

Spix's type specimens of Neotropical primates at the Bavarian State Collection of Zoology: a revision with reference to the currently recognised species

(Mammalia, Primates, Platyrrhina)

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Johann Baptist Ritter von Spix collected many interesting zoological specimens during his travels in South America from 1817 to 1820. The type specimens of Neotropical primates described by Spix (1823), which are stored at the Bavarian State Collection of Zoology (German: Zoologische Staatssammlung München, Staatliche Naturwissenschaftliche Sammlungen Bayerns), are listed in the present manuscript. With the exception of the type of *Pithecia capillamentosa*, all specimens were collected by Spix during his journey in Brazil from 1817–1820.

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Introduction

History of the type specimens

During his journey through Brazil from 1817 to 1820, Johann Baptist Ritter von Spix collected many primate specimens, which would later form the basis for his famous publication: “Simiarum et vespertilionum brasiliensium species novae ou histoire naturelle des espèces nouvelles de singes et de chauves-souris” (München, 1823; 68 pp., Latin and French, 36 colour plates and 2 uncoloured plates with depictions of skulls). The type specimen of *Pithecia capillamentosa* Spix = *Pithecia chrysocephala* (L. Geoffroy Saint-Hilaire, 1850) (Primates: Platyrrhina: Pitheciidae) is the only specimen that does not originate from this journey, but was already in the Munich natural history collection in the year 1816.

J. B. von Spix was not the only researcher describing South American primates at the start of the 19th century; at least 19 taxa had already been described previously by other researchers (Linnaeus 1758, É. Geoffroy Saint-Hilaire 1806, von Hoffmannsegg 1807, Goldfuss & Schreber 1809, Humboldt 1811–12, É. Geoffroy Saint-Hilaire 1812, Wied-Neuwied 1820, 1826, Pucheran 1845, I. Geoffroy Saint-Hilaire 1850, Elliot 1910, Cabrera & Yepes 1940). Nevertheless, of the 34 described primate species, 15 were new to science. Of the presently valid genus names, Spix only contributed *Brachyteles*. Spix correctly identified the differences between *Saguinus oedipus* (Linnaeus) and *Midas oedipus* (*varietas*) (Spix, 1823) (= *Saguinus goeffroyi* (Pucheran, 1845)), but, since the appellation “*varietas*” does not suffice to describe a new subspecies, the name does not have priority over that of Pucheran (1845). Additionally, specimen number 11

(Fig. 10B) carries a label with ‘Original exemplar / zu *Pithecia melanocephala* Humb. / in Schreb. Wagn. Säugeth. Bd. I / S. 223 und Suppl. Bd. V / S. 102/103’. Normally, this would indicate that the specimen is a type for *Cacajao melanocephalus* (Humboldt, 1812). Nevertheless, historic sources indicate this not to be the case (e.g., Alexander von Humboldt 1800).

Kraft (1983) observed: “In some cases, the postures of the animals in the plates of Spix’s original publication are remarkably similar to those of the mounts, so that it seems obvious that the mounts served as the examples for the plates. These cases are indicated clearly below” (translated from German).

Additionally, what is written on the labels is the only reliable source of information regarding the origin and species attribution of the type specimen (but see specimen number 11 of Spix’s black-headed uacari below), since Spix described species rather than types, as was common practice in his time.

Kraft (1983) further noted: “Most type specimens of the species described by Spix are stored in the Bavarian State Collection of Zoology (ZSM), and an additional few in the Zoological Museum of the Humboldt University in Berlin and Naturalis Biodiversity Center in Leiden (Elliot 1913). The specimens stored in Munich are primarily traditional skin-mounts, which are mounted on boards or branches, and a few skulls” (translated from German).

Most of the type specimens at the ZSM are stuffed skins that were originally displayed in the Alte Akademie in the Neuhauser Straße in Munich. The taxidermists working on the skins were unfamiliar with South American monkeys and were only given the skins to work with. This sometimes resulted in rather unnatural postures, such as a Paraguayan howler (specimen number 9) carrying an infant on her hip.

General information

The present manuscript is based on a previous publication “Die von J. B. von Spix beschriebenen neotropischen Primaten und Chiropteren. Verzeichnis der in der Zoologischen Staatssammlung München aufbewahrten Typusexemplare” (Kraft 1983). The figures consist of scientifically accurate renderings of the specimens in their current condition. They were created by a group of artists, associated with the ZSM, under the guidance of medal-winning scientific artist Barbara Ruppel, consisting of: Anja Bolata, Rudolf Gerer, Dr. Thassilo Franke, Dr. Tacia Ottowitz, Ruth Moch, Michael Jicha and Marco Calogera. The images have been given additional artistic value by adding elements, such as native plants. Larger versions of the images can be found in

the book “Über die Primaten der Brasilienexpedition des Johann Baptist Ritter von Spix” (Unsöld 2019) and online (<https://www.zsm.mwn.de/sammlung/spix-monkeys/> and <http://doi.org/10.5281/zenodo.3260267>). Photographs of the specimens were also made by Marianne Müller and can be found in the online type catalogue (<http://www.zsm.mwn.de/sammlung/typenexemplare-der-primates/>), where the scientific names of the specimens will be updated regularly.

Translated from Kraft (1983): “When two specimens are available for one species, one is labelled “Typus” and the others are “Co-Typus”. Following the current International Code of Zoological Nomenclature, all specimens of the type series (Typus and Co-Typus) are considered syntypes, because neither a holotype nor a lectotype has been fixed (International Commission on Zoological Nomenclature 2000). Even when only one type is available in the ZSM for a particular species, it is not certain that this is the holotype, since co-types may have been destroyed or lost over the years or stored at different institutions. The inventory numbers have all been written on the labels with pencil in the same handwriting and there is a card index with the same numbers. It is unknown when or by whom the specimens were numbered.”

Most species described by Spix are classified according to their currently valid genera and families, and in the order currently used in the Handbook of the Mammals of the World (Mittermeier et al. 2013). For the genus *Pithecia*, Marsh (2014) was followed. The page and plate numbers in the original publication are listed in parentheses after the name used by Spix. Below that, the currently valid genus and species names are listed with a reference to the author who equated the names. The type locality is recorded in quotation marks as indicated in the original description followed by the account of type specimens. Occasionally further information with regards to the locality and range are provided, which was sourced from modern literature and the IUCN red list (www.iucnredlist.org). Each specimen account consists of catalogue number, sex, age, and method of preservation, description of condition, with the inscription of the labels attached to the specimens in quotation marks.

Almost all of the primates in the present paper have the same red type labels. Handwritten on the labels, the species name is listed as it appeared in the original publication, as well as the title of Spix’s mammal publication and the respective page and plate numbers. Here, the red labels are not transcribed, since that information is already provided. Labels are transcribed only in those cases where additional labels have been added with references

to later taxonomic revisions or descriptions of the specimens.

Abbreviations

S	skull (cranium + mandibula)
SM	skin-mount
f	female
m	male
ad	adult
juv	juvenile
/	hard return on the label or skull
"..."	literal translation from Latin (or German in the case of specimen nr. 32)
'...'	literal transcription of text
pl.	plate in the original publication
fig.	figure in the original publication (whereas Fig. refers to figures herein)
Sp. nr.	specimen number

Type specimens

Order Primates
Suborder Platyrrhina

Family Callithrichidae Gray, 1812

Genus *Cebuella* Gray, 1866

The Handbook of the Mammals of the World (Mittermeier et al. 2013) lists the genus *Cebuella* as having been described by Spix in 1866. This is, however, incorrect, as Spix had already passed away in 1826. It was, in fact, Gray who described *Cebuella* in 1866.

Pygmy marmoset

Jacchus pygmaeus Spix, 1823 (p. 32, pl. 24, fig. 2)
= *Cebuella pygmaea pygmaea* (Spix, 1823): Cabrera 1958, p. 189.

"Tabatinga at the Rio Solimoes", State of Amazonas, Brazil. The subspecies further occurs in Ecuador and Peru, east of the Andes (Cabrera 1958).

Sp. nr. 20: ad, SM, S present. Partly bald, left foot is missing (Fig. 1A).

Genus *Callithrix* Erxleben, 1777

Black-tufted-ear marmoset

Jacchus penicillatus Spix, 1823 (p. 34, pl. 26)
= *Callithrix penicillata* (É. Geoffroy Saint-Hilaire, 1812): Hershkovitz 1977, p. 500.

No type specimen available at the ZSM.

Common marmoset

Jacchus albicollis Spix, 1823 (p. 33, pl. 25)
= *Callithrix jacchus* (Linnaeus, 1758): Cabrera 1958, p. 187 and Groves 2005, p. 131.

"In the forests near the city Bahia" (= Salvador), State of Bahia, Brazil. The common marmoset currently occurs in the scrub forest and Atlantic forest of north-eastern Brazil (Rylands et al. 2008).

Sp. nr. 6: ad, SM, S present. Hips and part of the tail bald (Fig. 1B).

According to Hershkovitz (1977), *J. albicollis* Spix is a hybrid between the subspecies *C. jacchus jacchus* L. and *C. jacchus penicillata* É. Geoffroy Saint-Hilaire, 1812. The locus typicus of *J. albicollis* Spix lies in the contact zone near Bahia (now Salvador) of the distributions of both subspecies, where natural hybridisation occurs (Hershkovitz 1977). The colouration of head, body and tail of Spix's type specimen corresponds to that of *C. jacchus jacchus*, but the ear tufts are narrow and erect, like *C. jacchus penicillata*. The hairs of the ear tufts are a yellowish white in the lower one thirds and become grey brown towards the tips.

Genus *Saguinus* Hoffmannsegg, 1807

Black-mantled tamarin

Midas nigricollis Spix, 1823 (p. 28, pl. 21)
= *Saguinus nigricollis nigricollis* (Spix, 1823): Hershkovitz 1977, p. 630.

"North bank of the Rio Solimoes near Sao Paulo de Olivença", State of Amazonas, Brazil. The distribution of this species extends from the mouth of the Rio Iça, Amazonas, Brazil, to the mouth of the Río Napo, Loreto, Peru (Hershkovitz 1977).

Sp. nr. 21: 2 SM, ad and juv, mounted to the same branch (Fig. 1C). S present in both specimens.

Spix's saddle-back tamarin

Midas fuscicollis Spix, 1823 (p. 27, pl. 20)
= *Saguinus fuscicollis fuscicollis* (Spix, 1823): Hershkovitz 1977, p. 644.

"Near Sao Paulo de Olivença in the forests between Rio Solimoes and Rio Içá", limited to the surroundings of Sao Paulo de Olivença at the south bank of the Rio Solimões by Hershkovitz (1977, p. 636), State of Amazonas, Brazil.

Sp. nr. 12: ad, SM, S present. Left foot is damaged (Fig. 2A).



Fig. 2. Spix's saddle-back tamarin (*Saguinus fuscicollis fuscicollis*). A. Sp. nr. 12 by Ruth Moch. B. Sp. nr. 5 by Taciana Ottowitz. C. Sp. nr. 13 by Ruth Moch. D. Black-handed tamarin (*Saguinus niger*) Sp. nr. 30 by Ruth Moch.

Sp. nr. 5: f, ad, SM, S present. Some fingers are broken off, extended bald patches (Fig. 2B).

Sp. nr. 13: ad, SM, S present (Fig. 2C).

Another SM, without S in a very bad condition (mostly bald) with the Sp. nr. 30 is labelled as the co-type of *Midas fuscicollis* Spix. As far as still recognisable, this specimen belongs to *Saguinus niger* E. Geoffroy Saint-Hilaire, 1803 (Fig. 2D). This species was not described by Spix.

Mustached tamarin

Midas mystax Spix, 1823 (p. 29, pl. 22)

= *Saguinus mystax mystax* (Spix, 1823): Hershkovitz 1977, p. 696.

“Near Sao Paulo de Olivença in the forests between Rio Solimoes and Rio Ica”, limited to the south bank of the Rio Solimões near Sao Paulo de Olivença by Hershkovitz (1977, p. 698), State of Amazonas, Brazil
Sp. nr. 29: f, ad, SM, S present (Fig. 3A).



Fig. 3. A. Mustached tamarin (*Saguinus mystax mystax*) Sp. nr. 29 by Taciana Ottowitz. B. Pied tamarin (*Saguinus bicolor*) Sp. nr. 7 by Taciana Ottowitz. C. Geoffroy's tamarin (*Saguinus geoffroyi*) Sp. nr. 4 by Michael Jicha. D. Black-horned capuchin (*Sapajus nigritus*) Sp. nr. 8 by Ruth Moch.

Pied tamarin

Midas bicolor Spix, 1823 (p. 30, pl. 24, fig. 1)
 = *Saguinus bicolor* (Spix, 1823): Hershkovitz 1977,
 p. 741.

“Forested planes near Rio Negro” (= Manaus), State of Amazonas, Brazil. *Saguinus bicolor* only occurs north of the Rio Amazonas, east of the Rio Negro, in the vicinity of Manaus (Mittermeier et al. 2008).

Sp. nr. 7: juv, SM, S present. Left forelimb damaged, tail partly bald (Fig. 3B).

Geoffroy's tamarin

Midas oedipus (varietas) Spix, 1823 (p. 30, pl. 23)
= *Saguinus geoffroyi* (Pucheran, 1845): Hershkovitz
1977, p. 757, as a subspecies, later elevated to
species level by Moore & Cheverud (1992).

“probably Guiana”. Actual distribution of this spe-
cies is: Panama, south-east Costa Rica, north-west
Columbia (Marsh et al. 2008).

Sp. nr. 4: f, ad, SM, S removed (Fig. 3C). Red label:
‘Typus / von *Jacchus spixii* / in: Reichenbach, Die
vollständige / Naturgeschichte der Affen (1863?)’,
white label: ‘Originalexemplar zu: *Midas oedipus*
(varietas) / Spix Sim. Et Ves. Bras. Sp. Nov. / S. 30
tab. XXIII’.

Spix points out the differences between this
specimen and *Simia oedipus* Linnaeus, 1758. Never-
theless, the designation “varietas” between brackets
cannot be interpreted as the establishment of subspe-
cific rank. Additionally, the distribution of *Saguinus*
oedipus geoffroyi (Pucheran, 1845) does not lie on the
travel route of Spix and Martius. So, this specimen
probably reached Spix indirectly and without exact
indications to its provenance. The claws on the fin-
gers and toes have grown long and semi-circular,
indicating that the animal was kept in captivity
for a long period of time. This specimen is also the
holotype of *Jacchus spixii* Reichenbach, 1862 (Die
vollständige Naturgeschichte der Affen, p. 1, pl. 1,
fig. 2) = *Saguinus geoffroyi* (Pucheran, 1845).

Family Cebidae Bonaparte, 1831

Genus *Sapajus* Kerr, 1792

Black-horned capuchin

Cebus cucullatus Spix, 1823 (p. 9, pl. 6)
= *Sapajus nigrurus* (Goldfuss, 1809): Silva Jr. 2001,
p. 252 as subgenus, elevated to genus level by
Lynch Alfaro et al. (2012). Silva Jr. (2001) unfor-
tunately misspelled *cucullatus* as *cuculatus*.

“In the forests of the province São Paulo and Gya-
nas.” Meaning of the latter locality is unclear, since
Guyana was neither visited by Spix, nor forms part
of the distribution of the subspecies.

Sp. nr. 8: ad, SM, probably S removed. Posture
corresponds mostly to the original plate (Fig. 3D).

Bearded capuchin

Cebus libidinosus Spix, 1823 (p. 5, pl. 2)
= *Sapajus libidinosus* (Spix, 1823): The subgenus *Sa-
pajus* (Silva Jr. 2001) was elevated to genus level
by Lynch Alfaro et al. (2012).

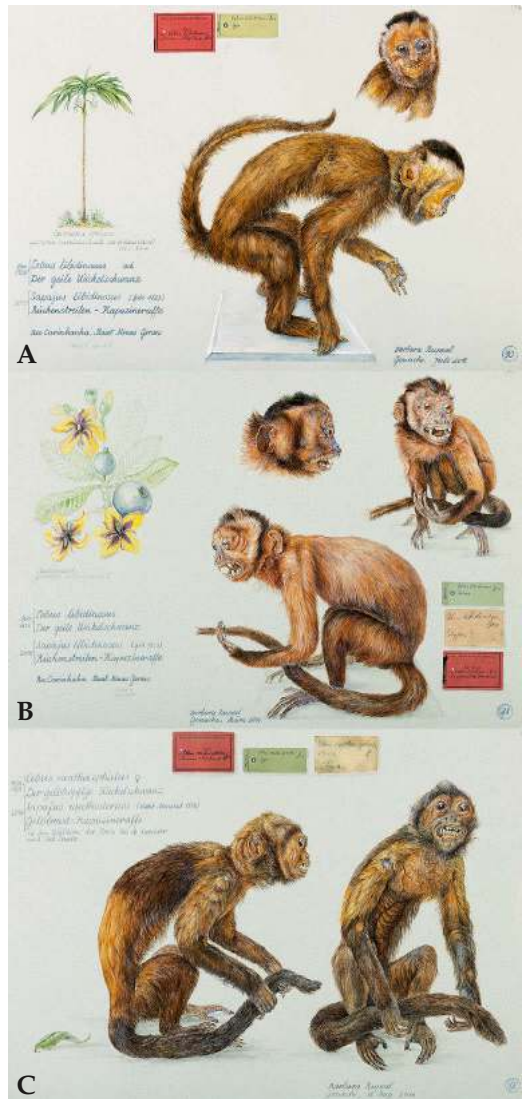


Fig. 4. Bearded capuchin (*Sapajus libidinosus*). A. Sp. nr. 90 by Barbara Ruppel. B. Sp. nr. 28 by Barbara Ruppel. C. Yellow-breasted capuchin (*Sapajus xanthosternus*) Sp. nr. 18 by Barbara Ruppel.

“Rio Carinhanha”, State of Minas Gerais, Brazil. *Sapajus libidinosus* occurs in north-east Brazil, being replaced by *Sapajus apella* (Linnaeus, 1758) to the north in transition to the Amazon rain forest and the dry forests of Mato Grosso and the southern limit being in the region of the Rio Grande (Rylands & Kierulff 2015).

Sp. nr. 90: ad, SM, S removed. Partly bald un-
derneath and on the face (Fig. 4A).

Sp. nr. 28: ad, SM, S present (Fig. 4B).



Fig. 5. Large-headed capuchin (*Sapajus macrocephalus*). **A.** Sp. nr. 17 by Rudolf Gerer. **B.** Sp. nr. 23 by Barbara Ruppel. **C.** Sp. nr. 25 by Barbara Ruppel. **D.** Sp. nr. 27 by Barbara Ruppel.

Yellow-breasted capuchin

Cebus xanthocephalus Spix, 1823 (p. 6, pl. 3)
 = *Sapajus xanthosternus* (Wied-Neuwied, 1826): Silva Jr. 2001, p. 227 as subgenus, elevated to genus level by Lynch Alfaro et al. (2012). Silva Jr. (2001) unfortunately misspelled *xanthocephalus* as *xanthocephalus*.

“In the forests of the provinces Rio de Janeiro and São Paulo”, Brazil. Historically, *Sapajus xanthosternus* probably occurred throughout the entire area west of, and north to, the Rio São Francisco, but is currently restricted to the Atlantic forest of southern Bahia, north of the Rio Jequitinhonha (Kierulff et al. 2015, Silva Júnior 2001).

Sp. nr. 18: f, ad, SM, S present. Partly bald underneath (Fig. 4C).

Large-headed capuchin

Cebus macrocephalus Spix, 1823 (p. 3, pl. 1)
 = *Sapajus macrocephalus* (Spix, 1823): the subgenus *Sapajus* (Silva Jr. 2001) was elevated to genus level by Lynch Alfaro et al. (2012).

“In the forests at the Rio Catuá”, State of Amazonas, Brazil. *Cebus microcephalus* is native to Bolivia, Brazil (Acre and Amazonas), Colombia, Ecuador and Peru (Rylands et al. 2015).

Sp. nr. 17: juv, SM, S present. Partly bald (Fig. 5A).
 Sp. nr. 23: f, ad, SM, S present (Fig. 5B).

Sp. nr. 25: ad, SM, S removed. Incisors and canines are plaster reproductions. Poor condition, almost completely bald (Fig. 5C).

Sp. nr. 27: ad, SM, S present (Fig. 5D).

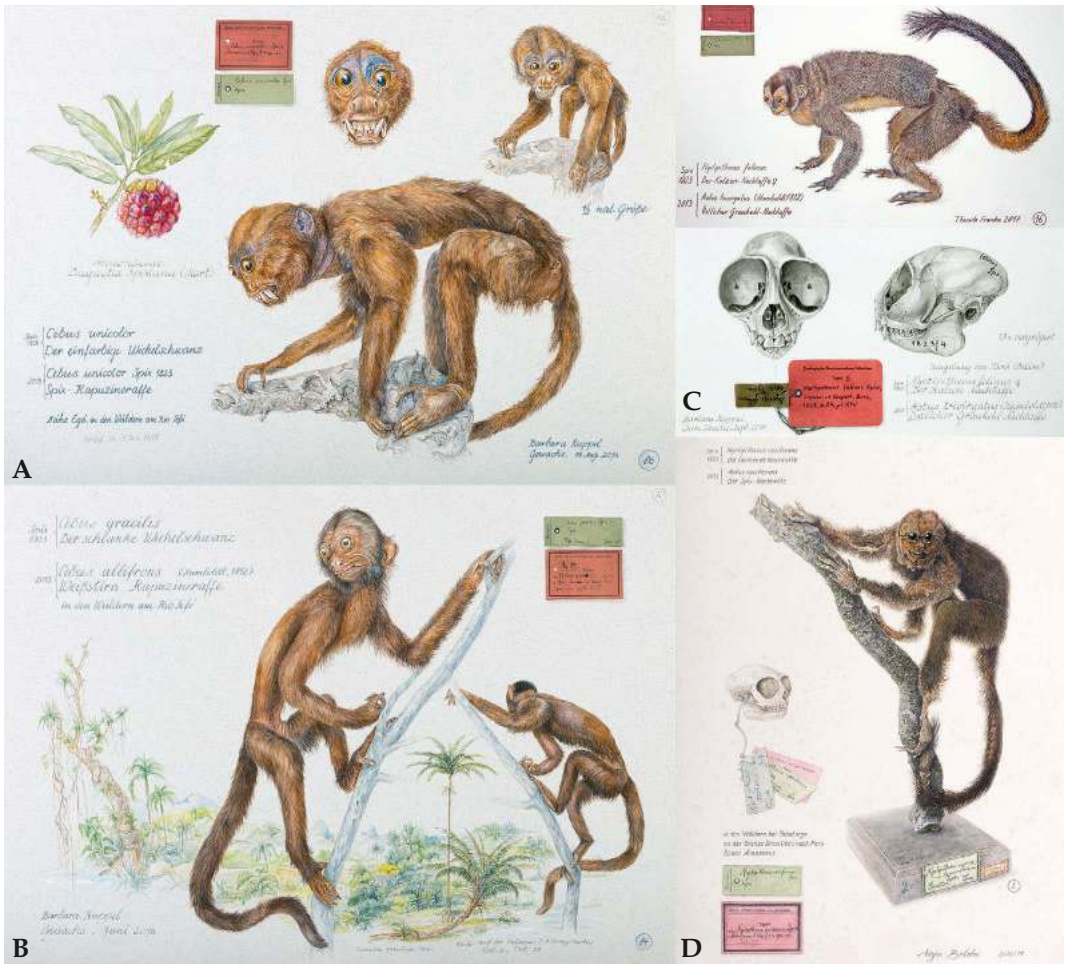


Fig. 6. A. Spix's white-fronted capuchin (*Cebus unicolor*) Sp. nr. 86 by Barbara Ruppel. B. Humboldt's white-fronted capuchin (*Cebus albifrons*) Sp. nr. 84 by Barbara Ruppel. C. Humboldt's night monkey (*Aotus trivirgatus*) Sp. nr. 16 by Thassilo Franke and Sp. nr. 1823/4 by Barbara Ruppel. D. Spix's night monkey (*Aotus vociferans*) Sp. nr. 2 by Anja Bolata.

Genus *Cebus* Erxleben, 1777

Spix's white-fronted capuchin

Cebus unicolor Spix, 1823 (p. 7, pl. 4)
 = *Cebus unicolor* Spix, 1823.

“Near Egá, in the forests at the Rio Tefé”, State of Amazonas, Brazil. *Cebus unicolor* occurs in the southwestern Amazon together with *Cebus yuracus* Hershkovitz, 1949 and *Cebus cuscinus* Thomas, 1901; the exact boundaries between these taxa have not been determined conclusively (Boubli et al. 2012).

Sp. nr. 86: ad, SM, S present. Partly bald underneath and on the head and extremities, skin is torn (Fig. 6A).

Humboldt's white-fronted capuchin

Cebus gracilis Spix, 1823 (p. 8, pl. 5)
 = *Cebus albifrons* (Humboldt, 1812): Hershkovitz 1949, p. 349, Defler & Hernández-Camacho 2002, p. 53, and Groves 2005, p. 136, Silva Júnior 2001, p. 131.

“In the forests at the Rio Tefé”, State of Amazonas, Brazil. *Cebus albifrons* has a western and central Amazonian range, a separate range in the northern Andes in Colombia, and isolated populations in Trinidad and west of the Andes in Ecuador and northern Peru (Boubli et al. 2012).

Sp. nr. 84: juv, SM, S removed (Fig. 6B).

Family Aotidae Poche, 1908

Genus *Aotus* Illiger, 1811

Humboldt's night monkey

Nyctipithecus felinus Spix, 1823 (p. 24, pl. 18)
= *Aotus trivirgatus* (Humboldt, 1812): Cabrera 1958,
p. 135, and Groves 2005, p. 140.

“Surroundings of Pará”, (= Belém), State of Pará, Brazil. *Aotus trivirgatus* is native to Brazil (Amazonas, Pará, Rondônia) and Venezuela (Veiga & Rylands 2008).

Sp. nr. 16: f, ad, SM, S removed (Fig. 6C).

Sp. nr. 1823/4: S, which probably belongs to Sp. nr. 16. Inscription: ‘1823-4 / *felinus* / Spix’. White label: ‘*Nyctip. felinus* / Spix. Type’. Red type label: ‘♀ / *Nyctipithecus felinus* Spix, / Simiar. et Vespert. Bras., / 1823, p. 24, pl. XIV’ (Fig. 6C).

Spix's night monkey

Nyctipithecus vociferans Spix, 1823 (p. 25, pl. 19)
= *Aotus vociferans* (Spix, 1823): Elliot 1905, p. 534.

“In the forests (near/of) Tabatinga, at the border of Brazil to Peru”, State of Amazonas, Brazil. *Aotus vociferans* occurs north of the Rio Amazonas-Solimões, west from the Rio Negro, and south of the Rio Solimões extending into Peru north of the Río Amazonas and Marañón, and north through the Ecuadorian Amazon into Colombia to the Río Guaviare (Morales-Jiménez et al. 2008).

Sp. nr. 2: f, ad, SM, S removed. Heavily damaged: bald on the face and underneath, colours bleached, skin is torn (Fig. 6D).

Sp. nr. 1823/5: S, which probably belongs to Sp. nr. 2. Inscription: ‘1823/5 / *vociferans* / Type’. Red type label and green label: ‘*Nyctipithecus / vociferans* / Type Spix’ and another green label with the same inscription and a reference to the locus typicus ‘in sylvis Tabatinga / Solimoes, Peru-Brasil’.

Family Pitheciidae Mivart, 1865

Genus *Callicebus* Thomas, 1903

Coppery titi

Callithrix cuprea Spix, 1823 (p. 23, pl. 17)
= *Callicebus cupreus* (Spix, 1823): Cabrera 1958, p. 138.

“In the forests of Solimões close to Peru”, State of Amazonas, Brazil. *Callicebus cupreus* occurs south of the Río Marañón / Río Solimões, as far as the east bank of the Río Ucayali, to the south it ranges into Acre as far as the Rios Juruá and Purús, and north-east as

far as the lower and middle Rio Juruá and extending into the Rios Juruá/Purús interfluvium, east it ranges as far as the left bank of the Rio Purús (Veiga 2008).

Sp. nr. 24: ad, SM, S removed. Bald underneath and on the thigh (Fig. 7A).

Sp. nr. 89a: m, ad, SM, S removed (Fig. 7B).

Sp. nr. 89b: ad, SM, S removed, mounted to the same board as 89a. Head partly bald, upper arm damaged (Fig. 7B).

Sp. nr. 10: f, ad, SM, S present. Head and neck partly bald (Fig. 7C).

Ashy titi

Callithrix cinerascens Spix, 1823 (p. 20, pl. 14)
= *Callicebus cinerascens* (Spix, 1823): Cabrera 1958,
p. 137, and Hershkovitz 1990, p. 51.

“In the forests at the bank of the Rio Putumayo or Rio Icó, close to the Peruvian border”, State of Amazonas, Brazil. The type locality is not in the known distribution of *C. cinerascens* and it seems likely that the type specimen was from the south bank of the Rio Madeira (van Roosmalen et al. 2002).

Sp. nr. 3: ad, SM, S removed. Slightly bleached (Fig. 8A).

Sp. nr. 1821/1: S, which is damaged (occiput is missing), probably belongs to Sp. nr. 3. Inscription: ‘1821/1 / *cinerascens*’. Red type label and white label: ‘*Call cinerascens* / Type Spix’

White-collared titi

Callithrix amicta Spix, 1823 (p. 19, pl. 13)
= *Callicebus torquatus* (Hoffmannsegg, 1807): Cabrera 1958, p. 143.

No type specimen available at the ZSM.

Black-fronted titi

Callithrix nigrifrons Spix, 1823 (p. 21, pl. 15)
= *Callicebus nigrifrons* (Spix, 1823): Cabrera 1958,
p. 141.

“In the province Minas Gerais at the Rio das Oncas”, Brazil. Although the locality was provided by Spix, Hershkovitz (1990) established that Rio da Onça, Município Campos, in the State of Rio de Janeiro (not Minas Gerais), meets all descriptions of the type locality and it is possible that Spix was uncertain about state boundaries.

Sp. nr. 88: ad, SM, S removed (Fig. 8B).

Masked titi

Callithrix personata Spix, 1823 (p. 18, pl. 12)
= *Callicebus personatus* É. Geoffroy Saint-Hilaire, 1812:
Cabrera 1958, p. 142.



Fig. 7. Coppery titi (*Callicebus cupreus*). A. Sp. nr. 24 by Ruth Moch. B. Sp. nr. 89 by Barbara Ruppel. C. Sp. nr. 10 by Barbara Ruppel.

“Province Rio de Janeiro”, Brazil. This species occurs in the Atlantic forest of south-eastern Brazil in the state of Espírito Santo, north-western Minas Gerais and northern Rio de Janeiro and the east (right) bank of the Rio Jequitinhonha (Veiga et al. 2008a).

Sp. nr. 1823/6: S slightly damaged (foramen magnus enlarged). Inscription: ‘1823/6 / *Callicebus personatus* (E., Geoffroy Saint-Hillaire, 1812) / Coll. Spix / *personata* / Spix’. White label: ‘*Call personata* / Mus Monac Spix’. Green label: ‘Orig. Exemplar / Jochbogen l. 6,35 / r. 6,70 / gr. L. 69,7’. Jochbogen means jugal arch with measurements on the left and right sides respectively. The measurements appear to be given in lines, closely corresponding to the English line (2.1 mm). The right measurement is given as being 6 % larger than the left. Remeasurement of the skull, however, showed that the left is, in fact 6 % larger than the right (14.18 mm and 13.40 mm, respectively). Gr. L. stands for largest length and is given in mm.

Southern Bahian titi

Callithrix gigot Spix, 1823 (p. 22, pl. 16)
= *Callicebus melanochir* (Wied-Neuwied, 1820): Cabrera 1958, p. 139, and Groves 2005, p. 144.

“In the forests at the coast of Bahia”, State of Bahia, Brazil. Formerly, this species may have occurred in the Pardo-Jequitinhonha interfluvial region, but currently it is only found in the Atlantic coastal forests of Brazil between the right margin of the Rio Paraguaçu in the state of Bahia and the left bank of the Rio Mucur in northern Espírito Santo, to the north, this species extends as far as the Rio Paraguaçu, to the south it may reach as far as the Rio Doce (Veiga et al. 2008b).

Sp. nr. 26: f, ad, SM, S removed (Fig. 8C).



Fig. 8. A. Ashy titi (*Callicebus cinerescens*) Sp. nr. 3 by Barbara Ruppel. **B.** Black-fronted titi (*Callicebus nigrifrons*) Sp. nr. 88 by Marco Calogera. **C.** Southern Bahian titi (*Callicebus melanochir*) Sp. nr. 26 by Ruth Moch. **D.** Golden-faced saki (*Pithecia chrysocephala*) Sp. nr. 1 by Barbara Ruppel.

Genus *Pithecia* Desmarest, 1804

Golden-faced saki

Pithecia capillamentosa Spix, 1823 (p. 16, pl. 11)
 = *Pithecia chrysocephala* (L. Geoffroy, 1850): Marsh
 2014, p. 21, *Pithecia capillamentosa*, though earlier,
 is considered a nomen dubium.

Without locality information. The locus typicus after Cabrera (1958, p. 148) is Cayenne, French Guayana. According to Marsh (2014) it occurs only in Brazil, north of the Rio Amazonas, both sides of the Rio Negro, especially in the lower reaches near Manacapuru, east to Faro along the Rio Nhamundá.

Sp. nr. 1: juv, SM, S present. Posture corresponds to the original plate (Fig. 8D). The specimen was not collected by Spix, but was already in the Munich collections in 1816 (Elliot 1913, p. 291; Wagner 1833, p. 993).

Hairy saki

Pithecia hirsuta Spix, 1823 (p. 14, pl. 9)
 = *Pithecia hirsuta* Spix, 1823.

“In the forests between the Rio Solimões and the Rio Negro”, State of Amazonas, Brazil. *Pithecia hirsuta* currently occurs west of the Rio Negro, north of the Rio Solimões, north of the Río Napo, and south



Fig. 9. Hairy saki (*Pithecia hirsuta*). A. Sp. nr. 14 by Ruth Moch. B. Sp. nr. 19 by Taciana Ottowitz. C. Sp. nr. 15 by Barbara Ruppel.

of the Río Caquetá, in Brazil, Peru and Colombia (Marsh 2014).

Sp. nr. 14: juv, SM, skull removed. Chest, head and tail partly bald, some fingers are missing (Fig. 9A).

Sp. nr. 19: ad, SM, S present. Bald underneath, head hair not complete (Fig. 9B).

Sp. nr. 15: ad, SM, skull removed. Bald underneath (Fig. 9C).

Burnished saki

Pithecia inusta Spix, 1823 (p. 15, pl. 10)
= *Pithecia inusta* Spix, 1923.

No type specimen available at the ZSM.

Genus *Chiropotes* Lesson, 1840

Black-bearded saki

Brachyurus israelita Spix, 1823 (p. 11, pl. 7)
= *Chiropotes satanas* (Hoffmannsegg, 1807): Cabrera 1958, p. 146.

“At the Rio Negro” (p. 11) or “In the forests at the Rio Japura” (p. 12), State of Amazonas, Brazil. Currently, this species is endemic to eastern Amazonia in Brazil and has a restricted range between the right bank of the Rio Tocantins and the eastern borders of the Amazon forest in the Brazilian states of Pará and Maranhão (Veiga et al. 2008c).

Sp. nr. 34: m, ad, SM, S present. Bald underneath, some fingers and toes are missing (Fig. 10A). Green label: ‘*Brachyurus Israelita* / ♂ Spix / Typus (1 Exemplar) / Rio negro Spix (1817–1820)’, white label: ‘Original exemplar / zu *Pithecia Israelita* Spix / in Schreb. Wagn. Säugethiere Suppl. Bd. I / S. 129 tab. XXXII B.’

Genus *Cacajao* Lesson, 1840

Spix’s black-headed uacari

Brachyurus ouakary Spix, 1823 (p. 12, pl. 8)
= *Cacajao ouakary* (Spix, 1823): Ferrari et al. (2014) do not list synonyms, but they reinstate *C. ouakary* as a separate species from *C. melanocephalus*.

“In the forests between Rio Solimoes and Rio Ica”, State of Amazonas, Brazil. From its known distribution, it seems more likely that the type specimen was collected at the Rio Japurá on the north bank of its confluence with the Solimões.

Sp. nr. 11: m, ad, SM, S present. Bald underneath (Fig. 10B). Two red type labels, white label: ‘Ori-

nalexemplar / zu *Pithecia melanocephala* Humb. / in Schreb. Wagn. Säugeth. Bd. I / S. 223 und Suppl. Bd. V / S. 102/103’

The white label indicates that this specimen should be the type specimen for *Cacajao melanocephalus* (Humboldt, 1812). As the whereabouts of this type are currently unknown, it might theoretically be possible that this is indeed the Humboldt specimen. Humboldt described and figured a young animal, whereas Spix described and figured an adult individual. So, it might be hypothesised that the animal continued to live after Humboldt’s description and was later described again by Spix as a different species. Humboldt’s own publication (Humboldt 1811–12, p. 316–319), however, indicates that Humboldt bought his monkey near San Francisco Solano, but that it died shortly thereafter: ‘Le seul individu que nous ayons eu de cette nouvelle espèce de singe, mourut d’un coup de soleil qui fut suivi d’une forte indigestions causée par le fruit laiteux du Papayer’. Additionally, the drawing was made after its death: ‘Le singe que j’ai dessiné après sa mort ...’ (Humboldt 1811–12, p. 316). Furthermore, Humboldt wrote in his handwritten notes that the animal had already died in May 1800 (Alexander von Humboldt 1800). Also from Spix’s historical documents it seems clear that the two monkeys could not have been the same. In their 10th letter, Spix and Martius themselves also wrote to Max I. Joseph, King of Bavaria, that a hunter had shot a short-tailed monkey, which had been described by Humboldt (Martius, after 1829, p. 711). Additionally, it is pertinent to point out that on page 103 in Schreber/Wagner it is written that no type specimen seems to be available for *Simia melanocephala*: ‘von Humboldt’s [sic] *S. melanocephala* scheint in keiner Sammlung ein Exemplar aufgestellt zu sein’.

Family Atelidae Gray, 1825

Genus *Alouatta* Lacépède, 1799

Colombian red howler

Mycetes stramineus Spix, 1823 (p. 45, pl. 31)
= *Alouatta macconelli* Elliot 1910: Gregorin 2006, p. 113.

No type specimen available at the ZSM.

Paraguayan howler

Mycetes barbatus Spix, 1823 (p. 46, pls 32 and 33)
= *Alouatta caraya* (Humboldt, 1812): Cabrera 1958, p. 153, Groves 2001, p. 185, and Gregorin 2006, p. 72.

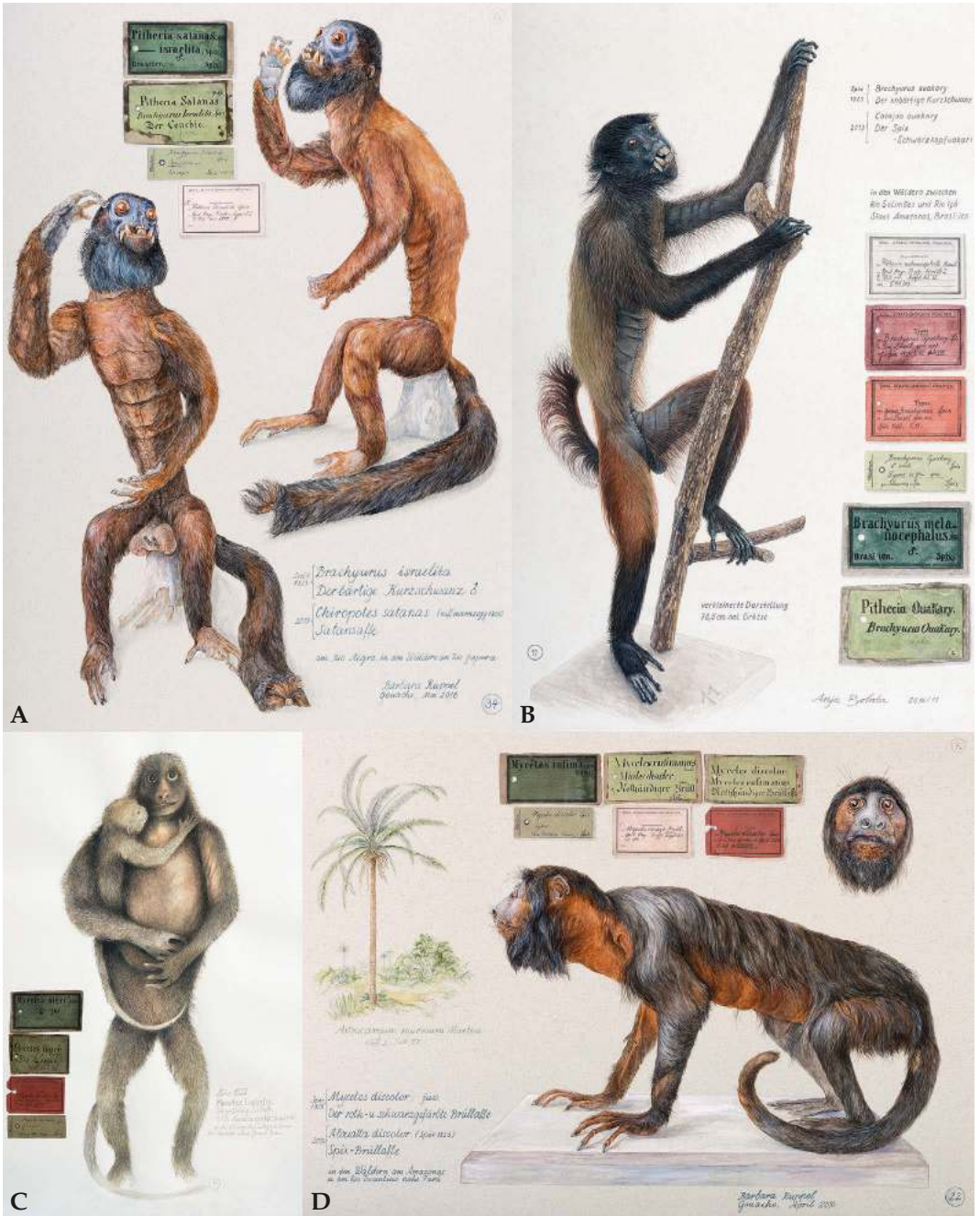


Fig. 10. A. Black-bearded saki (*Chirotopes satanas*) Sp. nr. 34 by Barbara Ruppel. B. Spix's black-headed uacari (*Cacajao ouakary*) Sp. nr. 11 by Anja Bolata. C. Paraguayan howler (*Alouatta caraya*) Sp. nr. 9 by Rudolf Gerer. D. Red-handed howler (*Alouatta discolor*) Sp. nr. 22 by Barbara Ruppel.

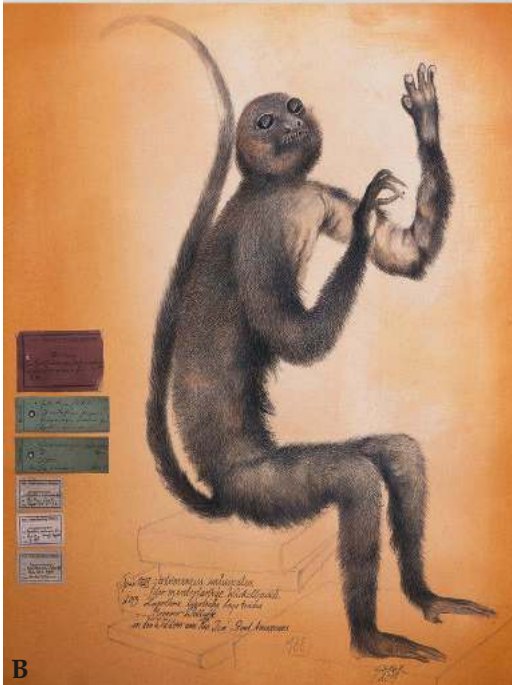


Fig. 11. Humboldt's woolly monkey (*Lagothrix lagotricha lagotricha*). **A.** Sp. nr. 194 by Barbara Ruppel. **B.** Sp. nr. 188 by Rudolf Gerer.

"In the forests (near/of) Tabatinga, in the centre of the Provinces Minas Gerais and Bahia", State of Amazonas, Brazil.

Sp. nr. 9: f, ad, SM, S removed, carrying juvenile on her arm. Bald underneath (Fig. 10C).

Red-handed howler

Mycetes discolor Spix, 1823 (p. 48, pl. 34)
= *Alouatta discolor* (Spix, 1823): Gregorin 2006, p. 91,
Groves 2001, p. 183.

"In the forests at the Amazon and at the Rio Tocantins near Pará", State of Pará, Brazil

Sp. nr. 22: m, juv, SM, S removed (Fig. 10D). Bald underneath, right ear is missing. Red type label and white label: 'Original exemplar / zu *Mycetes caraya* Humb. / ♂ juv., in Schreb. Wagn. Säugeth. Suppl. Bd. I / S. 184'.

Brown howler

Mycetes fuscus Spix, 1823 (p. 43, pl. 30)
= *Alouatta guariba clamitans* Cabrera, 1940: Gregorin 2006, p. 86.

No type specimen available at the ZSM.

Genus *Lagothrix* É. Geoffroy Saint-Hilaire, 1812

Humboldt's woolly monkey

Gastrimargus infumatus Spix, 1823 (p. 41, pl. 29)
= *Lagothrix lagotricha lagotricha* (Humboldt, 1812):
Groves 2001, p. 191 and Groves 2005, p. 152.

"In the forests at Rio Ica", State of Amazonas, Brazil

Sp. nr. 194: f, ad, SM, S removed. Partly bald (Fig. 11A). Red type label and 3 white labels: 'Original exemplar / zu Crit. Revision d. br. Aff / in Isis 1833 sp. 998 / von Andreas Wagner' and 'Original exemplar / zu *Lagothrix infumata* Spix / in Schreb. Wagn. Säugeth. / von Suppl. Bd. I S. 187' and 'Original exemplar / zu *Lagothrix infumata* Spix / in Schreb. Wagn. Säugeth. / von Suppl. Bd. V S. 73'.

Sp. nr. 188: f, ad, SM, S removed. Poor condition, large bald patches (Fig. 11B). Red type label with inscription 'Co-Typus ...' and 3 white labels with the same inscriptions as 194.

Sp. nr. No 1 (please note that this is not the same as Sp. nr. 1, which is a golden-faced saki): S, teeth very worn. Probably belongs to Sp. nr. 194 or Sp. nr. 188. Inscription: 'No 1 / *Lagothrix / infumata* Spix / ♀ senex, type', green label with the same inscription and addition: 'Rio Ica' (Fig. 11A).

Sp. nr. No 2 (please note that this is not the same as Sp. nr. 2, which is a Spix's night monkey): S, juvenile, still has its deciduous dentition, except for the premolars and first molars, which are permanent. White label: '*Lagothrix infumata* juv. / A. Wagner Abh. D. Akad. D. W. / II bd. 1937 s. 433 ff'

Of the skulls, Wagner (1937) writes that "the collection possesses two skulls of woolly monkeys, which were taken out of the skins under my supervision and of which I am certain that they belong to the species called *Gastrimargus infumatus* by Spix, which is identical to *Lagothrix Humboldtii* Geoffr. [sic] One of these skulls (tab. II, fig. 1) is of an old animal;

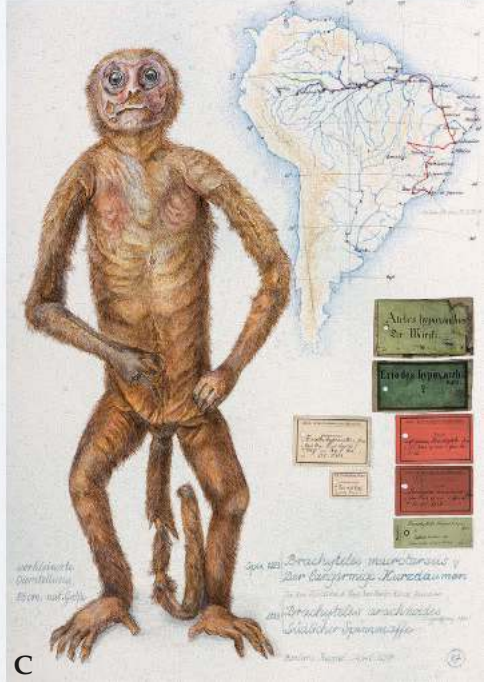


Fig. 12. Grey woolly monkey (*Lagothrix cana cana*). A. Sp. nr. 32 by Barbara Ruppel. B. Sp. nr. 91 by Taciana Ottowitz. C. Southern miquiqui (*Brachyteles arachnoides*) Sp. nr. 87 by Barbara Ruppel.

the other is of a very young individual, which only acquired the first 3 of his cheek teeth and whose sutures are all sharply indicated” (translated from German, the original text does not use italics). The senile skull was collected by Spix, which suggests that the juvenile skull was also collected by Spix, although this is not explicitly stated by Wagner (1836).

Grey woolly monkey

Gastrimargus olivaceus Spix, 1823 (p. 39, pl. 28)
= *Lagothrix cana cana* (É. Geoffroy Saint-Hilaire, 1812):
Groves 2001, p. 191 and Groves 2005, p. 152.

“In the forests near Cameta at the Rio Tocantin and the Rio Solimões from Villa Nova to the Peruvian realm”, limited to the mouth of the Rio Tefé into the Rio Solimões by Cabrera (1958, p. 181), State of Amazonas, Brazil.

Sp. nr. 32: m, ad, SM, S removed (Fig. 12A). Two red type labels and two white labels: ‘Originalexemplar / zu *Gastrimargus olivaceus* Spix / in Critische Revision der brasil. Affenarten / Andreas Wagner / Okens Isis 1833 S. 997’ and ‘Originalexemplar / zu *Lagothrix cana* Humb. / in Schreb. Wagn. Säugeth. Suppl. Bd. I / S. 186–87, tab. XXVI.I’.

Sp. nr. 206: S, which probably belongs to Sp. nr. 32. Inscription on S: ‘*Lagothrix / olivacea / Spix / typus*’. Red type label and white label: ‘Typus von *Lagothrix / olivacea* Spix / Nr. 206’. Additional green label with the inscription: ‘*Gastrimargus olivaceus* Spix / ♂ / Solimoes (?) / Tocantins (?) / Spix’ and on reverse side: ‘ist wahrscheinlich d. von Spix lebend gehaltene Exempl ... [illegible] Solimoes, der b. d. Azoren einging / *Lagothrix lagotrica* [sic] Humb. (Trousseau ... [illegible]), which translates to “is probably the specimen, which was kept alive by Spix ... [illegible] Solimoes, which died near the Azores / *Lagothrix lagotrica* [sic] Humb. (Trousseau) ... [illegible]”. There is also a small white piece of paper: ‘Affe der / neue Welt. / 216 / 216’, which translates to “new world monkey” and the dental formula.

Sp. nr. 91: juv, SM, S removed. Poor condition, partly bald (Fig. 12B). Red type label with inscription: ‘Co-Typus ...’, and two white labels with the same inscriptions as Sp. nr. 32.

Genus *Brachyteles* Spix, 1823

Southern miqui

Brachyteles macrotarsus Spix, 1823 (p. 36, pl. 27)
= *Brachyteles arachnoides* (É. Geoffroy Saint-Hilaire, 1806): Cabrera 1958, p. 179, Groves 2001, p. 190.

“In the forests of the provinces São Paulo, Rio de Janeiro, Espírito and Bahia”, Brazil

Sp. nr. 87: f, ad, SM, S removed. Partly bald, bleached (Fig. 12C). Red type label, white label: ‘Originalexemplar / zu *Eriodes hypoxanthus* Neuw. / in Schreb. Wagn. Säugeth. Suppl. Bd. I / S. 200ff. und Abhandl. Akad. / Bd. V S. 424’ and white label: ‘Originalexemplar / zu ... / in Isis 1833 S. 997 / von Andr. Wagner’.

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