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# A MORPHOLOGICAL ANALYSIS OF SOME SPECIES OF *CALLICEBUS,* THOMAS, 1903 (PITHECIIDAE - CALLICEBINAE)

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## Abstract

A chromogenetic field analysis was performed with 25 of 29 of the known species of the genus *Callicebus*. Some species presented polymorphism, such as *C. moloch, C. hoffmansii* and *C. cupreus. C. bernhardi* presents the same distribution of color in chromogenetic fields as *C. moloch*, differing only in pigment amount, mainly in ventral surfaces, suggesting *C. bernhardi* is a junior synonym of *C. moloch*. *C. hoffmansii* presents two distinct phenotypes, but without a geographic barrier between them. *Callicebus cupreus*, *C. dubius* and *C. caligatus* are distinct species.

**Key Words:** Callicebus, taxonomy, phenotypical polymorphism

## Resumo

Uma revisão taxonômica baseada nos campos cromogenéticos foi procedida em 25 das 29 espécies conhecidas do gênero *Callicebus*. Algumas espécies apresentaram polimorfismo como *C. moloch, C. hoffmansii e C. cupreus. Callicebus bernhardi* apresenta o mesmo padrão de distribuição de campos cromogenéticos de *C. moloch*, divergindo somente na quantidade de pigmentos, principalmente na face ventral da pelagem. Assim, *C. bernhardi* deve ser considerado sinônimo júnior de *C. moloch. C. hoffmansii* apresenta dois fenótipos distintos, porém não há uma barreira geográfica entre eles. *C. cupreus, C. dubius* e *C. caligatus* são espécies distintas.

**Palabras Clave:** *Callicebus*, taxonomia, polimorfismo fenotípico

## Introduction

Although new species of *Callicebus* have been described from Brazil and Bolivia during the last decade, few taxonomic studies had been made on this genus during the same period. The first taxonomic review was performed by Elliot (1913), who recognized 22 monotypic species. This arrangement has been modified by several researchers, such as Tate (1939), Thomas (1927), Lönnberg (1939), Cruz-Lima (1945), Vieira (1955) and Cabrera (1958), who proposed more detailed taxonomic arrangements, defined geographical distributions and suggested phylogenetic relationships within the taxon. Hill (1960), influenced by those authors, proposed a more complete taxonomic arrangement. More recently, only Hershkovitz (1990), Kobayashi (1995) and Anselmo (1997) performed taxonomic studies of *Callicebus*. Hershkovitz (1990) based in skull, skeleton morphology and pelage color, recognized 13 species with 25 subspecific taxa, divided among four groups, as listed in Table 1.

Kobayashi (1995) carried a phenetic analysis based on metric skull characters, besides cariotype, pelage coloration and geographic distribution of 23 species and subspecies (*C. oenanthe, C. aureipalatti* and *C. coimbrai* were not included; the last two had not been described at that time). He recognized five species groups (Table 1) and stated these groups are independent lineages since the rates of character differentiation were not significantly different among the nearest related groups. Among these groups, Kobayashi (1995) pointed out a great differentiation rate between *personatus* and *torquatus*, while *donacophilus*, *cupreus*, *moloch* appear more closely related. Concerning the pelage color pattern of the *moloch* group, Kobayashi considered *donacophilus* and *personatus* groups as "no contrasting pattern", burnt yellow for *donacophilus* and blackish to yellowish for *personatus*; the *cupreus* group was defined as "weakly contrasting" and *moloch* and *torquatus* groups as "contrasting ventral surfaces" and "throat with white band", respectively. Roosmalen *et al.* (2002) described two new species (*C. stephennashi* and *C. bernhardi*), and considered five species groups: 1. *torquatus,* 2. *personatus,* 3. *moloch,* 4. *cupreus,* 5. *donacophilus.*

The great individual and population color variation in *Callicebus* raises several doubts and, sometimes, misunderstanding about the taxonomy of this genus. Aquino *et al.* (2008) found two distinctive populations of *Callicebus torquatus* in northeast Peru. Although several characteristics such as the shape of the hair tuft on the throat

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(a characteristic of *torquatus* group), color tones on hands and the width of frontal band, seems to be different among those populations, the authors were not confident whether the two populations could be considered as different taxa or not. Heymann *et al.* (2002) also found problems with *Callicebus* phenotypical characterization, notably on the color of the hands. Moore (2009) tested the use of pelage color characters as diagnostic taxonomic markers across the geographic distribution of the *Callicebus* cupreus-group as an example. He found both a clinal variation along a geographic transect, as well as a localized intra-populational variation. He emphasizes that systematists should be careful while considering the relationship between intra-populational variation and geographic distribution. In this

**Table 1.** Taxonomic *status* synopsis of *Callicebus* as presented by some authors and this work (modified from Roosmalen, 2002).

| Hershkovitz (1963) | Hershkovitz (1988, 1990) | Kobayashi (1995) | Groves (2001) | Roosmalen et al, 2002 | Auricchio (2005) |
|---|---|---|---|---|---|
| | **Group** *modestus* | | **Group** *modestus* | | |
| | *C. modestus* | | *C. modestus* | | |
| | **Group** *donacophilus* | **Group** *donacophilus* | **Group** *donacophilus* | **Group** *donacophilus* | **Group** *donacophilus* |
| *C. moloch donacophilus* | *C. donacophilus donacophilus* | *C. donacophilus donacophilus* | *C. donacophilus* | *C. donacophilus* | *C. donacophilus* |
| | *C. d. pallescens* | *C. d. pallescens* | *C. pallescens* | *C. pallescens* | *C. pallescens* |
| | *C. oenanthe* | | *C. oenanthe* | *C. oenanthe* | *C. oenanthe* |
| | | *C. modestus* | | *C. modestus* | *C. modestus* |
| | *C. olallae* | *C. ollalae* | *C. olallae* | *C. olallae* | *C. olallae* |
| *C. m. moloch* | **Group** *moloch* | **Group** *moloch* | **Group** *moloch* | **Group** *moloch* | **Group** *moloch* |
| | *C. moloch* | *C. moloch* | *C. moloch* | *C. moloch* | *C. moloch* |
| | *C. cinerascens* | *C. cinerascens* | *C. cinerascens* | *C. cinerascens* | *C. cinerascens* |
| *C. m. hoffmannsi* | *C. h. hoffmannsi* | *C. h. hoffmannsi* | *C. hoffmannsi* | *C. hoffmannsi* | *C. hoffmannsi* |
| | *C. h. baptista* | *C. h. baptista* | *C. baptista* | *C. baptista* | *C. baptista* |
| *C. m. brunneus* | *C. brunneus* | *C. brunneus* | *C. brunneus* | *C. brunneus* | *C. brunneus* |
| | *C. caligatus* | | | *C. bernhardi* | |
| | *C. dubius* | **Group** *cupreus* | | **Group** *cupreus* | **Group** *cupreus* |
| *C. m. cupreus* | *C. cupreus cupreus* | *C. cupreus cupreus* | *C. cupreus cupreus* | *C. cupreus* | *C. cupreus* |
| *C m. discolor* | *C. c. discolor* | *C. c. discolor* | *C. c. discolor* | *C. discolor* | *C. discolor* |
| *C. m. ornatus* | *C. c. ornatus* | *C. c. ornatus* | *C. c. ornatus* | *C. ornatus* | *C. ornatus* |
| | *C. personatus personatus* | | *C. personatus personatus* | *C. caligatus* | *C. caligatus* |
| | | | *C. coimbrai* | | |
| | *C. p. melanochir* | | *C. p. melanochir* | *C. dubius* | *C. dubius* |
| | *C. p. nigrifrons* | | *C. p. nigrifrons* | *C. stephennashi* | *C. stephennashi* |
| | *C. p. barbarabrownae* | | *C. p. barbarabrownae* | | *C. aureipalatti* |
| | **Group** *torquatus* | **Group** *torquatus* | **Group** *torquatus* | **Group** *torquatus* | **Group** *torquatus* |
| *C. torquatus torquatus* | *C. torquatus torquatus* | *C. torquatus torquatus* | *C. torquatus torquatus* | *C. torquatus* | *C. torquatus* |
| *C. t. lugens* | *C. t. lugens* | *C. t. lugens* | *C. t. lugens* | *C. lugens* | *C. lugens* |
| | *C. t. lucifer* | *C. t. lucifer* | *C. t. lucifer* | *C. lucifer* | *C. lucifer* |
| | *C. t. purinus* | *C. t. purinus* | *C .t. purinus* | *C. purinus* | *C. purinus* |
| | *C. t. regulus* | *C .t. regulus* | *C. t. regulus* | *C. regulus* | *C. regulus* |
| *C. t. medemi* | *C. t. medemi* | *C. t. medemi* | *C. medemi* | *C. medemi* | *C. medemi* |
| | | **Group** *personatus* | | **Group** *personatus* | **Group** *personatus* |
| | | *C. personatus* | | *C. personatus* | *C. personatus* |
| | | *C. melanochir* | | *C. melanochir* | *C. melanochir* |
| | | *C. nigrifrons* | | *C. nigrifrons* | *C. nigrifrons* |
| | | *C. barbarabrownae* | | *C. barbarabrownae* | *C. barbarabrownae* |
| | | *C. coimbrai* | | *C. coimbrai* | *C. coimbrai* |

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article I present an analysis of the color pattern of all *Callicebus* specimens from the main Brazilian collections, in order to evaluate phenotypical polymorphism and the validity of these species using the color pattern of fur and hair as diagnosable characters.

## Material and methods

I examined 455 dry skins of 25 species from 136 localities belonging to the following collections: Museu de Zoologia da Universidade de São Paulo (MZUSP - 194 specimens); Museu Nacional do Rio de Janeiro (MNRJ - 97); Museu Paraense Emílio Goeldi (MPEG - 130); Instituto Nacional de Pesquisas da Amazônia (INPA - 10); Instituto Pau Brasil de História Natural (IPBHN - 10; Universidade de Brasília (UnB - 1) and Centro de Primatologia do Rio de Janeiro (CPRJ – 4). Appendix I lists the specimens together with geographic coordinates, label identification and a review of identification as found after this analysis. One specimen of *C. pallescens* and one of *C. caligatus* were studied alive in captivity. Material of *Callicebus medemi, C. oenanthe, C. ollalae, C. modestus* and *C. auriepallati* were not available so these were excluded from this study.

Characters were chosen based on the pelage color of body parts or chromogenetic fields. Following Hershkovitz (1977), these are defined as any part of the pelage showing a particular color pattern from nearby areas, (for instance, the forearm, the back, one sub-apical band in a hair, etc), as shown in Figure 1. I could find chromogenetic fields characters only in pelage, not in hair, so the analysis focused on those. Each specimen was morphologically analyzed and

**Table 2.** Distinctive characters among *C. cupreus, C. caligatus* and *C. dubius.*

| | ***C. cupreus* phenotype 1 (most common)** | ***C. caligatus*** | ***C. dubius*** |
|---|---|---|---|
| **Face** | Reddish-cream | Dark reddish brown | Sideburns, sides of head and beard deep red |
| **Forehead** | reddish-cream (agouti hair banded with light stripes longer than dark ones) | Frontal Black stripe with no abrupt division with nape | transversal frontal band whitish, with a fine black line of superciliar vibrissae which connects the blackish ears |
| **Crown** | reddish-cream (agouti hair banded with light stripes longer than dark ones). | Black (rostral part) | brownish agouti; hairs with 4–5 pheomelanic bands, each alternated with eumelanic band. |
| **Nape** | reddish-cream (agouti hair banded with light stripes longer than dark ones). | Dark reddish brown -agouti. Each hair reddish brown with black tip | brownish agouti; hairs with 4–5 pheomelanic bands, each alternated with eumelanic band. |
| **Back** | reddish-cream (agouti hair banded with light stripes longer than dark ones). | Black | Brownish agouti. brownish agouti; hairs with 4–5 pheomelanic bands, each alternated with eumelanic band. |
| **Lower back** | reddish-cream (agouti hair banded with light stripes longer than dark ones), but washed with brown. | Dark reddish brown -agouti. Each hair reddish brown with black tip | Reddish -brown -agouti brownish agouti; hairs with 4–5 pheomelanic bands, each alternated with eumelanic band |
| **External surface of fore legs and forearms** | intense redish brown which can vary to orangish. | Dark reddish brown -agouti. Each hair reddish brown with black tip | Reddish |
| **Back of Hands** | Brown, not agouti | Black | Blackish agouti, |
| **Fingers** | Brown, not agouti | Black | Contrasting white |
| **Back of Feet** | Brown, not agouti | Black | Contrasting white |
| **Base of tail** | Reddish-cream (agouti hair banded with light stripes longer than dark ones), but washed with brown. | Black (20%) | Reddish-brown -agouti |
| **Middle tail** | Reddish-cream (agouti hair banded with light stripes longer than dark ones), but washed with brown. | Greyish, black/beige or burnt yellow (blackish hairs with 0.7 cm of whitish tip) | Blackish. |
| **Tip of tail** | Reddish-cream (agouti hair banded with light stripes longer than dark ones), but washed with brown. | Burnt yellow/ beige brush (INPA 4032) | Contrasting white brush |
| **Ventral surface** | Intense reddish brown which can vary to orangish. | Deep reddish-brown agouti. Each hair reddish-brown with black tip; | Hairs of throat blackish agouti; chest, belly and ventral surface of legs and arms reddish or reddish-brown; not banded. |

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assigned to different chromogenetic pattern groups by comparing the color pattern of 14 regions (shown in Figure 1, plus chest, belly and ventral surface of limbs), considering color tone variation as character states. This variation is due to the pigment present in hairs. Hershkovitz (1977) points out pheomelanin as the pigment responsible for yellows, browns and reds, depending on the amount of it deposited in the hair. Melanin is the pigment which gives black and gray colors to the hair. The analyses were performed by simple visual inspection, for example: when the character was crown with melanin pigment, states could be gray or black. Characters used in this study are listed in Table 2.

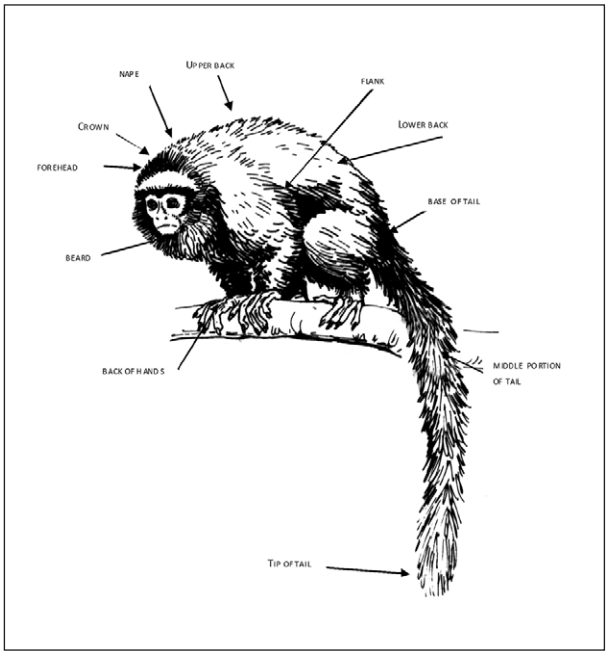



**Figure 1.** Pelage chromogenetic fields considered for this analysis.

Collecting sites were plotted (Fig. 2) and compared with bibliography. Although almost all *Callicebus* species were included in this analysis (25 of 29 species), only the ones with taxonomic problems are discussed in this paper. Table 3 lists these species and the number of specimens analyzed.

## Results and Discussion

*Morphological Analysis*

1. *C. moloch*/ *C. bernhardi*

Pelage chromogenetic analysis shows *C. moloch* has great color tone variation on several chromogenetic fields, especially on the ventral surface, which ranges from yellow to reddish-brown. I could split the specimens into three phenotypes: "*normal phenotype", "red phenotype"* and *"light phenotype"*. The "normal phenotype" is the commonest (84% of the sample) and has a cream forehead, crown (banded

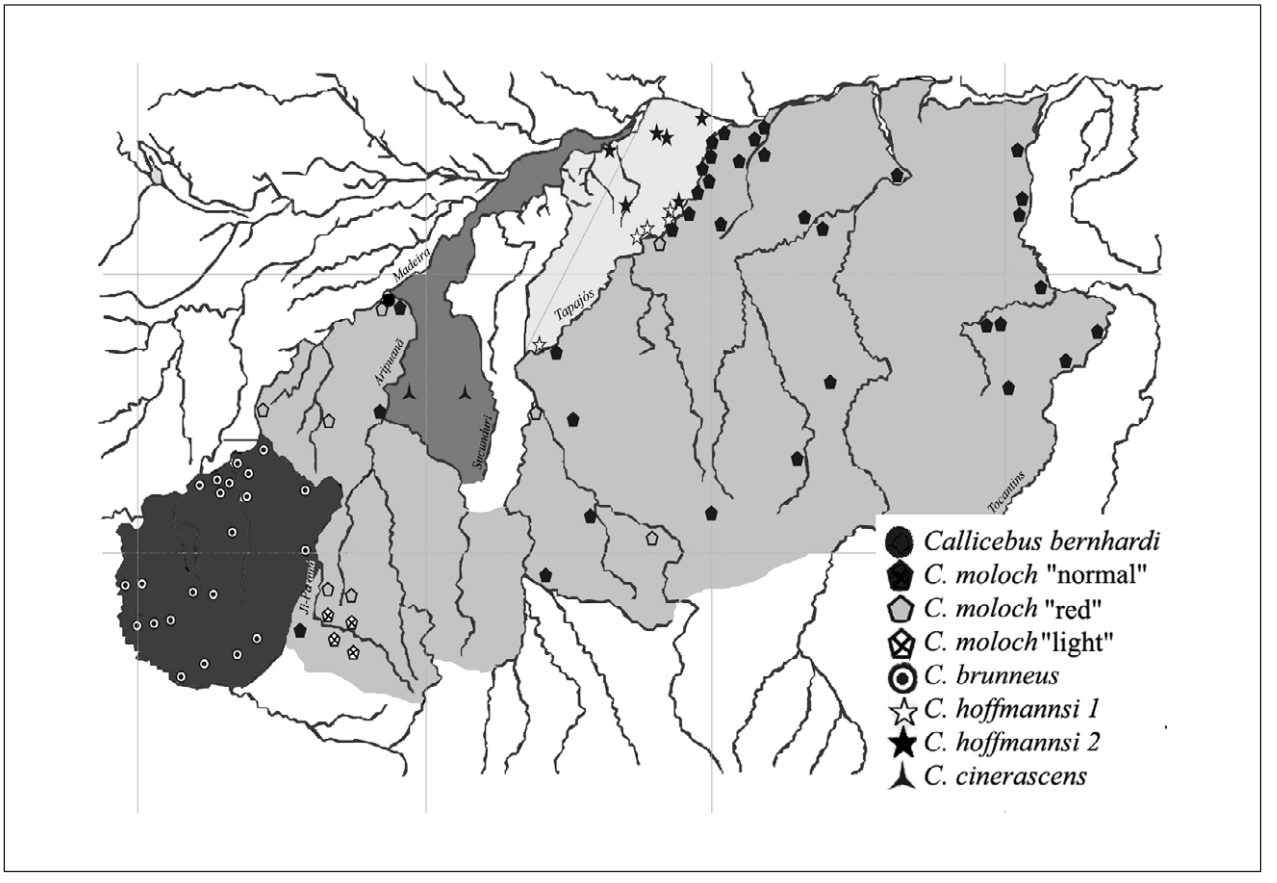



**Figure 2.** Map of collecting sites of *Callicebus* (*C. bernhardi, C. moloch* (3 forms), *C. brunneus*, *C. hoffmannsi* (2 forms) and *C. cinerascens*). Black arrow indicates a locality where all 3 phenotypes of *C. moloch* appear sympatric. Numbers refer to Appendix I localities.

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hair showing light bands broader than dark ones) flanks, dorsal surface of limbs, feet and hands; lower-back light brown with a slight brown stripe along the middle back, slightly darker than the flanks, not washed with brown or it has very little amount of this pigment. The middle portion of tail is very dark (from dark brown to black) and the tip lightening to very light brown or dirty white. Beard, chest, belly and ventral surface of limbs are light orange-brown, more pigmented at the tip of hairs.

The general color pattern of all specimens follows the description above, but specimens IPBHN 207, 208, 209 (loc. 52, Ig Almas, Rio Juruena, extreme north of Apiacás, MT); MZUSP *18956* (loc.53 – RO, Nova Colina Polonoroeste); MZUSP 18964, 20253, *20255*, 20058, 20067 (loc.54 - RO, Nova Brasília Polonoroeste); MPEG 21972 (loc. 112 - PA, Ig. do Patauá, Município de Itaituba); MPEG 22000 (loc. 113 - PA, Apui, BR-230 Humaitá-Itaituba km 17) have the ventral pelage extremely pheomelanized of a live reddish-brown. These represent what I called *"red phenotype"*. A third phenotype, called here *"light phenotype"* has ventral parts much lighter, sort of a lime-yellow (specimens MZUSP 5198 and 5200 from loc. 82 – AM, Bom Jardim, right margin of Amazonas River); MPEG 22014, 22015, 22016, 22017 (loc. 109 – PA, UHE Tucuruí, Tocantins River); MPEG 245 (loc. 95 – PA, São João do Araguaia); MPEG 246 (loc. 94 – PA, Alto Iriri River, Xingu).

Roosmalen *et al.* (2002) described *C. bernhardi* and identified specimens MPEG 22996, 22997 (locality 50 - BR km 150 Apis-Humaitá, right margin of Marmelos River, AM); MPEG 24590 and 24591 (locality 55 - Alta Floresta, MT) as belonging to this taxon. Paratypes of *C. bernhardi* (INPA 4029 and 4033; locality 57 - AM River Mariepauá left aff. River Madeira) show the same chromogenetic pattern as *C. moloch*, with identical chromogenetic fields. These specimens differ only in color tone and pigment amount on the ventral surface, exactly as seen in the *"red phenotype"*. In Roosmalen *et al.* (*op. cit.*), diagnostic characters that distinguish *C. bernhardi* of *C. moloch* are described as follows: "*...by grayish forehead and crown, white ear tufts, and blackish tail with a distinct white pencil*". Actually, there is wide variation in forehead and crown color tone among all 183 specimens of the 3 phenotypes, from grayish to light red-brown, and the description above agrees perfectly with most specimens analyzed of "normal phenotype" as well.

**Table 3.** Material used for this study.

| Species | Skins | Alive |
|---|---|---|
| *C. moloch "normal phenotype"* | 154 | |
| *C. moloch "red phenotype" / C. bernhardi** | 20 | |
| *C. moloch "light phenotype"* | 9 | |
| *C. hoffmannsi* | 27 | |
| *C. brunneus* | 56 | |
| *C. dubius* | 1 | |
| *C. cupreus* | 70 | |
| *C. caligatus* | 2 | 1 |
| **TOTAL** | **339** | **1** |

Concerning the auricular tufts, none of 183 specimens of *C. moloch* (3 phenotypes) and those identified as *C. bernhardi* in INPA and MPEG that I could analyze, presented white auricular tufts (including *C. bernhardi* paratypes). Tails of all *"red phenotype"* specimens as well as *C. bernhardi* specimens are identical to *C. moloch*: black with a lighter tip. Drawings of *C. moloch* in Roosmalen *et al.* (2002) do not show a black tail and the whitish back of the hands, not matching all specimens analyzed. Thus, all specimens of the "*normal phenotype", "red phenotype", "light phenotype"* and those described as *C. bernhardi* show the same chromogenetic field pattern, differing, as mentioned, only in the amount of pigment (color tone) of the ventral surface.

Concerning the geographic distribution of *C. moloch* (all phenotypes), it is the broadest among all *Callicebus* species, occurring south of the Amazonas River, between the right margin of Madeira/Ji-Paraná Rivers to the left margin of Tocantins River. *C. moloch* is not found between the right margin of Aripuanã River and the left margin of Abacaxis River, where *C. cinerascens* is found (Noronha, *et al.* 2007). *Callicebus moloch* is found in Rondônia on both margins of the medium/upper Ji-Paraná River (Ferrari, *et al.* 2000), what is confirmed by specimens MZUSP 18956 (RO, Nova Colina Polonoroeste, right margin of Ji-Paraná River 10°48'S61°43'W, *"red phenotype";* MZUSP 18964, 20253, 20255, 20058, 20067 (RO, Nova Brasília Polonoroeste, right margin of Ji-Paraná River – 10°56'S61°20'W *"red phenotype",* and MPEG 19709, 19710, 19712, 19713 (Alvorada d'Oeste, BR 429 linha 64 km 87, left margin of Ji-Paraná River - 11°23'S62°18'W *normal phenotype.* Monção *et. al.* (2008) also assigned specimens they called *C. bernhardi* (here, "*red phenotype*") to 90 km west of Alto Alegre dos Parecis (Chapada dos Parecis, Rondonia).

Roosmalen (2002) states that there is a gap in the range of *Callicebus* at the southern portion of this region, between Sucunduri/Juruena River and Tapajós River. I could not find any specimens in Brazilian museums from this region. Wide rivers such as the Juruena / Teles Pires / Tapajós are no barriers isolating the three phenotypes of *C. moloch.* Gascon *et al.* (2000) observed that wide rivers are not always obstacles to put apart small mammals and frogs as well.

Localities for *C. bernhardi* indicated by Roosmalen *et al.* (2002) are: 51 (AM, Comunidade de Nova Olinda, right margin of Aripuanã River, Novo Aripuanã – holotype, INPA 3929 only skeleton) and 57 (AM, Mariepauá River, right tributary of Madeira River – paratypes of *C. bernhardi*). Specimens MNRJ 2480 and 2481 (from AM, right margin of São João do Aripuanã River) presents *"light phenotype*" and this locality is only 30 km straight line from locality 51 and 60 km from locality 57, mentioned

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above, on the same bank of Aripuanã River. In the locality 109 (PA, UHE Tucuruí rio Tocantins) it is possible to find both *"light and normal phenotype*" as can be seen in specimens MPEG 21442, 21443, 22014, 22015, 22016, 22017, 22016 (normal phenotype) MPEG 22018 (light phenotype), one evidence of polymorphism. *"Red phenotype"* can be found far to the east from known localities of *C. bernhardi*. Specimens MPEG 21972 (locality 112- Ig. Patauá, Itaituba, PA), MPEG 22000 (BR 230 Itaituba, PA) and IPBHN 207, 208, 209 (locality 52- Ig. Almas, Juruena River, Apiacás, MT) are *"red phenotype"* (see Appendix I for coordinates). These localities are among others where phenotype can be *normal phenotype* or *light phenotype,* one more evidence of polymorphism.

One specimen from Alta Floresta (locality 55) MPEG 24590, label identificated as *C. bernhardi,* had its DNAmt sequenced and it is more similar to the sequence of IPBHN 207 (from Apiacás, MT), both *"red phenotypes"*. A phylogenetic analysis for *Callicebus* carried by me (to be published elsewhere) shows strong evidence for the three phenotypes of *C. moloch* to be considered a polymorphism of the same taxon. Also, *C. bernhardi* appears as sister group of *C. moloch*. It is possible to recognize a trend to a clinal variation along a east-west transect through the range of the species, with specimens from western localities showing more pigmented ventral parts (phenotype red) and specimens with lighter ventral parts (phenotype light) to the east. "Normal phenotype" is found throughout the range. Moore (2009) found similar results in *C. cupreus*. *C. hoffmannsi* showed similar south-north differences in ventral amount of pigments as can be seen bellow. Based on this, I suggest here *C. bernhardi,* Roosmalen *et al.* (2002), to be considered as a junior synonym of *C. moloch*.

2. *C. hoffmannsi*

Analysis of chromogenetic fields of *C. hoffmannsi* found two phenotypes differing only in the color tones of the ventral parts: *hoffmannsi 1,* yellow similar to that observed in typical *C. moloch*; and *hoffmannsi 2* which looks a very light lime-yellow. Pattern *hoffmannsi 2* is found north of pattern 1, the boundary between them set approximately by latitude 4ºS (Itaituba, Para) (Fig. 2). Despite color differences and non-overlapping ranges, I could not find any geographic barrier or an ecological feature supporting the possibility that *C. hoffmannsi* should be split into two taxa. So, I consider these two phenotypes as polymorphisms of the same species until other evidence of speciation arises.

3. *C. cupreus*

*Callicebus cupreus* also shows three phenotypes: **Phenotype 1:** forehead and crown reddish-cream (agouti hair banded with light stripes broader than the dark ones). Back and nape almost concolor with crown. Lower back similar, but washed with brown. Tail as back; arms, legs, chest, belly and ventral surface of an intense reddish brown, sometimes orangish. Back of hands and feet are brown, not agouti. **Phenotype 2:** specimens MZUSP11831 and 11832 from Pauini, AM, have arms, legs, chest and ventral surfaces orangish. **Phenotype 3** *C. cupreus* MZUSP7332 from Iquiri River, AM, holotype of *C. cupreus acreanus* and MZUSP5067 and 5068 from Santa Cruz do Eiru River have forehead and crown agouti-brown with black and cream, lighter than described for the phenotype 1, back as *moloch* and lower-back more brownish. Tail is dark-brown, gradually getting lighter to the tip, which is cream. Arms, legs, ventral surfaces and beard are dark reddish-brown, almost dark red.

Six specimens (MPEG 1587, 1588, 1605, 1608, 1609 and 1845) from Amazonas (Rio Javari, Estirão do Equador) are darker than the phenotype 3, described here. Phenotypes are distributed in four localities (Figure 2) that are inside the known distribution of *C. cupreus* and do not show a geographic pattern that could suggest an existence of more than one only taxon. As it was not possible to identify geographical limits that could indicate segregation among taxa, and it was not possible to perform a DNA analysis, definite considerations about the taxonomic status of *C. cupreus* must await, intra-specific color polymorphism being the best explanation for the observed pattern.

4. *C. cupreus, C. caligatus* and *C. dubius*

Grooves (2001) follows Hershkovitz (1990) in *Callicebus* taxonomy, but doubts him concerning some propositions. One of them considers *C. caligatus, C. dubius* and *C. cupreus* as synonyms. Roosmalen *et al.* (2002) described differences among these three species, considering all of them valid, a view I agree based on morphological grounds. All three show several distinctive characters, as pointed out by Roosmalen (2002) and revised here (shown in Table 2), such as the presence or absence of chromogenetic fields, e.g. frontal white and black stripes, tip of tail and white fingers.

## Conclusions

*C. bernhardi* must be considered as a junior synonym of *C. moloch*, since the only difference between them is the amount of pigment in the hairs and it occurs in sympatry with *C. moloch* in several localityes. *C. hoffmannsii* shows two phenotypes with parapatric ranges, but without any defined geographic barrier that could support their assignment as two different taxa. Phenotype variation in *C. cupreus* is polymorphic, and do not show a geographic pattern that could support the idea of splitting it in more than one taxon; *Callicebus cupreus, C. dubius* e *C. caligatus* are distinct species since they present several distinctive characters and allopatric ranges.

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## References

Anselmo, N. P. 1997. *Estudo das relações intragenéricas em* Callicebus *(Primates) usando a subunidade II do gene mitocondrial do Citocromo c Oxidase (COII)*. Dissertação de Mestrado. Belém, Universidade Federal do Pará.

Aquino, R; Terrones, W; Cornejo, F. and Heymann, E. W. 2008. Geographic distribution and possible taxonomic distinction of *Callicebus torquatus* populations (Pitheciidae: Primates) in Peruvian Amazonia. *Am. J. Primatol.* 70:1181–1186.

Cabrera, A. 1958. Catálogo de mamíferos de américa de sur. *Revista Museo Argentino Ciencias Naturales, Bernardino Rivadavia* 4 (1): 1–307.

Cruz-Lima, E. 1945. *Mammals of Amazonia. General Introduction and Primates*. Belém, Museu Paraense Emílio Goeldi. 274 p.

Elliot, D. G. 1913. *A review of the primates*. New York, American Museum of Natural History. v.1.

Gascon, C., Malcolm, J. R., Patton, J. L., Silva, M. N. F. da, Bogart, J. P., Lougheed, S. C., Peres, C. A., Neckel, S. and Boag, P. 2000. Riverine barriers in the geographic distribution of Amazonian species. *P. Natl. Acad. Sci.* 97 (25): 13672–13677.

Grooves, C. P. 2001. *Primate Taxonomy*. Washington, Smithsonian Institution. 350p.

Hershkovitz, P. 1990. Titis New World monkeys of the genus *Callicebus* (Cebidae, Platyrrhini): a preliminary taxonomic review. *Fieldiana Zool.*, 55: 1–109.

Heymann E. W., Encarnación F. C. and Soini, P. 2002. On the diagnostic characters and geographic distribution of the "yellow handed" titi monkey, *Callicebus lucifer* in Peru. *Neotrop. Primates* 10:124–126.

Hill, W. C. O. 1960. *Primates, comparative anatomy and taxonomy. IV Cebidae, Part A*. New York, Wiley Intercience. vii+523p.

Kobayashi, S. 1995. A phylogenetic study of titi monkeys, genus *Callicebus*, based on cranial mesurements, I: Phyletic groups of *Callicebus*. *Primates*, 36(1): 101.

Moore, 2009. Levels of resolution in the geographic distribution of pelage color characters as diagnostic taxonomic markers. *Am. J. Phys. Anthropol.* Suppl 120.

Lönnberg, E. 1939. Notes on some members of the genus *Callicebus*. *Arkiv fur Zoologi*, 31A (13):1–18.

Monção, G. R.; Selhorst, V. and Soares-Filho, J. A. R. 2008. Expansão da distribuição geográfica de *Callicebus bernhardi* a oeste do Rio Ji-Paraná, Estado de Rondônia, Brasil. *Neotrop. Primates* 15: 67–68.

Moore, W. D. 2009. Levels of resolution in the geographic distribution of pelage color characters as diagnostic taxonomic markers. *Am. J. Phys. Anthropol.* Suppl 48: 193.

Noronha, M. A., Spironello, W. R. and Ferreira, D. C. 2007. New occurrence records and eastern extension to the range of *Callicebus cinerascens* (Primates, Pitheciidae). *Neotrop. Primates* 14: 137–139.

Roosmalen, M. G. M., Roosmalen, T. and Mittermeier, R. A. 2002. A taxonomic Review of the titi monkeys, Genus *Callicebus*, Thomas, 1903, with description of two new species, *Callicebus bernhardi* and *Callicebus stephennashi*, from brazilian amazonia. *Neotrop. Primates*, 10: 1–52.

Schneider, H.; Schneider, M.P.; Sampaio, I.; Montoya, E.; Tapia, J.; Encarnación, F.; Anselmo, N. P. & Salzano, F. M. 1993a. Divergence beetween biochemical and citogenetic differences in three species of the *Callicebus moloch* group. *Am. J. Phys. Anthropol.* 90: 345–350.

Tate, G. H. H. 1939. The mammals of Guines region. *B. Am. Mus. Nat. His.* 76: 151–229.

Thomas, O. 1927. On further monkeys of the *Callicebus torquatus* group. *Annals and Magazine of Natural History* Série 9, 20: 287.

Vieira, C. O. C. 1955. Lista remissiva dos mamíferos do Brasil. *Arquivos de Zoologia*, São Paulo, 8 (11): 341–474.

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## Appendix I

Collecting sites of all specimens analyzed. Label: Taxon indicated in label; Analysis = identification by the author of this article; Specimens = specimens' Number at collection; Listing numbers in bold are those cited in the map of Figure 2.

| No | Collecting Locality | Coordinates | Label | Analysis | SPECIMENS |
|---|---|---|---|---|---|
| 1 | Colombia (loctip região de Villavicencio Rio Meta) | 04°15'N 73°50'W | *C. ornatus* | *C. ornatus* | MNRJ 2486 |
| 2 | Ecuador, Rio Anaray | 00°30'S 76°22'W | *C. discolor* | *C. discolor* | MNRJ 3917 |
| 3 | AM Ig. Iá Pq. Nac. Pico da Neblina | 00°17'N 66°25'W | *C. lugens* | *C. lugens* | MNRJ 59657 |
| 4 | AM, Barcelos, Rio Aracá Ig Jauari | 00°10'S 63°05'W | *C. lugens* | *C. lugens* | MNRJ 67071 |
| 5 | AM Ig. Japomeri, Rio Padauiri | 00°00'S 64°00'W | *C. lugens* | *C. lugens* | CRB 2570 MNRJ 27070 |
| 6 | RR Lago da Cobra dir. Rio Mucajaí | 01°40'N 60°55'W | *C. torquatus* | *C. lugens* | MZ 9689, 9690 |
| 7 | AM São Gabriel da Cacheira | 00°07'S 67°04'W | *C. lugens* | *C. lugens* | INPA 4066 |
| 8 | AM Rio Tootobi af.dir. rio Demini | 01°40'N 63°34'W | *C. lugens* | *C. lugens* | MPEG 10018 |
| 9 | AM Rio Mucajaí | 02°45'N 62°00'W | *C. torquatus* | *C. lugens* | MPEG 1928, 1929, 1931,1932, 26374 |
| 10 | PA 54 km S 150 km W de Altamira Gleba 61 lote 02 | 03°12'N 52°13'W | *C. torquatus* | *C. lugens* | MPEG20181 near Rio Uruará |
| 11 | AM, Rio Juruá | 06°00'S 68°00'W | *C. regulus* | *C. regulus* | MZUSP 911; MZ911mounted |
| 12 | AM, Fonte Boa | 02°33'S 66°02'W | *C. regulus* | *C. regulus* | MNRJ 2465, 21047, 25 899 |
| 14 | AM Lg. Taoaria Grande, Rio Purus | 6°30'S 64°15'W | *C. purinus* | *C. purinus* | MNRJ 2461 |
| 15 | AM Lg. Ayapuá, R. Purus | 04°28'S 62°08'W | *C. purinus* | *C. purinus* | MNRJ 2464, 2466, 2470 |
| 16 | AM Porangaba mg.dir. rio Juruá Porto Walter | 8°39'S 72°50'W | *C. cupreus* | *C. cupreus* | MPEG 22998 (black tail), 23000 |
| 17 | AM Barro Vermelho mg.esq. rio Juruá Eirunepé | 06°28'S 68°46'W | *C. cupreus* | *C. cupreus* | MPEG 23001 |
| 18 | AM São Luiz do Mamoriá rio Purus | 07°33'S 66°25'W | *C. cupreus* | *C. cupreus* | MPEG 270 (light colored) |
| 19 | Peru Iquitos Parque do MPEG | 03°47'S 73°13'W | *C. cupreus* | *C. cupreus* | MPEG 253 (leucometopa), 672, 6874, 6875, 259 |
| 20 | Peru Rio Marañons Iquitos | 04°30'S 73°27'W | *C. cupreus* | *C. cupreus* | MPEG 677 |
| 21 | AM Rio Javari Estirão do Equador | 04°32'S 71°38'W | *C. cupreus* | *C. cupreus* 2 | MPEG 1587, 1588, 1605, 1608,1609,1845 |
| 22 | AC Rio Branco | 9°57'S 67°48'W | *C. cupreus* | *C. cupreus* | MPEG 7102, 7103 |
| 23 | AM Rio Jaquirana (Cach Jaquirana) | 8°43'S 66°48'W | *C. cupreus* | *C. cupreus* | MPEG 8903 |
| 24 | AM Lago Tefé Porto da Castanha | 3°34'S 64°47'W | *C. cupreus* | *C. cupreus* | MPEG 13207, 13208, 13211 |
| 25 | AM Santo Antonio do R. Eiru | 07°10'S 70°25'W | *C. cupreus* | *C. cupreus* | MZUSP 4798,4805 |
| 26 | AM Santa Cruz do R. Eiru | 07°30'S 70°49'W | *C. cupreus* | *C. cupreus* | MZUSP 5054, 5057, 5062**,** 5064, 5066, 5067, 5068, 5069, 5070, 5071, 5072, 5073, 5076, 5077, 5081, 5082, 5085, 5086, 5087, 5088, 5089, 5090 |
| 27 | AM Eirunepé | 06°40'S 69°53'W | *C. cupreus* | *C. cupreus* | MZUSP 5052, 5055, 5056, 5058, 5059, 5060, 5061, 5063, 5065, 5074, 5075**,** 5078, 5079, 5080, 5083, 5084, 11534 |
| 28 | AC Manoel Urbano | 08°53'S 69°40'W | *C. cupreus* | *C. cupreus* | MZUSP 11237, 19542 |

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| No | Collecting Locality | Coordinates | Label | Analysis | SPECIMENS |
|---|---|---|---|---|---|
| 29 | AC Sena Madureira | 09°04'S 68°44'W | *C. cupreus* | *C. cupreus* | IPBHN 820 |
| 30 | AM, São Paulo de Olivença -Mata Juratuba | 03°57'S 68°57' W | *C. cupreus* | *C. cupreus* | MNRJ 21049 |
| 31 | AM Pauini | 07°40'S 66°57'W | *C. cupreus* | *C. cupreus* 2 | MZUSP 11831,11832 |
| 32 | AC Iquiri | 09°50'S 67°45'W | *C. cupreus* | *C. cupreus* 2 | MZUSP 7332 |
| 33 | RO EE Antonio Mugica Nava, Porto Velho esq Rio Madeira | 09°24'S 64°56'W | *C. dubius* | *C. dubius* | *MZ (no number sat at time)* |
| 35 | AM Ig. Bacana marg. Oeste lago Jarí marg dir baixo Purus | 04°00'S 61°20'W | *C. caligatus* | *C. caligatus* | INPA 4032; MZUSP 11722(unknown locality) |
| 36 | AM Humaitá Lábrea BR 230 km 41 mg.dir rio Ipixuna | 07°30'S 63°23'W | *C. cupreus* | *C. caligatus* | MPEG 22011, 22012 |
| 37 | AM Interfluvio R. Ipixuna e Mucuim no Purus | 06°30'S 64°00'W | *C. stephennashi* | *C. stephennashi* | INPA 4030, 4031 |
| 38 | AM médio e alto rio Purus | 05°30'S 63°00'W | *C. stephennashi* | *C. stephennashi* | *INPA (no number sat at time)* |
| 39 | Bolivia Sta Cruz de la Sierra Provincia de Cercado | 17°60'S 63°20'W | *C. donacophilus* | *C. donacophilus* | MNRJ 5537, 21059, 21060 |
| 40 | MS Corumbá | 19°00'S 57°38'W | *C. donacophilus* | *C. donacophilus* | MZUSP 3355, 3356, 3358, 3359, 3371 |
| 41 | RO Alto Paraíso. Polonoroeste | 09°37'S 63°27'W | ? | *C. brunneus* | MZUSP 20075 |
| 42 | RO Porto Velho | 08°47'S 63°55'W | *C. brunneus* | *C. brunneus* | MZUSP 7798**,** 7799 |
| 43 | RO Santa Bárbara | 09°10'S 63°04'W | *C. brunneus* | *C. brunneus* | MZUSP 20141 |
| 44 | RO Rio Machado Cach Nazaré | 08°52'S 62°07'W | *C. brunneus* | *C. brunneus* | MZUSP 20432, 20433**,** 20434,20435; MPEG 22993, 22994, 22995 |
| 45 | RO Pedra Branca | 10°01'S 62°05'W | *C. brunneus* | *C. brunneus* | MZUSP 22897 |
| 46 | RO Faz. Rio Candeias município Porto Velho | 08°57'S 63°38'W | *C. brunneus* | *C. brunneus* | MPEG 10941,10942 |
| 47 | RO UHE Samuel rio Jamari afl.dir. rio Madeira | 08°40'S 63°25'W | *C. brunneus* | *C. brunneus* | **MPEG** 21686,21687, 21688, 21689, 21690, 21691, 21692, 21693, 21694,21695, 21696, 21697, 21698, 21699, 21700, 21701, 21702, 21703, 21704, 21705, 21706, 21707, 21710, 21711, 21748, 21795, 21943, 21944, 21945, 21946, 21947, 21948, 21949, 21954, 21955, 21956, 23035, **MNRJ** 28487, 28488, 28489 |
| 48 | RO Calama margem direita Rio Ji-paraná | 08°03'S 62°53'W | *C. moloch* | *C. brunneus* | MPEG 22006 |
| 49 | PA Ig. Mundo novo margem direita do médio Rio Iriri | 05°25'S 54°25'W | *C. moloch* | *C. moloch* | MPEG21836 |
| **50** | AM BR-230 Humaitá-Apis km 150 mg.dir. rio Marmelos | 07°45'S 61°44'W | *C. bernhardi* | *C. moloch* "red phenotype" | MPEG 22996, 22997 |
| **51** | AM Com. Nova Olinda dir. R. Aripuanã Novo Aripuana | 05°15'S 60°20'W | *C. bernhardi* | *C. moloch* "red phenotype" | INPA 3929 (holotype - only skeleton) |
| **52** | MT Apiacás Ig. Almas Rio Juruena | 07°40'S 58°05'W | - | *C. moloch* "red phenotype" | IPBHN 207, 208, 209, |
| **53** | RO Nova Colina Polonoroeste | 10°48'S 61°43'W | *C. moloch* | *C. moloch* "red phenotype" | MZUSP 18956 |
| **54** | RO Nova Brasília Polonoroeste | 10°56'S 61°20'W | *C. moloch* | *C. moloch* "red phenotype" | MZUSP 18964, 20253, 20255, 20058, 20067 |
| **55** | MT Alta Floresta | 09°52'S 56°04'W | *C. bernhardi* | *C. moloch* "red phenotype" | MPEG 24590, 24591 |
| **56** | AM Com. Nova Olinda Rio Aripuanã | 05°31'S 60°25'W | *C. bernhardi* | *C. moloch* "red phenotype" | INPA 3929 |

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|---|---|---|---|---|---|
| **57** | AM Rio Mariepauá aff. esq. Madeira | 05°30'S 60°34'W | *C. bernhardi* | *C. moloch* "red phenotype" | INPA 4033 (paratype), 4029 (paratype) |
| 58 | AM Prainha Rio Aripuanã | 07°16'S 59°19'W | ? | *C. cinerascens* | MZUSP 11806, 11807**,** 11808, 11809, 11810, 11811, 11812 |
| 59 | AM Prainha perto de Cipotuba m dir Rio Aripuanã. | 07°16'S 60°20'W | ? | *C. cinerascens* | INPA 4085 |
| 60 | AM Lago do Batista marg dir R. Amazonas I. Tupinambarana | 03°15'S 58°15'W | *C. baptista* | *C. baptista* | **MZUSP** 4802**,** 4957, 5141, 5145, 5161, 5162, 5163, 5164, 5168, 5170, 7168, 7169, 7173, 7174, **MNRJ** 5923, 5903, 6003 |
| 61 | AM Tapaiuna marg dir R. Amazonas I. Tupinambarana | 03°27'S 58°18'W | *C. baptista* | *C. baptista* | MZUSP 7166,7167,7171 |
| 62 | Uíra Curapá | 03°20'S 58°17' W | *C. baptista* | não visto | MGMvanR50 |
| **63** | AM Parintins | 02°50'S 56°45'W | *C. moloch* | *C. hoffmannsi* | MPEG 690 |
| **64** | PA Fordlandia | 03°47'S 55°35'W | *C. hoffmannsi* | *C. hoffmannsi* 1 | MZUSP 11731, 11839 |
| **65** | PA Itaituba marg esq R. Tapajós | 04°18'S 56°05'W | *C. hoffmannsi* | *C. hoffmannsi* 1 | MZUSP 3574, 3575, 3576 |
| **66** | PA Brasilia Legal , marg esq R. Tapajós | 03°55'S 55°35'W | *C. hoffmannsi* | *C. hoffmannsi* 1 | MZUSP 11715, 11721, 11726 |
| **67** | PA Vila Braga Tapajós | 04°24'S 56°18'W | *C. hoffmannsi* | *C. hoffmannsi* 1 | MPEG 251, MNRJ 2472 |
| **68** | PA Jacareacanga 17km Rod. Transamazônica | 06°15'S 58°00'W | *C. hoffmannsi* | *C. hoffmannsi* 1 | IPBHN 444 |
| **69** | PA Samauma R Tapajós | 03°35'S 55°35'W | *C. hoffmannsi* | *C. hoffmannsi* 2 | MZUSP 11741, 11745 |
| **70** | PA Aruã Rio Arapiuns marg esq R. Tapajós | 02°40'S 55°50'W | *C. hoffmannsi* | *C. hoffmannsi* 2 | MZUSP 5091 |
| **71** | PA Urucurituba marg esq Rio Tapajós | 03°45'S 55°30'W | *C. hoffmannsi* | *C. hoffmannsi* 2 | MZUSP 10154, 10155, 11743, 11815, 11833, 19534 |
| **72** | PA Santa Rosa Ilha de Urucurituba | 03°48'S 56°33'W | *C. hoffmannsi* | *C. hoffmannsi* 2 | MZUSP 11834, 11835, 11836 |
| **73** | PA Rio Arapiuns Santarém Tapajós | 02°20'S 55°13'W | *C. hoffmannsi* | *C. hoffmannsi* 2 | MPEG 587 |
| **74** | PA Vila Maripá, marg dir R Tapajós | 02°39'S 55°57'W | *C. hoffmannsi* | *C. hoffmannsi* 2 | MPEG 21444 |
| **75** | PA Itaituba-Jacareacanga km 19 | 04°18'S 56°08'W | *C. hoffmannsi* | only skull | MPEG 8499, 8500, 8501, 8502 |
| **76** | PA Monte Cristo marg dir R. Tapajós | 04°05'S 55°38'W | *C. moloch* | *C. moloch* | MZUSP 3567, 3568, 3569, 11817 |
| **77** | PA Taperinha | 02°32'S 54°18'W | *C. moloch* | *C. moloch* | MZUSP 3570; MPEG 4733, 4734, 4735, 4736, 4737, 4738, 4739, 4740, 4743, 4744, 4745, 4746, 4747, 4748, 4749, 4750, 4751, 4752, 4753, 4754, 4755, 4756, 4757, 4758, 4759, 4760, 4761, 4762, 4763, 4764, 4765, 4766, 4767, 4768,4769, 4770, 4778 |
| **78** | PA Santarém Faz Maruá | 02°26'S 54°42'W | *C. moloch* | *C. moloch* | MZUSP 3571, 3572 |
| **79** | PA Piquiatuba | 03°03'S 55°07'W | *C. moloch* | *C. moloch* | **MZUSP** 5142,5153, 5155, 5156,5158, 5160, **MNRJ** 5981, 5979, 5980 |
| **80** | PA Caxiricatuba R. Tapajós | 02°36'S 54°56'W | *C. moloch* | *C. moloch* | MZUSP 5143, 5144, 5146, 5147, 5148, 5149, 5150, 5151, 5152, 5157, 5159, 5165, 5166, 5167, 5169, 24735 |
| **81** | PA Foz do Curuá | 02°23'S 54°05'W | ? | *C. moloch* | MZUSP 5196, 5197, 5202 |
| **82** | PA Bom Jardim dir Rio Amazonas | 02°48'S 54°08'W | *C. moloch* | *C. moloch* | MZUSP 5198, 5200 |

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|---|---|---|---|---|---|
| **83** | Pa Cachimbo | 09°22'S 54°58'W | *C. moloch* | *C. moloch* | MZUSP 8062 |
| **84** | PA Fordlandia | 03°47'S 55°23'W | *C. moloch* | *C. moloch* | MZUSP 10151, 10153,11716, 11717, 11718, 11719, 11720, 11723, 11724, 11725, 11727, 11728, 11729, 11730, 11732, 11733, 11734, 11735, 11736, 11737, 11738, 11739, 11740, 11742, 11744, 11813, 11814, 11816, 11837, 11838, 11840, 11841, 19690 |
| **85** | PA Itapoama R. Tapajós | 03°15'S 55°00'W | *C. moloch* | *C. moloch* | MZUSP 10152 |
| **86** | PA Sto Antonio R. Tocantins | 02°55'S 49°40'W | *C. moloch* | *C. moloch* | MZUSP 13472 (-= IPBHN 444 breast redish) |
| **87** | PA dir Rio Tapajós esq R. Mutuns | 06°10'S 57°35'W | *C. moloch* | *C. moloch* | IPBHN 203 |
| **88** | MT R. Arinos, aff dir R. Juruena | 10°35'S 58 o00'W | *C. moloch* | *C. moloch* | MZUSP 11244 (SP Zoo), MNRJ 2915, 2923 |
| **89** | PA Largo do Souza Rio Iriri | 04°00'S 53°03'W | ? | *C. moloch* | MZUSP 25441, 25442, 25443 |
| **90** | PA Boca do rio Bacajá | 03°25'S 51°48'W | ? | *C. moloch* | MZUSP 25444, 25445 |
| **91** | PA, Santarém, Rio Curuatinga, Aff Rio Curuauna | 02°55'S 54°35'W | *C. moloch* | *C. moloch* | MNRJ 11590, 11593 |
| **92** | PA, Alto Cururu | 07°45'S 57°27'W | *C. moloch* | *C. moloch* | MNRJ 23867 |
| **93** | PA, Rio Xingu | 07°00'S 53°00'W | *C. moloch* | *C. moloch* | MNRJ 54834, 54835, 54836 |
| **94** | PA Alto rio Iriri Xingu | 08°20'S 53°30'W | *C. moloch* | *C. moloch* "light phenotype" | MPEG 246 |
| **95** | PA São João rio Araguaia | 06°14'S 48°23'W | *C. moloch* | *C. moloch* "light phenotype" | MPEG 245 |
| **96** | PA Igarapé João Ribeiro mg.esq. rio Iriri | 03°55'S 53°20'W | *C. hoffmannsi* | *C. moloch* | MPEG 21837, 21883 |
| **97** | Luzilândia rio Araguaia Prox. Itaipava | 06°41'S 48°50'W | *C. moloch* | *C. moloch* | MPEG 10932 |
| **98** | PA Luzilândia rio Araguaia Xinguara | 06°56'S 49°54'W | *C. moloch* | *C. moloch* | MPEG 10933, 10939 |
| **99** | PA Serra Norte Carajás N1 | 06°0'S 50°16'W | *C. moloch* | *C. moloch* | MPEG 10943, 10944,11843 |
| **100** | PA Serra Norte Carajás N2 área de manganês | 06°00'S 50°00'W | *C. moloch* | *C. moloch* | MPEG 11832 |
| **101** | PA 170 km S de Tucuruí Saúde mg.esquerda rio Tocantins | 05°18'S 49°17'W | *C. moloch* | *C. moloch* | MPEG 12175, 12176 |
| **102** | PA Santarém-Cuiabá Itaituba BR 165 zona Sul | 04°05'S 54°55'W | *C. moloch* | *C. moloch* | MPEG 12627 |
| **103** | PA Santarém Rod BR-163 km125 Flora do Tapajós. =78 | 03°27'S 55°10'W | *C. moloch* | *C. moloch* | MPEG 26406 |
| **104** | MT Apiacás | 09°30'S 57°05'W | *C. moloch* | *C. moloch* | *IPBHN 208, 209* |
| **105** | Alvorada d'Oeste BR 429 linha 64 km 87 | 11°23'S 62°18'W | *C. moloch* | *C. moloch* | MPEG 19709, 19710, 19712, 19713 |
| **106** | AM, São João, R. Aripuanã | 05°29'S 60°25'W | *C. moloch* | *C. moloch* | MNRJ 2480, 2481 |
| **107** | PA, Santarém, Belterra = 80 | 02°39'S 54°57'W | *C. moloch* | *C. moloch* | MNRJ 5494 |
| **108** | AM, Foz do Rio Castanho ( R Roosevelt) | 07°33'S 60°42'W | *C. moloch* | *C. moloch* | MNRJ 2482, 2484, 2485 |
| **109** | PA UHE Tucuruí rio Tocantins | 03°40'S 49°40'W | *C. moloch* | *C. moloch* | MPEG21442, 21443, 22014, 22015, 22016, 22017, 22016 |
| **109a** | PA UHE Tucuruí rio Tocantins | 03°40'S 49°40'W | *C. moloch* | *C. moloch* "light phenotype" | MPEG 22018 |

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| No | Collecting Locality | Coordinates | Label | Analysis | SPECIMENS |
|---|---|---|---|---|---|
| **110** | PA Mun Tucuruí Sítio Calandri acima da barragem mg esq Rio Tocantins | 03°50'S 49°42'W | *C. moloch* | *C. moloch* "light phenotype" | MPEG 22015, 22016 |
| **111** | PA, Ipanema, beira da Rodagem esquerda Santarém = 78 | 02°47'S 54°55'W | *C. moloch* | *C. moloch* | MNRJ 11588, 11591, 11592 |
| **112** | PA Ig. do Patauá af. esq. Rio ?? Município de Itaituba | 04°16'S 55°48'W | *C. moloch* | *C. moloch* "red phenotype" | MPEG 21972 |
| **113** | PA, Apui, BR-230 Humaitá-Itaituba km 17 | 07°35'S 62°50'W | *C. moloch* | *C. moloch* "red phenotype" | MPEG 22000 |
| 114 | (loctip 30 milles north Concepción, Paraguai) | 22°50'S 57°27'W | | *C. pallescens* | *Criad. Velho Jatobá* |
| 115 | Ba, Mirorós - Faz Conceição | 11°24'S 42°17'W | *C. barbarabrownae* | *C. barbarabrownae* | UNB 1510 |
| 116 | SE, Cristinapolis, Faz. Cruzeiro | 11°28'S 37°45'W | *C. personatus* | *C. coimbrai* | MNRJ 30550 |
| 117 | BA, (loctip Morro Dárara ou Faz Arara) | 14°00'S 40°00'W | *C. melanochir* | *C. melanochir* | MZUSP 3884 |
| 118 | MG Teófilo Otoni | 17°52'S 41°28'W | *C. personatus* | *C. personatus* | MZUSP 2712, 2713, 2714 |
| 119 | MG Baixo R. Suaçui | 18°47'S 41°45'W | *C. personatus* | *C. personatus* | MZUSP 5839, 5931, 5932 |
| 120 | ES Colatina | 19°32'S 40°37'W | *C. personatus* | *C. personatus* | MZUSP 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227 |
| 121 | ES Rio Doce | 19°30'S 40°30'W | *C. personatus* | *C. personatus* | MZUSP 2409, 2410, 2411, 2412, 2413 |
| 122 | ES Sooretama | 19°00'S 40°00'W | *C. personatus* | *C. personatus* | MZUSP 11142, 11148, 111152, 111164, 11711, 11712, 11713, 11714, 11803, 11804, 11805 |
| 123 | MG, Passos, Foz do Brejo, São João da Glória | 20°42'S 46°37'W | *C. personatus* | *C. personatus* | MNRJ 21065, 21066, 25898 |
| 124 | ES, São Domingos, Mata 10 de Agosto, Faz 10 de Agosto | 19°08'S 40°38'W | *C. personatus* | *C. personatus* | MNRJ 21054, 21052, 21053 |
| 125 | ES, Lagoa Juparaua, Sant´anna | 19°22'S 40°07'W | *C. personatus* | *C. personatus* | MNRJ 2478 |
| 126 | ES, Estrada Linhares, São Matheus km 54 | 19°15'S 40°05'W | *C. personatus* | *C. personatus* | MNRJ 21051 |
| 127 | ES, Rio São José, Braço do Sul | 19°05'S 40°40'W | *C. personatus* | *C. personatus* | MNRJ 54782, 54788 |
| 128 | MG, Ituete, Rio Poço | 19°25'S 41°18'W | *C. personatus* | *C. personatus* | MNRJ 11986 |
| 129 | RJ Itatiaia | 22°31'S 44°32'W | *C. nigrifrons* | *C. nigrifrons* | MZUSP 7426, 7427, 7428, 7429, 7430,19548 |
| 130 | SP Serra da Cantareira | 23°32'S 46°37'W | *C. nigrifrons* | *C. nigrifrons* | IPBHN 318 |
| 131 | SP Itatiba | 23°00'S 46°50'W | *C. nigrifrons* | *C. nigrifrons* | IPBHN 605, IPBHN 1016, IPBHN 1017 |
| 132 | RJ, Itatiaia, Chevap - Funil | 22°30'S 44°34' W | *C. personatus* | *C. nigrifrons* | MNRJ 25897 |
| 133 | Cabeceiras do Paranatinga | | *C. personatus* | *C. personatus* | MNRJ 3008 |
| 134 | | | *C. personatus* | *C. personatus* | MNRJ 2479 |
| 135 | | | *C. melanochir* | *C. melanochir* | MNRJ 11049 |
| 136 | | | *C. purinus* | *C. purinus* | CPRJ 005 |

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