.56	1.68	—	2.01	1.18	
R	60.16-64.77	58.94-62.27	59.39-61.13	58.94-62.27	58.78-62.32	57.66-61.99	58.60-65.53	58.59-64.14	60.29-63.75	59.21-65.83	—	59.72-65.61	58.49-60.79	
N	2	8	5	8	4	4	31	37	6	11	1	6	3	
CBL														
M	49.83	49.48	48.06	49.48	49.66	47.92	48.75	47.93	49.53	50.1	51.33	49.79	48.87	
SD	3.59	0.95	1.15	0.95	2.03	0.56	1.68	2.07	1.74	1.99	—	1.58	1.5	
R	47.29-52.37	48.65-51.23	46.95-49.63	48.65-51.23	47.66-52.21	47.31-48.66	44.21-51.86	41.90-51.19	47.32-51.54	46.72-54.31	—	46.69-51.16	47.40-50.40	
N	2	8	5	8	4	4	31	37	6	10	1	6	3	
GBB														
M	36.54	36.47	35.7	36.47	37.75	35.91	36.40	35.83	36.13	36.34	38.29	36.4	34.24	
SD	2.47	0.88	1.05	0.88	0.67	1.54	1.51	1.19	1.46	1.4	—	0.57	1.04	
R	34.03-38.96	35.69-37.87	34.3-36.9	35.69-37.87	37.12-38.54	34.46-38.03	34.00-40.40	32.36-38.14	34.45-38.47	33.78-37.90	—	35.74-37.27	33.22-35.30	
N	3	8	5	8	4	4	28	36	6	10	1	6	3	
ZB														
M	40.37	39.32	38.88	39.32	40.37	38.94	39.49	39.04	40.13	39.56	42.99	39.7	38.01	
SD	2.96	1.36	1.61	1.36	0.99	0.66	1.61	1.34	2.11	1.23	—	1.39	0.8	
R	38.27-42.46	36.75-40.76	36.91-41.15	36.75-40.76	39.49-41.44	38.12-39.66	34.72-43.02	36.07-41.32	37.74-43.28	37.97-41.37	—	37.79-41.11	37.10-38.63	
N	2	8	5	8	3	4	28	38	5	9	1	4	3	
OB														
M	36.49	36.47	36.47	37.43	36.08	34.28	35.73	36.02	37.24	36.56	37.23	36.39	32.61	
SD	—	0.84	1.16	0.84	0.24	1.02	1.09	3.16	1.77	1.27	—	1.05	0.57	
R	—	35.24-37.81	35.24-38.84	36.38-38.84	35.86-36.32	33.30-35.25	32.27-37.96	33.24-53.41	34.32-39.07	34.74-38.77	—	34.69-37.42	32.05-37.18	
N	1	8	5	8	3	4	31	37	6	11	1	6	3	
POB														
M	29.77	30.74	30.74	30.88	29.19	30.2	30.79	30.48	30.5	31.25	31.47	30.85	28.33	
SD	0.05	0.62	0.62	1.28	1.43	1.12	1.07	0.84	0.94	1.34	—	0.9	0.32	
R	29.75-29.79	29.92-31.51	29.92-31.51	29.01-33.12	27.17-30.45	28.85-31.59	28.27-32.84	28.70-32.10	29.16-31.61	28.58-33.09	—	29.64-31.92	28.03-28.66	
N	2	8	5	8	4	4	32	38	6	11	1	6	3	

TABLE 4: Continued.

	<i>C. viteirai</i>		<i>C. baptista</i>		<i>C. brunneus</i>		<i>C. moloch</i>		<i>C. hoffmannsi</i>		<i>C. cinerascens</i>		<i>C. pallascens</i>	
	males	females	males	females	males	females	males	females	males	females	males	females	males	unknown sex
NL	M	6.76	7.53	7.4	6.78	6.51	6.35	6.25	6.71	6.88	6.64	7.08	6.84	
	SD	0.05	0.54	0.42	0.7	0.49	0.64	0.49	0.55	0.39	—	0.38	0.79	
	R	6.72-	7.22-	6.79-	5.83-	5.87-	4.99-	5.29-	5.92-	6.29-	—	6.66-	6.28-	
		6.79	8.34	7.94	7.50	6.92	7.67	7.13	7.32	7.56	—	7.68	7.40	
	N	2	4	8	4	4	31	37	6	11	1	6	2	
PL	M	19.49	19.29	19.19	18.95	18.27	18.63	18.49	19.21	19.06	19.61	19.48	19.11	
	SD	2.43	0.71	0.74	0.64	0.51	1.20	0.92	1.52	0.67	—	0.82	1.15	
	R	17.77-	18.12-	18.00-	18.22-	17.65-	16.80-	16.65-	17.22-	17.89-	—	17.98-	17.83-	
		21.21	20.02	20.29	19.42	18.71	21.08	20.07	21.34	19.93	—	20.21	20.07	
	N	2	5	8	3	4	32	39	6	10	1	6	3	
FOM	M	8.86	9.02	9.36	8.81	8.9	8.70	8.63	9.1	8.94	9.45	8.48	8.89	
	SD	0.69	0.85	0.43	0.42	0.64	0.44	0.38	0.24	0.45	—	0.16	0.32	
	R	8.4-	7.87-	8.56-	8.18-	8.40-	7.64-	7.86-	8.74-	8.26-	—	8.28-	8.66-	
		9.66	9.69	9.86	9.08	9.83	9.51	9.41	9.30	9.59	—	8.69	9.11	
	N	3	4	8	4	4	31	37	6	10	1	6	2	
BL	M	17.51	17.14	17.01	18.41	17.59	17.66	17.58	17.75	17.55	18.14	17.88	17.7	
	SD	0.70	0.47	0.75	0.90	0.30	0.70	0.51	0.63	0.88	—	0.53	0.67	
	R	16.9-	16.64-	15.99-	17.61-	17.27-	15.52-	16.61-	17.12-	15.57-	—	17.24-	16.99-	
		18.28	17.76	18.44	19.70	17.99	19.16	18.99	18.75	19.16	—	18.68	18.32	
	N	3	5	8	4	4	32	38	6	11	1	6	3	
RC	M	13.66	13.63	13.82	13.74	12.94	13.76	13.63	13.61	13.93	14.25	14.02	12.43	
	SD	0.94	0.48	0.6	0.41	0.51	0.65	0.51	0.59	0.6	—	0.28	0.3	
	R	12.99-	12.90-	12.89-	13.38-	12.39-	12.70-	12.48-	13.12-	12.96-	—	13.87-	12.15-	
		14.32	14.23	14.47	14.17	13.56	15.27	14.72	14.70	14.95	—	14.58	12.75	
	N	3	5	8	4	4	32	38	6	11	1	6	3	
PB	M	20.02	19.96	20.02	19.88	19.28	20.07	20.06	20.35	20.74	20.85	20.53	18.62	
	SD	0.37	0.85	0.7	0.7	0.33	0.81	0.57	0.76	0.6	—	0.56	0.26	
	R	19.76-	18.95-	19.16-	19.40-	19.07-	18.43-	18.75-	19.23-	20.01-	—	20.08-	18.38-	
		20.28	20.69	20.93	20.91	19.76	22.50	21.01	21.37	21.81	—	21.46	18.90	
	N	2	4	8	4	4	32	38	6	8	1	6	3	
MTR	M	17.83	17.22	17.56	17.35	16.76	17.57	17.46	17.57	18.05	18.85	18.03	18.12	
	SD	0.18	0.65	0.44	0.51	0.81	0.49	0.50	0.52	0.71	—	0.52	0.26	
	R	17.63-	16.27-	16.99-	16.88-	15.90-	16.79-	16.46-	16.84-	16.90-	—	17.41-	17.83-	
		17.94	17.96	18.27	17.82	17.86	18.52	18.33	18.26	19.08	—	18.78	18.32	
	N	3	5	8	4	4	32	39	6	11	1	6	3	

TABLE 4: Continued.

	<i>C. vicina</i>		<i>C. baptista</i>		<i>C. brunneus</i>		<i>C. moloch</i>		<i>C. hoffmannsi</i>		<i>C. cinerascens</i>		<i>C. pallascens</i>	
	males	females	males	females	males	females	males	females	males	females	males	females	unknown sex	
MBL	M	40.71	40.66	41.54	41.81	39.71	40.73	39.98	41.06	42.32	42.47	41.19	41.42	
	SD	2.49	1.5	1.4	0.95	1.27	1.80	1.62	1.54	1.62	—	1.52	0.87	
	R	38.14- 43.11	38.92- 42.92	39.54- 43.47	40.48- 42.74	38.17- 41.12	36.41- 44.84	35.09- 43.50	39.62- 43.53	38.95- 44.64	—	38.55- 42.59	40.77- 42.41	
	N	3	5	8	4	4	32	39	6	11	1	6	3	
IDG	M	11.17	10.94	11.16	11.34	10.95	11.24	10.97	11.45	11.87	—	11.69	10.89	
	SD	1.11	1.28	0.56	0.26	0.52	0.84	0.62	0.7	0.66	—	0.64	0.18	
	R	9.89- 11.90	9.08- 12.57	10.36- 11.97	11.10- 11.61	10.17- 11.27	9.80- 12.87	9.76- 12.71	10.69- 12.64	10.88- 12.75	—	10.65- 12.48	10.76- 11.02	
	N	3	5	8	3	4	32	37	6	11	—	6	2	
CPH	M	34.69	31.57	32.78	35.56	33.44	34.79	34.12	37.07	35.35	35.83	35.15	32.4	
	SD	2.36	1.76	1.03	1.36	0.97	2.06	2.01	3.18	2.52	—	2.85	0.87	
	R	32.52- 37.20	29.27- 34.08	31.65- 34.44	33.86- 37.13	32.58- 34.83	31.07- 39.40	30.10- 39.21	32.54- 40.59	33.24- 42.19	—	32.42- 40.02	31.44- 33.12	
	N	3	5	6	4	4	30	37	5	11	1	6	3	
LTR	M	18.96	19.33	19.6	19.24	18.33	18.96	18.94	19.5	20.17	20.31	20.08	19.51	
	SD	0.36	0.76	0.38	0.51	0.67	0.80	0.81	0.55	0.75	—	0.31	0.31	
	R	19.22- 19.38	18.52- 20.27	18.89- 20.08	18.50- 19.62	17.79- 19.28	17.06- 20.27	16.26- 20.04	18.64- 20.17	19.06- 21.26	—	—	19.77- 20.55	19.22- 19.84
	N	3	5	8	4	4	32	39	6	11	1	6	3	
MIB	M	18.96	18.36	18.12	18.42	17.68	18.53	18.37	18.68	18.92	19.19	19.31	17.36	
	SD	0.36	1.02	0.59	0.48	0.49	0.62	0.57	0.65	0.45	—	0.71	0.23	
	R	18.72- 19.38	16.98- 19.71	17.17- 18.76	17.74- 18.85	17.20- 18.37	16.63- 19.67	17.20- 19.89	17.56- 19.25	18.44- 19.70	—	—	18.48- 20.53	17.10- 17.51
	N	3	5	8	4	4	31	39	6	11	1	6	3	
LCB	M	9.82	9.85	9.96	9.7	9.28	9.82	9.76	9.88	9.95	9.89	10.53	9.08	
	SD	9.48- 10.07	8.92- 10.30	0.36	0.03	0.24	0.48	0.42	0.22	0.3	—	0.22	0.34	
	R	0.31	0.55	9.63- 10.40	9.67- 9.73	8.95- 9.49	9.13- 11.24	8.83- 10.46	9.60- 10.27	9.40- 10.30	—	—	10.29- 10.89	8.70- 9.35
	N	3	5	8	4	4	32	39	6	11	1	6	3	



FIGURE 6: Detail view of the head of *C. vieirai* paratypes (from Rio Iriri, Pará, Brazil), showing the variation color pattern in forehead: MZUSP 25441 (female) (left), MZUSP 25442 (male) (center) and MZUSP 25443 (male) (right). Photographs by Luciano Moreira Lima.

sideburns, pale grayish brown agouti dorsum, pale yellowish coloration in the throat, chest and belly, whitish agouti hands and feet, instead of a blackish to grayish agouti forehead, dark reddish brown sideburns, throat, chest and belly, blackish to grayish agouti dorsum, and blackish to grayish hands and feet.

C. vieirai differs from *C. brunneus* by the overall coloration of body a pale grayish brown agouti instead of dark brown agouti, and crown, sideburns, beard, hands and feet white or whitish instead dark brown.

C. vieirai differs from *C. hoffmannsi* by possessing a grayish tail instead of blackish, by the white sideburns and beard instead of yellowish or orangish, and hands and feet white or whitish instead dark grayish agouti.

C. vieirai differs from *C. pallescens* by the white or whitish agouti forehead instead pale grayish agouti or orangish agouti, and by the absence of a perceptible white ear tufts.

Table 3 summarizes the comparisons of color patterns in the studied species.

The species of the *C. moloch* group have great similarity in skull morphology and morphometrics (Table 4), as well as a wide individual variation of

skull characters. Thus, there are few skull characters that may be used to distinguish the species of group.

The chromatic fields of pelage coloration easily distinguish the species. The distinctive pattern of coloration of each species of *Callicebus* may be an adaptation to recognize conspecifics, and may operate like a mechanism of reproductive isolation, especially among sympatric species, avoiding or reducing the probability of hybridization. For example, in four marmoset species (*Callithrix kuhli*, *C. penicillata*, *C. jacchus*, and *C. geoffroyi*) the recognition behaviors related to facial color pattern may be interpreted as responsible for reproductive isolation mechanisms (Cavalcanti & Langguth, 2008). These authors observed that intruders of the same species of resident individuals, recognized by the animals as potentially sexual competitors, were responsible to stimulate more responses than did intruders of different species bearing different facial color patterns, and this can be an indication of species level recognition. Further, Cavalcanti & Langguth (2008) also suggested that if a the intruder individual is not recognized as a potential reproductive partner of the resident mate, showing low frequency of tuft flicking and

genital display, then the matting and consequent hybridization among the species of *Callithrix* studied will be more difficult.

According to our data, *C. vieirai* has at least records from three separated geographical samples (Fig. 1). Two of them are located in the State of Mato Grosso, nearby the city of Cláudia, including the Rio Renato, Ribeirão Carmelita and surrounding areas, and another in the region of Juína, while a third sample occurs in the Largo do Souza, Rio Iriri, center-northwestern Pará. The records from Cláudia and surroundings and from Largo do Souza occur within the area of distribution of *C. moloch* (Fig. 1), suggesting the existence of an overlap in their respective geographic range. Nevertheless, the characters of *C. vieirai* are not within the variation observed in the specimens of *C. moloch* studied. The latter species shows a broader distribution, occupying the easternmost portion of general distribution of the group, occurring from the west bank of Rio Tocantins-Araguaia to the east bank of the Rio Tapajós in Pará, southwards to the headwaters of the Rios Araguaia, Xingu, and Tapajós in northern Mato Grosso and westwards to the eastern bank of the Rio Ji-Paraná in Rondônia and east bank of the Rio Aripuanã in Amazonas (Fig. 1) (de Vivo, 1985; de Vivo, unpublished data; Hershkovitz, 1990). On the other hand, according to Van Roosmalen *et al.* (2002) [and subsequently Pimenta & Silva Júnior (2005)], the southwestern limit of this species is the Rio Juruena, and the Juruena-Ji-Paraná interfluvium is inhabited by a new species, *C. bernhardi*, described by them and consequently the samples of *Callicebus* from this area can be assumed to belong to this species. According to Van Roosmalen *et al.* (2002), *C. bernhardi* is distinguished of *C. moloch* by its grayish forehead and crown, white ear tufts, and blackish tail with a distinct white pencil. However, our analysis and comparisons between the samples of Rondônia and other localities of *C. moloch* (e.g., Fordlândia) suggest that there are not significant differences in the variation of the chromatic fields and the same variations described for *C. bernhardi* are found in specimens from distinct localities. In other words, the sample of Rondônia is not different from the other *C. moloch* samples, which agrees with the results obtained by Auricchio (2010), who suggested that *C. bernhardi* is a junior synonym of *C. moloch*.

Furthermore, the Rio Ji-Paraná apparently is not an efficient barrier to *C. moloch*. Ferrari *et al.* (1996, 2000) recorded the presence of *C. moloch* in the left bank of the Rio Ji-Paraná and also in two

localities far away, between the Serra dos Pacaás Novos, to the north, and the Chapada dos Parecis, to the south, where it shows evidence of a contact zone with *C. brunneus*. Considering the wide geographical range of *C. moloch*, we cannot reject the possibility sympatry between this species and *C. cinerascens* in the Rio Roosevelt – Rio Aripuanã interfluvium. Hershkovitz (1990) and de Vivo (unpublished data) suggested the occurrence of sympatry between these species in this region, however further studies in the field are necessary to confirm this hypothesis. Besides, Van Roosmalen *et al.* (2002) suggested that the region between the right bank of Rio Sucundurí and Rio Aripuanã and the left bank of the Rio Juruena might be inhabited either by *C. hoffmannsi*, which would extend its geographic range further southwards, or by a species not described yet. Within this region we recorded the specimens of *C. vieirai* from the Juína region, which is located in the left bank of the Rio Juruena.

Van Roosmalen *et al.* (2002) affirmed that the species of the *cupreus* and *moloch* groups are adapted to disturbed habitats and cannot occur sympatrically, due to them occupying the same ecological niche and therefore belonging to the same “ecospecies”. Further, the authors also argued that sympatry in *Callicebus* only occur between members of the *moloch/cupreus* groups and the *torquatus* group species, and that it is very common due to the fact that these species exhibit different habitat preferences, dietary requirements, and foraging behavior. However, the ecological niche is just another attribute of a species, not a defining attribute (Groves, 2001), and as the evidences had previously shown, especially the sympatry between *C. vieirai* and *C. moloch*, they suggest a view contrary to Van Roosmalen *et al.* (2002).

According to Ferrari *et al.* (1996), the zoogeography of platyrrhines in southwestern Brazilian Amazonia is much more complex than it had been assumed previously. Herein, we also reinforce this affirmation and further expand it to the other regions, especially the southern and eastern parts of the Brazilian Amazonia. Additional studies, including the collection of specimens in order to suppress the geographic sample gaps, the meticulous identification of the taxa from these regions, and the application of phylogenetic studies using combined morphological, karyological and molecular data will improve the understanding of relationships among taxa of the same and different *Callicebus* species group, and also their respective evolutionary and biogeographic histories.



FIGURE 7: Specimens of *C. vicirai* kept in the Parque Zoológico Municipal Quinzinho de Barros, Sorocaba, Brazil. Photographs by Juliana Gualda-Barros.

Conservation

In the last decades, the regions where *Callicebus vieirai* was recorded has suffered from constant human made changes, such as substitution of forested areas by cultivations of soybean, to raising livestock, explorative logging, and the construction of hydroelectric power plants along the main drainages of the region (Alho & Martins, 1995; Pivello & Coutinho, 1996; Pavan 2001; 2007; Pivello, 2003; Klink & Machado, 2005). Some of these activities, especially livestock raising and logging, were observed on the vicinities of the type locality already in 1997. *Callicebus vieirai* has an unknown conservational status and further studies may reveal the real status for this species. Furthermore, the Parque Zoológico Municipal Quinzinho de Barros, Sorocaba, keeps live seven specimens of *C. vieirai* in exhibition (Figure 7), that were mistakenly identified as *Callicebus moloch donacophilus*. As previously mentioned, the original couple is from the Juína region, in northwestern Mato Grosso.

RESUMO

Descrevemos uma nova espécie de zogue-zogue, gênero *Callicebus* Thomas, 1903, baseado em quatro indivíduos, um coletado em um pequeno tributário da margem direita do rio Teles Pires, Estado do Mato Grosso, e os demais no Largo do Souza, Rio Iriri, Estado do Pará, Brasil. A nova espécie pertence ao grupo de espécies *Callicebus moloch* e as principais características diagnósticas da nova espécie são a presença de coloração branca na fronte, nas costeletas e na barba, formando uma moldura branca ao redor da face escura; coloração geral do corpo aguti castanho acinzentado pálido; mãos, pés e extremidade da cauda são esbranquiçados; e ventre e porções internas dos membros anteriores e posteriores com coloração uniforme e alaranjada. Padrões de coloração da pelagem e caracteres qualitativos e comparativos cranianos também são descritos e comparados aos das outras espécies do grupo. Os táxons do grupo de espécies *Callicebus moloch* apresentam grande similaridade na morfologia e morfometria do crânio, fazendo com que os caracteres morfológicos externos, especialmente os campos cromáticos da pelagem, sejam os caracteres diagnósticos mais confiáveis para a identificação das espécies. *Callicebus* sp. nov. e *Callicebus moloch* apresentam distribuição geográfica simpátrica, e os caracteres morfológicos externos claramente apontam que são duas entidades taxonômicas distintas.

PALAVRAS-CHAVE: *Callicebus*; Nova espécie; Grupo *Callicebus moloch*; Brasil.

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APPENDIX 1

Specimens examined: Callicebus (N = 142). *Callicebus vieirai*, 4 specimens. *Mato Grosso*: Cláudia: MZUSP 34663 (skull and skin). *Pará*: Largo do Souza: Rio Iriri: MZUSP 25441, MZUSP 25442, MZUSP 25443 (skull and skin). *Callicebus baptista*, 17 specimens. *Amazonas*: Lago do Baptista: MZUSP 4802, MZUSP 5141, MZUSP 5170 (skin); MZUSP 4957, MZUSP 5145, MZUSP 5161, MZUSP 5162, MZUSP 5163, MZUSP 5164, MZUSP 5168 (skull and skin); MZUSP 7168, MZUSP 7169, MZUSP 7173, MZUSP 7174 (skull). Lago Tapaiúna: MZUSP 7171 (skull). Tapaiúna: Rio Amazonas: MZUSP 7166, MZUSP 7167 (skull). *Callicebus brunneus*, 9 specimens. *Rondônia*: Alto Paraíso: MZUSP 20075 (skull and skin). Cachoeira de Nazaré: Machado River (= Rio Ji-Paraná): MZUSP 20433 (skull); MZUSP 20432, MZUSP 20434, MZUSP 20435 (skull and skin). Pedra Branca: MZUSP 22897 (skull and skin). Porto Velho: MZUSP 7798, MZUSP 7799 (skull and skin). Santa Bárbara: MZUSP 20141 (skull and skin). *Callicebus cinerascens*, 7 specimens. *Amazonas*: Prainha: Rio Aripuanã: MZUSP 11806, MZUSP 11807, MZUSP 11808, MZUSP 11809, MZUSP 11810, MZUSP 11811, MZUSP 11812 (skull and skin). *Callicebus palleescens*, 5 specimens. *Mato Grosso do Sul*: Corumbá: MZUSP 3371 (skin); MZUSP 3355, MZUSP 3359 (skull); MZUSP 3356, MZUSP 3358 (skull and skin). *Callicebus hoffmannsi*, 20 specimens. *Pará*: Aruá: Rio Arapiúns: MZUSP 5091 (skull and skin); Brasília Legal: MZUSP 11715, MZUSP 11721, MZUSP 11726 (skull and skin); Fordlândia: MZUSP 11731, MZUSP 11839 (skull and skin) [According to Hershkovitz (1990: 57) the specimens of *C. hoffmannsi* from Fordlândia (right bank of Rio Tapajós) “are either mislabeled or had been transferred in an oxbow cutoff from west to east bank”]; Itaituba: MZUSP 3574 (skull); MZUSP 3575, MZUSP 3576 (skull and skin); Sumaúma: Rio Tapajós: MZUSP 11741, MZUSP 11745 (skull and skin); Urucurituba: Rio Tapajós: MZUSP 19534 (skull); MZUSP 10154, MZUSP 10155, MZUSP 11743, MZUSP 11815, MZUSP 11833, MZUSP 11834, MZUSP 11835, MZUSP 11836 (skull and skin). *Callicebus moloch*, 65 specimens. *Pará*: Mouth of the Rio Bacajá: MZUSP 25444, MZUSP 25445 (skull and skin). Bom Jardim: Rio Amazonas: MZUSP 5198 (skin); MZUSP 5200 (skull and skin). Cachimbo: MZUSP 8062 (skull and skin). Caxiricatuba: Rio Tapajós: MZUSP 24735 (skull and skin). Fordlândia: MZUSP 19690 (skull); MZUSP 11728, MZUSP 11837, MZUSP 11841 (skin); MZUSP 10151, MZUSP 10153, MZUSP 11716-11720, MZUSP 11723-11725, MZUSP 11727, MZUSP 11729, MZUSP 11730, MZUSP 11732-11740, MZUSP 11742, MZUSP 11744, MZUSP 11813, MZUSP 11814, MZUSP 11816, MZUSP 11838, MZUSP 11840 (skull and skin). Mouth of the Rio Curuá: MZUSP 5196, MZUSP 5197, MZUSP 5202 (skull and skin). Itaituba: MZUSP 3566 (skull and skin). Itapoama: MZUSP 10152 (skull and skin). Monte Cristo: Rio Tapajós: MZUSP 3568 (skin); MZUSP 3567, MZUSP 3569, MZUSP 11817 (skull and skin). Piquiatuba: Rio Tapajós: MZUSP 5153, MZUSP 5155 (skin); MZUSP 5142, MZUSP 5156, MZUSP 5160 (skull and skin). Santarém: BMNH 1876.6.19.1 (photographs of the skull and skin; holotype of *C. remulus*). Santarém: Fazenda Marucá: MZUSP 3571, MZUSP 3572 (skull and skin). Santo Antônio: Rio Tocantins: MZUSP 13472 (skull and skin). Taperinha: MZUSP 3570 (skull and skin). *Mato Grosso*: Rio Arinos: MZUSP 11244 (skull and skin). *Rondônia*: Nova Brasília: MZUSP 18964, MZUSP 20053, MZUSP 20055, MZUSP 20058 (skull and skin); Nova Colina: MZUSP 18956 (skull and skin).

APPENDIX 2

Gazetteer

Amazonas: 1. Lago do Batista [03°18'S, 58°15'W] [24 m]; 2. Lago Tapaiúna, Rio Amazonas [03°23'S, 58°18'W] [28 m]; 3. Prainha, Rio Aripuanã [05°45'S, 60°12'W] [44 m]; *Pará*: 4. Aruá, Rio Arapiúns [02°39'S, 55°43'W] [33 m]; 5. Mouth of the Rio Bacajá [03°36'S, 51°54'W] [112 m]; 6. Bom Jardim, Rio Amazonas [02°22'S, 51°00'W] [37 m]; 7. Brasília Legal [03°49'S, 55°36'W] [34 m]; 8. Cachimbo [08°57'S, 54°54'W] [400 m]; 9. Caxiricatuba, Tapajós River [02°36'S, 54°56'W] [102 m]; 10. Fordlândia [03°40'S, 55°18'W] [90 m]; 11. Mouth of the Rio Curuá [05°22'S, 54°27'W] [191 m]; 12. Itaituba [04°16'S, 55°59'W] [44 m]; 13. Itapoama [03°18'S, 55°12'W] [46 m]; 14. Largo do Souza, Rio Iriri [04°01'S, 53°05'W] [200 m]; 15. Monte Cristo, Rio Tapajós [04°06'S, 55°38'W] [11 m]; 16. Piquiatuba, Rio Tapajós [02°27'S, 54°55'W] [41 m]; 17. Fazenda Marucá, near Santarém [02°26'S, 54°42'W] [77 m]; 18. Santo Antônio, Rio Tocantins [02°54'S, 49°40'W] [51 m]; 19. Sumaúma, Rio Tapajós [03°40'S, 55°30'W] [165 m]; 20. Taperinha [02°32'S, 54°17'W] [65 m]; 21. Urucurituba, Rio Tapajós [03°45'S, 55°31'W] [71 m]; *Rondônia*: 22. Alto Paraíso [09°42'S, 63°19'W] [129 m]; 23. Cachoeira Nazaré, Rio Machado (= Rio Ji-Paraná) [09°45'S, 61°55'W] [100 m]; 24. Pedra Branca [09°19'S, 62°49'W] [111 m]; 25. Porto Velho [08°45'S, 63°54'W] [84 m]; 26. Santa Bárbara [09°11'S, 62°55'W] [107 m]; 27. Nova Colina [10°48'S, 61°43'W] [160 m]; 28. Nova Brasília [11°09'S, 61°34'W] [370 m]; *Mato Grosso*: 29. Cláudia [11°30'S, 54°53'W] [362 m]; 30. Ribeirão Carmelita, Cláudia [11°01'S, 54°28'W] [344 m]; 31. Juína [11°22'S, 58°44'W] [370 m]; 32. Rio Arinos [12°21'S, 57°00'W] [306 m].

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