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A TAXONOMIC REVISION OF THE SAKI MONKEYS, *PITHECIA* DESMAREST, 1804

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Abstract

For more than 200 years, the taxonomy of *Pithecia* has been floating on the misunderstanding of a few species, in particular *P. pithecia* and *P. monachus*. In this revision, historical names and descriptions are addressed and original type material is examined. For every museum specimen, all location, collection, and museum data were recorded, and photographs and measurements of each skin, skull, mount, or fluid specimen were taken. The revision is based on work conducted in 36 museums in 28 cities from 17 countries in North America, South America, Europe, and Japan, resulting in the examination of 876 skins (including mounts and fluids), 690 skulls, and hundreds of photographs taken by the author and by colleagues in the field of living captive and wild sakis of all species, and through internet searches. Per this revision, there are 16 species of *Pithecia*: five currently recognized, three reinstated, three elevated from subspecies level, and five newly described.

Key Words: *Pithecia*, saki, taxonomy, revision, new species, *P. pithecia*, *P. monachus*

Resumen

Por más de 200 años, la taxonomía de *Pithecia* ha estado flotando en la confusión de unas pocas especies, en particular *P. pithecia* y *P. monachus*. En esta revisión, los nombres históricos y descripciones son abordadas y el material tipo original es examinado. Para cada espécimen de museo, todos los datos de localidad, colección y museo fueron registrados, y fotografías y medidas de cada piel, cráneo, montaje, o especímenes conservados en fluido fueron tomadas. La revisión está basada en trabajo llevado a cabo en 36 museos en 28 ciudades de 17 países en Norte América, Sur América, Europa, y Japón, resultando en la examinación de 876 pieles (incluyendo montajes y fluidos), 690 cráneos, y cientos de fotografías tomadas por la autora y por colegas en el campo, de individuos vivos en cautiverio o estado silvestre de todas las especies de *Pithecia*, y mediante búsquedas en internet. Con base en esta revisión, hay 16 especies de *Pithecia*: cinco actualmente conocidas, tres reclasificadas, tres elevadas del nivel de subespecie y cinco nuevas descritas.

Palabras Clave: *Pithecia*, saki, taxonomía, revisión, nueva especie, *P. pithecia*, *P. monachus*

*What gets us into trouble is not what we don't know,
it's what we know for sure that ain't so.*

Mark Twain

Introduction

The saki monkeys of the genus *Pithecia* are a poorly studied group of Neotropical primates. Found throughout tropical forests of South America from the Guiana Shield, west to the foothills of the Andes in Ecuador and Peru, south to northern Bolivia, and throughout the Amazon Basin in Brazil as far east as Altamira on the Rio Xingu, these secretive, fast moving, medium-sized monkeys (called “flying monkeys” in many languages) have eluded researchers for decades. There have been few long-term field studies, thus creating a huge knowledge and conservation gap for these unusual animals.

Sakis are the smallest of the pitheciines, but are larger than other non-prehensile-tailed platyrrhines (*Aotus*, *Saimiri*, *Callicebus*, and the Callitrichinae). Adults weigh in at 1.5–4.0 kg, with a wide range in total body length (250–980 mm) and tail length (255–545 mm) reflecting the diversity among the taxa (Buchanan *et al.*, 1980; Mittermeier *et al.*, 1981; L.K. Marsh, unpubl. data). Their tails are often 1:1 with the body length, but in many species tails are longer by >100 mm (based on museum specimen data) for both males and females. Size dimorphism is not striking but, depending on the species, females tend to be smaller in weight and overall size. Sakis are characterized by their long, coarse, fluffy hair that easily piloerects when they are approached in the wild, making them look bigger than they actually are. The hair on the tail tends to be longer than on the back, but this varies among species, and the tail hair also “puffs up” as a threat. Hair on the trunk is always longer than that on the forearms and hind limbs, and underbellies are very lightly covered or bare. Coronal hairs are directed forward as a hood, and, depending on the species, overlap the facial region making them appear to have “bangs.” Both males and females have distinct throat glands for scent marking, with varying development depending on the species; some males have obvious neck folds and others only a bare skin patch (Brumloop *et al.*, 1994; Setz and Gaspar, 1997). Sakis are frugivore/seed predators, but they eat insects such as army ants, as well as spiders, and other arthropods (Buchanan *et al.*, 1980; Defler, 2004; pers. obs.). Locomotion consists of quadrupedal walking/running, climbing, and leaping (Youlatos, 1999; Defler, 2004). They vocalize in grunts, chirps, whistles, and low calls, but can be exceptionally quiet when sneaking away from a perceived threat such as a field researcher (pers. obs.).

All species tend to prefer mature forest that includes variations of flooded forest—*várzea* (white-water flooded forest) and *igapó* (black-water flooded forest)—palm swamp (*Mauritia* swamp for some), and terra firma forest (Rylands, 1987; Rylands and Mittermeier, 2009). They can be found in disturbed habitats and in fragments with secondary forest, but as seed predators of large forest tree species (notably of the family Lecythidaceae), they tend to be in higher densities in mature forest

(Norconk 2003). One possible explanation for their very large geographic distribution as a genus and as individual species is their ability to use a range of forest types, from *várzea* to *igapó* to terra firma (Ayres and Clutton-Brock, 1992).

Previous Taxonomy

There has been a great deal of confusion in *Pithecia* taxonomy. The most recent revision was by Hershkovitz (1987). Later publications (e.g., Rylands *et al.*, 2000; Groves, 2001; Defler, 2004) reiterate Hershkovitz's work (Table 1). Hershkovitz (1987) defined five species with three of them polytypic. They were arranged into two groups as follows:

- 1) *Pithecia pithecia* Group –
Guianan region: *P. pithecia pithecia*,
P. pithecia chrysocephala, and
- 2) *Pithecia monachus* Group –
Amazonian region: *P. monachus milleri*, *P. monachus monachus*,
P. irrorata irrorata, *P. irrorata vanzolinii*, *P. aequatorialis*,
P. albicans.

Hershkovitz was compelled to force everything in the genus into this construct, thus missing key differences in what prove to be distinct species, including those that may be different enough that they should not be grouped together (e.g., *irrorata*, *aequatorialis*, or *albicans*). An interpretation of the specimens identified in Hershkovitz (1987) is in Table 2, elaborating the difficulty and confusion he faced while studying these animals.

For Hershkovitz and others, *Pithecia* was a succession of allopatric species with no overlap or chance for mixing. In reality throughout the range, *Pithecia* species likely show sympatry with other members of the genus, or are parapatric with hybrid zones between them. The use of groupings and subspecies has been suspended in this publication until detailed studies on genetics, behavior, morphology, current distribution, and evolutionary relationships have been completed with the guidance of this new taxonomy. Only then can comparable studies be performed and subspecies accurately determined (Groves, 2004).

Early taxonomists

Early taxonomists (1700s through the turn of the 20th century) had a hard time describing sakis because they were so unusual. One of the common mistakes made in describing them was the use of the term “beard,” as members of the genus *Pithecia* do not have beards. Since *Pithecia* was originally included with *Chiropotes* (the truly bearded sakis), this mistake was common. More often than not, what the early taxonomists were referring to in *Pithecia* as a “beard” was their chest ruff, distinct in several species. It is a shame that *Pithecia* shares the colloquial name of “saki” (a Quichua term for *Pithecia*) with *Chiropotes*, as the native term

for *Chiropotes* is *cuxiú* (coo-shiu). Perhaps if we make a distinction in the common names for these two, we will stave off confusion later.

Early taxonomists and collectors also had no idea about the behavior of *Pithecia* in the wild. Gray in 1870 called them “gregarious, slow, sad, voracious, and vociferous” (p.59). And while it was clear Gray never saw sakis in the wild, Bates (1892) had seen one as a pet:

“The Parauacú is a timid inoffensive creature, with a long bear-like coat of harsh speckled-grey hair. The long fur hangs over the head, half concealing the pleasing diminutive face, and clothes also the tail to the tip, which member is well developed, being eighteen inches in length, or longer than the body. [...] The Parauacú is also a very delicate animal, rarely living many weeks in captivity; but any one who succeeds in keeping it alive for a month or two, gains by it a most affectionate pet. One of the specimens of *Pithecia albicans* now in the British Museum was then living on the property of a young Frenchman, a neighbour of mine at Ega. It became so tame in the course of a few weeks, that it followed him about the street like a dog. My friend was a tailor, and the little pet used to spend the greater part of the day seated on his shoulder, whilst he was at work on his board. It showed, nevertheless, great dislike to strangers, and was not on good terms with any other member of my friend’s household than himself. I saw no monkey that showed so strong a personal attachment as this gentle, timid, silent little creature” (p. 336).

Slater (1879) probably understood best: “We know very little of [*Pithecia*] habits in the wild state, although it appears that they are normally silent” (p.174). It has been my experience with captive sakis of various species that they are indeed quite calm, gentle, and allow themselves to be petted by humans.

The Trouble with Sakis

Many erroneously labeled types have been placed in the museums that house *Pithecia* specimens. There are a number of reasons for this, including the historic methods of specimen collection and the lack of field observations; the age of individuals placed as types and the longevity of sakis in the wild; misunderstanding of females and their anatomy; and the business of “transitional” males.

Historic collection of specimens

Until the latter half of the 20th century, the taxonomist in question might have gone to the country of interest for collecting, but he likely remained behind any real expedition into the forest in favor of a nearby town or city. He would have a team of local hunters or collection experts culling the animals for him, and more often than not, sakis were among the wild-life plunder as opposed to animals of targeted interest. Thus,

many specimens have location designations such as “Cayenne,” “Iquitos,” “Manaus,” “Sarayacu,” or other similar towns even if the animals are from much further afield or from the other side of a river. This leads to more than one species being described for a site and does not necessarily account for actual distribution. For instance, the abundance of types in French Guiana and from Cayenne in particular likely represents the number of French explorers at the time more than the diversity of the region. Worse, early explorers (1700–1800s) would simply label locations as “Tropical America,” “South America” or “Brasils,” which may or may not have actually meant the country of Brazil, as “Brasils” was a generic term for South America 100–200 years ago.

Even some of South America’s most prolific collectors, the Olalla brothers, may not have been as reliable as we would wish to believe by their specimen tag information. Wiley (2010), in an excellent tracing of the history of the Olalla family’s work collecting birds in Peru and Brazil, recounts the then (1965) curator for Field Museum Emmet R. Blake’s impression of the men: “Blake’s impression was that Carlos [Olalla] was suspect, but that Alfonso [A.M. Olalla] was ‘not given to actual skullduggery, although generally he didn’t bother to indicate which side of a river his [specimens] came from [...] he simply didn’t know any better.’ Blake went on to say that ‘[Philip] Hershkovitz ... bears me out on this and has had exactly the same trouble with monkeys borrowed from the AMNH that you are having with some of our Olalla birds. In fact, Philip [Hershkovitz] admits that in his younger collecting days he also was less than precise in specifying localities as related to the banks of rivers’ ” (p.5).

Traditional taxonomists, including Hershkovitz, almost always made their determinations once the samples were back in the home museums. Out of context and far from the forests where the sakis lived, they gave names to juvenile males and all ages of females as though they were adult males of a new species. It has only been in the last decade that information for determinations has been so readily available to a taxonomist in the form of digital photography, international cross-referencing, easy communication with colleagues around the world, and photos of living animals—in the wild and captivity—throughout the range. In the past, memory, notes, verbal descriptions, the occasional painted plate, or later film photography (which relied heavily on the development process) were the principal ways to determine and compare species.

Taxonomists working from their home museums, particularly 100–200 years ago, worked almost blind when describing saki specimens. If they had not been to Paris, London, or Munich to see the actual specimens placed there by Étienne Geoffroy St.-Hilaire, John Edward Gray, or Johann Baptist von Spix, then comparative descriptions often began with apologia for not having seen the types, but they would press on regardless having maybe read about them or seen, at some moment, a painting of one. This kind of “doing the best one could” in taxonomy was prevalent through the turn of the

20th century and speaks volumes to the perpetual confusion having to do with the age and sex of animals brought in. Without having seen the animals in the wild or living in any way, it was nearly impossible for early taxonomists to accurately describe them. After nearly two paragraphs of both apology and cross reference to what he had read about *Pithecia*, W. H. Flower in 1862 described a female that came to the British Museum as “securely adult,” but he confessed that the dimensions of his specimen were “rather inferior” to either Spix’s description of *P. hirsuta* or Gray’s of *P. irrorata*.

I examined the very same specimen myself (BMNH No. 1863.6.15.3), and found it to be a small juvenile female.

The age of individuals

I had the opportunity to examine available saki skulls in addition to reference skins, mounts, and fluids during the course of this revision. And while I only performed the most cursory of examinations (i.e., tenpoint measurements and photographs; see “Methods”), I noted the relative age-class of individuals based on general tooth wear, canine development, and cranium suturing. I was repeatedly surprised going

Table 1. Classifications of *Pithecia* from nominal species to Hershkovitz (1987), Rylands *et al.* (2000), Groves (2001), and this paper.

Nominal Species	Hershkovitz (1987)	Rylands <i>et al.</i> (2000)	Groves (2001)	This paper
<i>Simia monacha</i> É. Geoffroy St.-Hilaire, 1812	<i>P. monachus monachus</i>	<i>P. monachus monachus</i>	<i>P. monachus monachus</i>	<i>P. monachus</i>
<i>P. monachus</i> É. Geoffroy St.-Hilaire, 1812	<i>P. monachus monachus</i>	<i>P. monachus monachus</i>	<i>P. monachus monachus</i>	<i>P. monachus</i>
<i>P. hirsuta</i> Spix, 1823	<i>P. monachus monachus</i>	<i>P. monachus monachus</i>	<i>P. monachus monachus</i>	<i>P. hirsuta</i>
<i>P. inusta</i> Spix, 1823	<i>P. monachus monachus</i>	<i>P. monachus monachus</i>	<i>P. monachus monachus</i>	<i>P. inusta</i>
<i>P. guapo</i> Schinz, 1844	<i>P. monachus monachus</i>	<i>P. monachus monachus</i>	<i>P. monachus monachus</i>	Type not seen
<i>P. milleri</i> J.A. Allen, 1914	<i>P. monachus milleri</i>	<i>P. monachus milleri</i>	<i>P. monachus milleri</i>	<i>P. milleri</i>
<i>P. napensis</i> Lonnberg, 1938	<i>P. monachus monachus</i>	<i>P. monachus napensis</i>	<i>P. monachus napensis</i>	<i>P. napensis</i>
<i>P. monachus</i> É. Geoffroy St.-Hilaire, 1812	<i>P. aequatorialis</i> Hershkovitz, 1987	<i>P. aequatorialis</i>	<i>P. aequatorialis</i>	<i>P. aequatorialis</i>
<i>P. monachus</i> É. Geoffroy St.-Hilaire, 1812	–	–	–	<i>P. isabela</i> sp. nov.
<i>P. monachus</i> É. Geoffroy St.-Hilaire, 1812	–	–	–	<i>P. cazuzai</i> sp. nov.
<i>P. irrorata</i> Gray, 1842	<i>P. irrorata irrorata</i>	<i>P. irrorata irrorata</i>	<i>P. irrorata irrorata</i>	<i>P. irrorata</i>
<i>P. irrorata</i> Gray, 1842	<i>P. irrorata vanzolinii</i> Hershkovitz, 1987	<i>P. irrorata vanzolinii</i>	<i>P. irrorata vanzolinii</i>	<i>P. vanzolinii</i>
<i>P. irrorata</i> Gray, 1842	–	–	–	<i>P. rylandsi</i> sp. nov.
<i>P. irrorata</i> Gray, 1842	–	–	–	<i>P. mittermeieri</i> sp. nov.
<i>P. irrorata</i> Gray, 1842	–	–	–	<i>P. pissinattii</i> sp. nov.
<i>P. albicans</i> Gray, 1860	<i>P. albicans</i>	<i>P. albicans</i>	<i>P. albicans</i>	<i>P. albicans</i>
<i>Simia pithecia</i> Linnaeus, 1766	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia</i>
<i>Simia leucocephala</i> Audebert, 1797	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia</i>
<i>Simia rufiventer</i> É. Geoffroy St.-Hilaire, 1812	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. chrysocephala</i>
<i>P. adusta</i> Olfers, 1818	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	Type not seen
<i>P. nocturna</i> Olfers, 1818	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia</i>
<i>P. saki</i> Muirhead, 1819	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	Type not seen
<i>P. rufibarbata</i> Kuhl, 1820	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	Type not seen
<i>P. ochrocephala</i> Kuhl, 1820	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia</i>
<i>P. capillamentosa</i> Spix, 1823	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. chrysocephala</i>
<i>P. pogonias</i> Gray, 1842	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. pithecia pithecia</i>	<i>P. chrysocephala</i>
<i>P. chrysocephala</i> I. Geoffroy St.-Hilaire, 1850	<i>P. pithecia chrysocephala</i>	<i>P. pithecia chrysocephala</i>	<i>P. pithecia chrysocephala</i>	<i>P. chrysocephala</i>
<i>P. monachus lotichiusi</i> Mertens, 1925	<i>P. pithecia chrysocephala</i>	<i>P. pithecia chrysocephala</i>	<i>P. pithecia chrysocephala</i>	<i>P. chrysocephala</i>

back through the data at the disparity in what appeared to be adult skins—based on size, facial color, pelage, or reproductive status—that they had older juvenile or subadult skulls. This certainly lead to some confusing early taxonomic determinations, including the fraught *P. monachus* type in the Muséum National d'Histoire Naturelle in Paris, which is a long-faded juvenile male based on canine size and body size of the overall mount (cf. *P. monachus*).

Based on skull morphology, some females (among museum specimens) that appeared to have been lactating, or at least were preserved with noticeable, elongated nipples, that

may or may not have had distended vulva associated (see “*Pithecia* Females,” below), often were juveniles. According to Pereira and Fairbanks (1993), age of reproduction correlates to juvenile mortality and adult longevity. In primates whose females reproduce younger, there tends to be less juvenile mortality and longer-lived adults. Skins that had signs of reproductive maturation characteristics, such as well-developed throat glands in males or nipples in females, often did not have skulls that were fully adult. It appears that *Pithecia* may live longer in the wild and have a longer window of reproduction than may have been determined previously, but this clearly needs further investigation.

Table 2. Interpretation of Hershkovitz (1987): specimen number call-outs and comparisons with this paper. AM = Adult male, AF = Adult female, JM = juvenile male, JF = juvenile female. Hershkovitz (1987) is first appearance; many used several times.

Museum	Specimen No.	Hershkovitz ref.	Hershkovitz det.	LKM det.
FMNH	88862	Figure 8	<i>P. m. monachus</i> (AM)	<i>P. monachus</i> (AM)
FMNH	71806	Figure 8	<i>P. m. monachus</i> (AF)	AMNH, not FMNH with that number <i>P. napensis</i> (AF)
FMNH	46176	Figure 8	<i>P. p. pithecia</i> (AM)	<i>P. pithecia</i> (SAM)
AMNH	94132	Figure 8	<i>P. p. pithecia</i> (AF)	<i>P. chrysocephala</i> (JM)
FMNH	46172	Figure 11	<i>P. monachus</i> (AF)	typo FMNH 46176: <i>P. pithecia</i> (M)
FMNH	91806	Figure 13	<i>P. monachus</i> (AF)	typo AMNH 71806: <i>P. napensis</i> (AF)
UCMVZ	157795	Figure 13	<i>P. monachus</i> (AM)	<i>P. napensis</i> (SAM)
AMNH	93255	Figure 14	<i>P. pithecia</i> (JF)	9325x series in FMNH, but no skull in either AMNH or FMNH with this number
FMNH	86995	Figure 15	<i>P. monachus</i> (AF)	<i>P. aequatorialis</i> (JF)
FMNH	79387	Figure 15	<i>P. pithecia</i> (AM)	<i>P. chrysocephala</i> (SAM)
FMNH	87000	Figure 16	<i>P. m. monachus</i> (AM)	<i>P. isabela</i> sp. nov. (AM)
FMNH	86993	Figure 16	<i>P. aequatorialis</i> (SAM)	<i>P. aequatorialis</i> (SAM)
	Art	Figure 17	<i>P. monachus</i>	unknown – amalgam
	Art	Figure 17	<i>P. irrorata irrorata</i>	unknown – amalgam
	Art	Figure 18	<i>P. monachus</i>	unknown – amalgam
PHOTO		Figure 24	<i>P. m. milleri</i> (AF)	<i>P. milleri</i> (AF)
PHOTO		Figure 25	<i>P. i. irrorata</i> (AM)	<i>P. mittermeieri</i> sp. nov. (AM)
PHOTO		Figure 26	<i>P. i. irrorata</i> (AM)	<i>P. irrorata</i> (AM)
FMNH	122796	Table VI	<i>P. monachus</i> (AM)	<i>P. isabela</i> sp. nov. (AM)
FMNH	70638	Table VI	<i>P. monachus</i> (AM)	<i>P. milleri</i> (AM)
FMNH	79635	Table VI	<i>P. monachus</i> (AM)	Typo 70635: <i>P. milleri</i> (AM)
FMNH	70641	Table VI	<i>P. monachus</i> (AM)	<i>P. milleri</i> (AM)
FMNH	122797	Table VI	<i>P. monachus</i> (JF)	<i>P. isabela</i> sp. nov. (JF)
FMNH	70636	Table VI	<i>P. monachus</i> (JF)	<i>P. milleri</i> (JM)
FMNH	93251	Table VI	<i>P. pithecia</i> (AM)	<i>P. pithecia</i> (SAM)
FMNH	93252	Table VI	<i>P. pithecia</i> (AM)	<i>P. pithecia</i> (SAM)
FMNH	95504	Table VI	<i>P. pithecia</i> (AM)	<i>P. pithecia</i> (AM)
FMNH	95508	Table VI	<i>P. pithecia</i> (AM)	<i>P. pithecia</i> (JM)
FMNH	95509	Table VI	<i>P. pithecia</i> (AM)	<i>P. pithecia</i> (AM)
FMNH	95510	Table VI	<i>P. pithecia</i> (AF)	<i>P. pithecia</i> (AF)
FMNH	93250	Table VI	<i>P. pithecia</i> (JF)	<i>P. pithecia</i> (JF)
FMNH	93253	Table VI	<i>P. pithecia</i> (JF)	9325x series in FMNH, but not in either AMNH or FMNH
FMNH	95511	Table VI	<i>P. pithecia</i> (JF)	<i>P. pithecia</i> (JF)

Studies of comparative cranial morphology struggle in that, as with genetics, they tend to mix species together. For instance, in Marroig and Cheverud (2004, 2009) and Marroig *et al.* (2003) skulls used for comparison, according to the few reported specimen numbers and location maps, lumped several species. In Figure 2 of their 2004 paper, the *P. monachus* sample comprised animals in Brazil from Benjamin Constant south along the Río Yavari into Río Galvez (*P. monachus*), southwest of the Río Ucayali (*P. inusta*), as well as one from northern Peru (no number, but likely *P. aequatorialis* or *P. napensis* by location), and one in Colombia (*P. milleri*). They encountered a similar problem with *P. irrorata*, where none of the animals per the map (or few samples mentioned) are actually *P. irrorata* (see the species sections in this paper). I observed sagittal cresting in some skulls, but it was not necessarily something that could be used to determine species differences. It is quite possibly more associated with the kinds of foods available in the region and what is being consumed rather than a species trait, although some species, like *P. monachus*, appear more structurally prone to it.

Comparisons of skull morphology must be made with care and the understanding that the differences in age can make a skull in the same species appear to be quite different if it truly is an older adult versus a subadult. The key in my opinion is twofold to understanding saki skulls: 1) The slope of the braincase and face in the articulated skull, particularly as the animal ages, but especially when comparing adults, and 2) the wideness at the back of the mandible—while not perfect across all species, the mandible is wide in young sakis and becomes more constricted as the animal ages. In females, again for some but not all species, the older mandibles are wider than their counterpart adult males, which have mandibles that tend to be more constricted. Infants, juveniles, and some subadults seem to have “bubble heads,” but as the animal matures the braincase narrows and stands up higher, depending on the species.

Hershkovitz lamented, “Consistent size, and cranial or dental differences between species of the *P. monachus* group have not been found” (p.410). I suspect this is due not only to the morphological age variation in the skulls, but the fact that he combined several species together in a single taxon. His lamentation is further corroborated in that across museums there were proportionally more juvenile specimens than adults, and far more females than males for most species, except perhaps *P. pithecia*, which was the closest to equal proportions. Additionally, the older the individual, the more likely the coloration matures to portray the true “type” pattern (see “*Transitional males*” below). As seen in older captive animals, chromatic characteristics may change the appearance dramatically as facial and body hair falls out, or is added, depending on the species.

Pithecia females

Another issue that contributes to errors in *Pithecia* taxonomy is that females of most species can be quite similar, especially as preserved specimens. Many (and in some cases all)

females in the museums that I have worked in have been mislabeled as male *P. monachus*. Hershkovitz (1987) stated the problem accurately: “Contributing to the confusion was the failure by all authors to recognize sexual dimorphism in facial pillar pattern. This was further complicated by incorrect sexing, as indicated on collectors’ skin labels of a large number of the preserved specimens I examined in the various museums” (p.409). He went on to say, “Failure to recognize sexual dimorphism among sakis has been the greatest stumbling block for sorting the species. The striking similarity between females of all species persuaded some taxonomists to treat all as members of the *Pithecia monachus* group and even some females of the *P. pithecia* group as conspecific; irrespective of significant differences between the males, that of male *Pithecia pithecia* excepted” (p.415). Hershkovitz himself suffered from this confusion leading to his mass lumping of species. Hershkovitz also admitted that it is really sexual dichromatism more than dimorphism that differentiates the sexes, if not species.

The problem was perpetuated with live animals in captivity up through the 1960s where the males of *P. pithecia* were often placed with males of *P. monachus* because *monachus* was considered “the female” and *pithecia* “the male” (C.P. Groves, pers. comm.). In the current worldwide captive population I suspect that most of the “white-faced sakis” are likely hybrids; the most common being *P. pithecia* males (or a hybrid male) housed with a *P. chrysocephala* female (Fig. 1).



Figure 1. A mixed, breeding pair at Elmwood Park Zoo: *P. chrysocephala* female and *P. pithecia* male. Photo Elmwood Park Zoo.

Something that is very confusing among the females is their genitalia. I finally understood what I was seeing in numerous specimens after viewing several living females of various species: a swollen vulva resembling male testicles (particularly when dried), and a protruding clitoris, which in museum specimens can resemble a penis (Figs. 2 and 3). The swelling varies among specimens, species, and age groups. Very young juveniles often have the swollen vulvar

area even in living individuals, suggesting that age of reproductive readiness is within the juvenile class. Since females can also have distinct throat glands like males and often similar coloration, when coupled in an individual with male-like genitalia and no obvious teats, it is no wonder there is confusion!

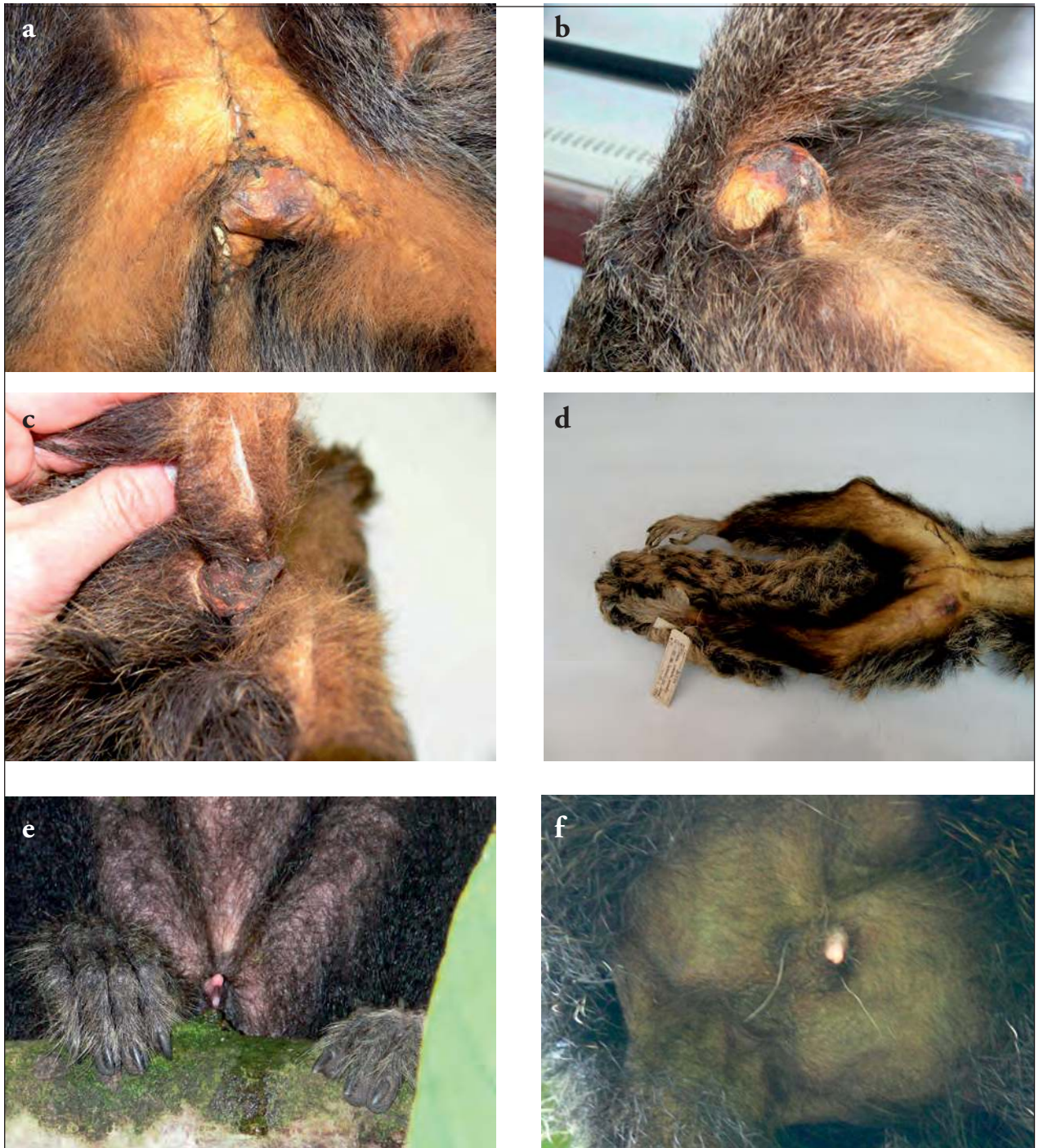


Figure 2. Examples of female sexual swelling in museum specimens and living sakis: (a) Adult female *P. chrysocephala* (BMNH No. 33.12.6.3); (b) juvenile female *P. chrysocephala* (MPEG 6971); (c) subadult female *P. chrysocephala* (MZSP No. 4249); (d) adult female "Jamari Saki" (MPEG No. 21934; Appendix II); (e) free-ranging juvenile female *P. inusta* at Isla de Los Monos, Iquitos; (f) free-ranging juvenile female *P. aequatorialis* at Isla de Los Monos, Iquitos. Photos by L.K. Marsh.

Females can also confuse the casual observer in the wild. In Ecuador, *P. napensis* lives in smaller family groups of two to eight depending on location, where the main pair often has older offspring or a second adult female living with them (pers. obs.). It was my experience tracking unhabituated sakis in the wild that often the adult males would do elaborate “laps” around the forest to distract the threat (observer), while the primary female remained behind on a more obvious branch, often accompanied by another adult or large juvenile female offspring. The females would eventually retreat as well, but not before the untrained observer

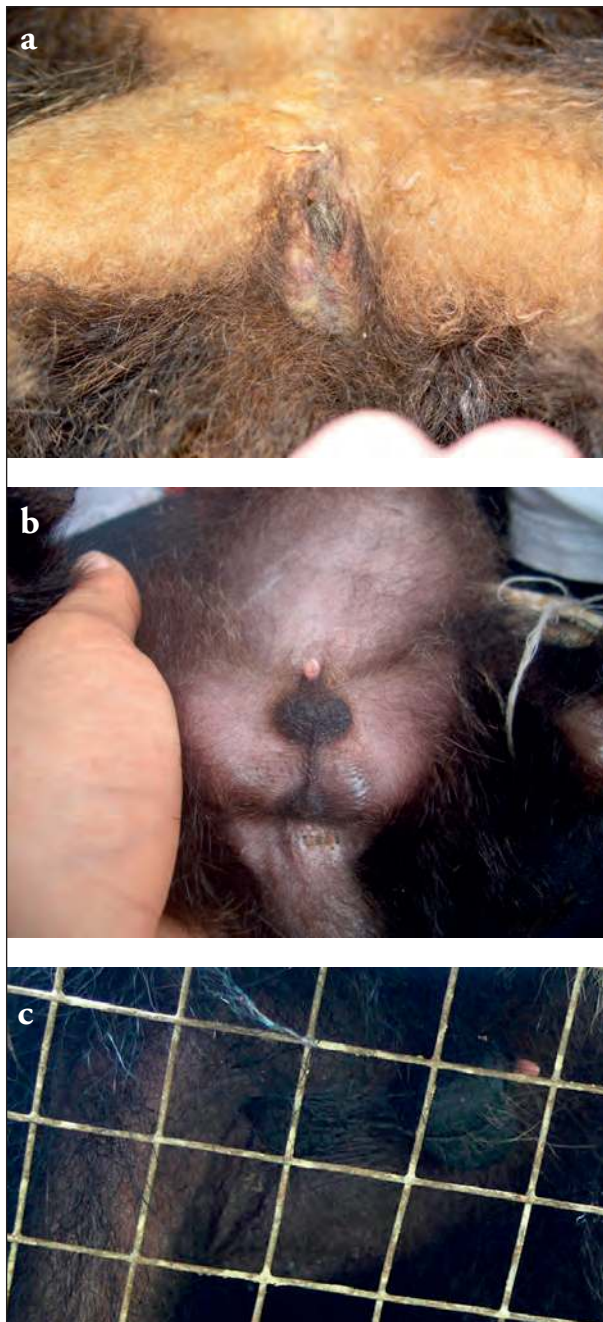


Figure 3. Examples of juvenile male genitalia: (a) *P. chrysocephala* (BMNH No. 12.5.11.2), (b) *P. monachus* pet in Iquitos, (c) free-ranging *P. aequatorialis* at Isla de Los Monos, Iquitos. Photos (a) and (c) by LKM, photo (b) by R. Aquino.

might dub the pair “*monachus*” assuming their identical coloration meant they were male and female of that species. Hershkovitz maintained, “Chromatic differences between the sexes are absent or insignificant in *P. monachus*, *irrorata*, and *albicans*” (p.415). My experience is different: while some species are less derived, such as *P. hirsuta* and *P. albicans*, in most cases the sexes are easily separated by appearance. Females placed as male type specimens include: *P. rufiventer/pogonias* (adult female *P. chrysocephala*, same specimen for both type determinations), *P. lotichiusi* (adult female *P. chrysocephala*), and one of the Spix *P. hirsuta* syntypes is a young juvenile female.

Transitional males

There are several specimens throughout the collections misassigned as adult males of a new species, but are actually juvenile or subadult males that are “transitional.” The reason for this is that many of the saki species, and perhaps all to varying degrees, have dramatic “transitional” males where the young male has color characteristics of the adult females or something else entirely. For example, in *P. chrysocephala*, the juvenile to subadult males are grey-agouti, have orange bellies, white bangs, and indistinct orange/black faces—all resembling an odd looking female rather than an adult male (cf. *P. chrysocephala*). By comparison, the fully adult males are silky black, lack stippling or brownish/grey pelage, lack the orange belly, and have solid orange-ochraceous facial disks. This has led to intense confusion in museum specimens, especially those whose genitalia were removed or lost during taxidermy, or which are confusing (see “*Pithecia* females” above). All species have transitional males to some degree and in some cases females as well. The adaptive significance of this coloration is not known.

Likewise the extent and intensity of the ruff in males, while in many cases a species trait, can also vary within species. It seems to change with age, but not always. It would be useful to know whether the color of the ruff, in species which tend to have brighter ruffs, is coincident with breeding status, age, amount of glandular chemical available, or something else. It would also be interesting to know whether any of this kind of passive sexual signaling is at all coincident with female sexual swelling. A lot more work needs to be done on sexual physiology and behavior in general in the genus. Juvenile males placed as adult types: *P. monachus* (see “Discussion” in *P. monachus* section), *P. capillamentosa* (*P. chrysocephala*), *P. nocturnal/P. ochracephala* (two type descriptions on same mount, Surinamese *P. pithecia*).

Methods

I use the phylogenetic species concept following Groves (2001, 2004) and Rylands and Mittermeier (2009). Since the designation of subspecies is vague and has been assigned in many cases arbitrarily to describe the diversity of Neotropical primates, I have elected to elevate all *Pithecia* to full species status until evidence is provided to delineate

them further (Winston, 1999; Van Roosmalen *et al.*, 2002; Groves, 2004, pers. comm.).

In 2001, I first noticed that the sakis at Tiputini Biodiversity Station, Ecuador, were different (Marsh, 2004), and found that publications about sakis were vague, confusing, or simply repeated information from previous publications (Hill, 1960; Napier and Napier, 1967, 1985; Hernández-Camacho and Cooper, 1976; Moynihan, 1976; Hershkovitz, 1979, 1987; Kavanagh, 1983; Wolfheim, 1983; Soini, 1986; Fleagle, 1988; Emmons and Feer, 1990, 1999; Kinzey, 1992, 1997; Groves, 1993; Schneider *et al.*, 1993, 1995; Bodini and Pérez-Hernández, 1995; Burton, 1995; Rowe, 1996; Reid and Engstrom, 1996; Nowak, 1997; Eisenberg and Redford, 1999; de la Torre, 2000; Rylands *et al.*, 2000; Heymann *et al.*, 2002). To make sense of what I was seeing at Tiputini, I conducted field research throughout Ecuador, visited field sites and wildlife rehabilitation centers in Ecuador, Peru and Brazil, and went to zoos and primate research centers worldwide to see as many living sakis as possible (Table 3).

I also studied collections in 36 museums, where I reviewed 876 skins and fluids and 690 skulls in US, European, and South America (Table 4). For each specimen, whether fluid, skin or mount, I took numerous digital photographs, collected all available information from labels, and field notebooks if available, and went back to any original documents from the original authors, such as É. Geoffroy St.-Hilaire, Spix, Gray, Lönnberg (see references for full list) to get as accurate a fix as possible on some of the more vague type localities. I took twelve photo angles and measured ten aspects of most of the available skulls. I consistently measured: braincase length, braincase width, zygomatic arch width, greatest orbital distance, nasal constriction, orbit width and height, greatest muzzle width, mandible length, mandible height and, when possible, canine length.

To fully corroborate type and museum data with actual animals, I also studied photographs of wild and captive animals throughout South America from a multiplicity of sources, including researchers *in situ* and travelers in areas where sakis live, reviewed the ISIS database for US and European zoos, and worked with the members of the Pitheciine Action Group as well as established taxonomists (C.P. Groves, A.B. Rylands, and A. Kitchener) to validate my findings. Every attempt to use pre-existing types and species names before naming a new species was made. Any new names followed the rules of taxonomic nomenclature (ICZN, 1999; Wilson, 1999).

While some research on the genetics of *Pithecia* has been conducted over the years, I have not used the results here since most of the publications do not have photos or specimen identification of the test subjects, and thus I cannot identify the species used per this revision (but see Martins *et al.*, 1992; Fleck *et al.*, 1999; Voss and Fleck, 2011). Because most of the studies have followed Hershkovitz (1987) and

assumed that *P. monachus*, for example, represented a species that covered the vast majority of the Amazon, I am afraid that (to use a metaphor) apples were compared to elephants and the data may not be entirely meaningful as currently published (see “Discussion” for more on this topic).

Conservation Status

Pithecia, like all South American primates, suffer from the effects of region-wide habitat disturbances, including fragmentation of their habitats (Marsh, 2003; Marsh and Chapman, 2013) and hunting. Sakis are hunted throughout their range for subsistence, pets, trophies (e.g., as a tourist trade commodity in Ecuador as “shrunken heads,” pers. obs.), and their tails used as “feather dusters” or their skins for hats (Mittermeier, 1977, 1991; Peres, 2000, 2001; Bodmer *et al.*, 2001; de Thoisy *et al.*, 2005; Aquino *et al.*, 2009). Work done by Mittermeier in the 1970s in Suriname detailed the culled biomass and consumption preference of *Pithecia* as compared to the rest of the primate community (Mittermeier, 1977). He discovered that while *Pithecia* was considered a preferred food by 26.7% of the combined indigenous population, they were rare in the regions where he worked, difficult to hunt, small for the (meat) payoff, and proportionally were one of the least hunted of the primates in the country (Mittermeier, 1977). In Ecuador, the Amazonian Quichua do not prefer *Pithecia* meat, although they will eat it if available. They say that the meat is “toxic,” and that it cannot be fed to young children or to dogs as they will become ill or even die (pers. obs.). And while *Pithecia*, as a group, are hunted throughout their distribution, it is the cumulative effects of all combined human-induced pressures that ultimately will decide each population’s conservation status.

To date, *Pithecia* as a genus is considered Least Concern (IUCN 2010), but the IUCN Red List of Threatened Species classifies only *P. pithecia*, *P. monachus*, *P. irrorata*, *P. aequatorialis*, and *P. albicans*, as per Hershkovitz (1987). *Pithecia albicans* is listed as Vulnerable with populations decreasing, but this was a best-guess estimate by L.K. Marsh in 2007 as part of the IUCN SSC Primate Specialist Group Red-Listing workshop. In actuality, there is very little data on any of the taxa in the wild. Examples are: *P. pithecia*, which has been studied the longest with the most publications, but in particular by Norconk and associates¹, and others (e.g., Mittermeier and Van Roosmalen, 1981; Oliveira *et al.*, 1985; Vié *et al.*, 2001; Riveros and Ferreira, 2001; Lehman *et al.*, 2001; Cunningham and Janson, 2006, 2007); *P. chrysocephala* (see Rylands, 1992; Setz, 1993; Setz and Gaspar, 1997; Setz *et al.*, 1999; Gilbert and Setz, 2001; Gilbert, 2003); *P. napensis* (called “*aequatorialis*” by DiFiore *et al.*, 2007); *P. aequatorialis* (see Aquino *et al.*, 2009); *P. albicans* (see Johns, 1985, 1986, Peres 1993); and a handful of other species (Heymann and Bartecki, 1990; Heymann *et al.*, 2002; Frisoli, 2009; Palminteri and Peres 2012).

1 <http://www.personal.kent.edu/~mnorconk/suriname.html>; <http://www.personal.kent.edu/~mnorconk/venezuela.html>.

Table 3. Living *Pithecia* in captivity or the wild (not including US zoos) studied for this publication.

Status	Country	Location	Site	Species
Wild	Ecuador	Yasuní Biosphere Reserve 0°40'32"S, 76°24'19"W	Estación Científica Yasuní de la Pontificia Universidad Católica del Ecuador	<i>P. napensis</i>
Wild	Ecuador	Yasuní Biosphere Reserve 00°37'05"S, 76°10'19"W	Tiputini Biodiversity Station	<i>P. napensis</i>
Wild	Ecuador	Sucumbios 0°13'34"S, 75°52'34"W	Cuyabeno National Reserve	<i>P. milleri</i>
Wild	Ecuador	Yasuní Biosphere Reserve 0°28'09"S, 76°45'25"W	Yarina Tourist Lodge	<i>P. napensis</i>
Wild	Ecuador	Yasuní Biosphere Reserve 0°32'54"S, 76°02'30"W	Yuturi Tourist Lodge	<i>P. napensis</i>
Wild	Ecuador	Orellana 0°27'49"S, 76°43'59"	Comuna Pamiwa Kocha	<i>P. napensis</i>
Wild	Ecuador	Pastaza 0°27'49"S, 76°43'59"W	Shiripuno River Lodge/Research Station	<i>P. napensis</i>
Captive	Ecuador	Río Arajuno 1°04'41"S, 77°32'16"W	AmaZOOnico Rescue Center	<i>P. milleri</i>
Captive	Ecuador	Guayllabamba, Quito	Zoológico de Quito	N/A
Captive	Colombia	Leticia, Amazonas 3°49'43"S, 70°12'23"W	Maikuchiga Primate Rescue, Amacayacu National Park ¹	<i>P. hirsuta</i>
Wild	Brazil	Manaus, Amazonas 2°30'00"S, 60°0'00"W	INPA BDFFP ²	<i>P. chrysocephala</i>
Captive	Brazil	Manaus, Amazonas	Universidade Federal do Amazonas	<i>P. rylandsi</i> sp. nov.
Captive	Brazil	Rio de Janeiro	Jardim Zoológico do Rio de Janeiro	<i>P. mittermeieri</i> sp. nov. (M) <i>P. rylandsi</i> sp. nov. (F)
Captive	Brazil	Rio de Janeiro	Centro de Primatologia do Rio de Janeiro	<i>P. albicans</i> <i>P. mittermeieri</i> sp. nov.
Captive	Brazil	Sao Paulo	Parque Zoológico do São Paulo	<i>P. albicans</i> <i>P. chrysocephala</i>
Captive	Brazil	Ananindeua, Pará	Centro Nacional de Primatas	<i>P. rylandsi</i> sp. nov.
Captive	Peru	Lima	Parque de las Leyendas	<i>P. inusta</i>
Captive	Peru	Huachipa, Lima	Parque Zoológico de Huachipa	<i>P. isabela</i> sp. nov. <i>P. inusta</i> (hybrid)
Captive	Peru	Iquitos	Zoológico de Quistococha	N/A
Captive	Peru	Iquitos	Proyecto Peruano de Primatología, "Manuel Moro Sommo" Primate Center	N/A
Free-ranging	Peru	Iquitos	Pilpintuwasi Rescue Center	<i>P. aequatorialis</i> <i>P. isabela</i> sp. nov.
Free-ranging	Peru	Iquitos, Pto. Indiana	Isla de los Monos	<i>P. aequatorialis</i> <i>P. monachus</i>
Captive	France	Paris	Ménagerie du Jardin des Plantes	N/A
Captive	Switzerland	Zürich	Zoo Zürich	<i>P. pithecia</i>
Captive	Germany	Frankfurt	Zoo Frankfurt	<i>P. pithecia</i> (M) <i>P. chrysocephala</i> (F)
Captive	Sweden	Djurgården, Stockholm	Skansen	<i>P. pithecia</i>
Captive	Scotland	Edinburgh	Edinburgh Zoo	<i>P. pithecia</i> (M) <i>P. chrysocephala</i> (F)
Captive	England	London	London Zoo	<i>P. pithecia</i>

¹ Photos from Rhett Butler (Flickr) and Xyomara Carretero² Biological Dynamics of Forest Fragments Project (BDFFP), confirmed by Brian Lenz, visited by LKM

Table 4. Museums visited or studied for this revision, including facilities that did not have any specimens available, but were checked for completeness. “No. of specimens” is the total number of skins, mounts, fluids, or frozen samples for *Pithecia* studied in the collection.

Museum	Location	No. of specimens	No. of skulls	Types	Notes on types
North America					
County Museum of Natural History (CMNHCLA)	Los Angeles, California	3	0		
American Museum of Natural History (AMNH)	New York City, New York	183	8 1	<i>P. milleri</i> (holo- topo-) <i>P. rylandsi</i> sp. nov. (holo-) <i>P. inusta</i> (key) <i>P. monachus</i> (key) <i>P. napensis</i> (key)	Allen (1914) Marsh [‡] Marsh Marsh Marsh
Smithsonian Institution Natural History Division (SMITH)	Washington, DC	24*	6	<i>P. aequatorialis</i> (holo-) <i>P. rylandsi</i> sp. nov. (para-) <i>P. isabela</i> sp. nov. (holo-, para-) <i>P. irrorata</i> (key) <i>P. milleri</i> (key) <i>P. monachus</i> (key) <i>P. napensis</i> (key)	HersHKovitz (1987) Marsh Marsh Marsh Marsh Marsh Marsh
The Field Museum (FMNH)	Chicago, Illinois	72	5 1		
U.C. Berkeley Museum of Vertebrate Zoology (MVZ)	Berkeley, California	6	4		
South America					
Universidad Politécnica Nacional (POLI)	Quito, Ecuador	7	3		
Museo de Ciencias Naturales	Quito, Ecuador	0	0		
Universidad Católica	Quito, Ecuador	0	0		
Universidad de San Francisco	Quito, Ecuador	0	0		
Museo Amazónico (AMAZ)	Quito, Ecuador	1	0	<i>P. inusta</i> (para-) <i>P. monachus</i> (key)	Spix (1823) Marsh
Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos (UNSM)	Lima, Peru	4 [^]	1		
Museo de Zoología de Universidad Nacional de la Amazonía Peruana (UNAP)	Iquitos, Peru	0	3 7		
Proyecto Peruano de Primates, R. Aquino Collection	Iquitos, Peru	4	0	<i>P. vanzolinii</i> (holo-, para-) <i>P. rylandsi</i> sp. nov. (para-) <i>P. irrorata</i> (key) <i>P. mittermeieri</i> sp. nov. (para-)	HersHKovitz (1987) Marsh Marsh Marsh
Museo de Zoologia, Universidade de Sao Paulo (MZUSP)	São Paulo, Brazil	79	111	<i>P. mittermeieri</i> sp. nov. (para) <i>P. pissinattii</i> sp. nov. (para-)	Marsh Marsh
Instituto Nacional Pesquisas da Amazônia (INPA)	Manaus, Brazil	9	9	<i>P. cazuzai</i> sp. nov. (holo-, para-)	Marsh
Museu Paraense Emílio Goeldi (MPEG)	Belem, Brazil	102	8 1	<i>P. cazuzai</i> sp. nov. (para-) <i>P. irrorata</i> (key) <i>P. mittermeieri</i> sp. nov. (para-)	Marsh Marsh Marsh
Museu Nacional Rio de Janeiro (MNRJ)	Rio de Janeiro, Brazil	57	3 7		
Centro Nacional de Primatas (CENP)	Belem, Brazil	3	0		
Instituto de Investigación de Recursos Biológicos Alexander von Humboldt (IAVH)	Bogotá, Colombia	10	8	<i>P. milleri</i> (key)	Marsh

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Table 4. *continued*

Museum	Location	No. of specimens	No. of skulls	Types	Notes on types
Museo de Historia Natural, Universidad de los Andes (MHNA)	Bogotá, Colombia	3	3		
Instituto de Ciencias Naturales Universidad Nacional de Colombia (ICN)	Bogotá, Colombia	8	4		
Colección Manuel Ruiz-García, Pontificia Universidad Javeriana	Bogotá, Colombia	0	11		
Europe					
British Museum of Natural History (BMNH)	London, UK	85	8 7	<i>P. irrorata</i> (holo-) <i>P. albicans</i> (holo- para-) <i>P. pogonias</i> (holo-) <i>P. hirsuta</i> (key) <i>P. pissinattii</i> sp. nov. (holo-, para-) <i>P. inusta</i> (key) <i>P. monachus</i> (key) <i>P. napensis</i> (key)	Gray (1843) Gray (1860) Gray (1842) Marsh Marsh Marsh Marsh Marsh
Museum für Naturkunde (BER)	Berlin, Germany	35	1 6	<i>P. albicans</i> (para-)	Gray (1860)
Zoologische Staatssammlung (ZSM)	Munich, Germany	4	2	<i>P. hirsuta</i> (holo- syn-) <i>P. capillamentosa</i> (holo-) <i>P. inusta</i> (N/A)	Spix (1823) Spix (1823) Spix (1823)
Anthropological Institute and Museum (AIM)	Zürich, Switzerland	4	1 7	<i>P. pogonias</i> (N/A)	
Naturmuseum Senckenberg (SEN)	Frankfurt, Germany	16	1 4	<i>P. m. lotichiusi</i> (holo-) <i>P. hirsuta</i> / <i>P. monacha</i> (syn-) <i>P. isabela</i> sp. nov. (para)	Mertens (1925) N/A Marsh
Naturalis Nationaal Natuurhistorisch Museum (LEID) [formerly Rijks Museum van Natuurlijke Historie (RMNH)]	Leiden, Holland	35	2 6	<i>P. ochracephala</i> <i>P. nocturna</i> (holo-) <i>P. chrysocephala</i> (neo-) <i>P. irrorata</i> (key)	Temminck (1863) Marsh Marsh
Naturhistoriska Riksmuseet (STOCK)	Stockholm, Sweden	54	5 0	<i>P. napensis</i> (holo-) <i>P. irrorata</i> (key)	Lönnberg (1938) Marsh
Museum National d'Histoire Naturelle (MNHN)	Paris, France	38	2 1	<i>P. leucocephala</i> (holo-) <i>P. pithecia</i> (neo-) <i>P. monachus</i> (holo- para-) <i>P. inusta</i> (neo-) <i>P. mittermeieri</i> sp. nov. (holo- para-)	Poiteau (1822) Marsh É. Geoffroy (1812) Spix (1823) Marsh
Royal Scottish Museum (RSM)	Edinburgh, Scotland	4	6		
Museo di Storia Naturale di Firenze (MSNF)	Florence, Italy	4	0		
Naturhistorisches Museum Wien (NHMW)	Vienna, Austria	18	1		
Zoologisches Forschungsmuseum Alexander Koenig (ZFMK)	Bonn, Germany	2	0		
Magyar Természettudományi Múzeum	Budapest, Hungary	2	0		

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Table 4. *continued*

Museum	Location	No. of specimens	No. of skulls	Types	Notes on types
Asia					
Kyoto University Primate Research Institute (KUPRI)	Kyoto, Japan	0	3		
Total	36	876	690		

‡ All Marsh references are to this paper. “Key” refers to Key Specimens determined by Marsh as important clarifications to type.

*Does not include fluid specimens.

^ The Fleck Lima Collection is at AMNH, accounting for 22 skins and 28 skulls tallied in the AMNH collection.

° Collection now in Lima at UNSM.

N/A = Original type no longer available.

All photos and measurements of specimens in Colombian museums by Xyomara Carretero.

Data from Museo di Storia Naturale di Firenze provided by Dr. Cecilia Veracini.

Data from Naturhistorisches Museum Wien provided by Simon Engelberger and Alice Schuhmacher.

Data from UC Berkeley MVZ provided by Francisco Ponatal.

Data from Zoologisches Forschungsmuseum Alexander Koenig provided by Dr. Gustav Peters.

Data from Magyar Természettudományi Múzeum provided by Dr. Gabor Csorba.

Data from KUPRI provided by Dr. Masanaru Takai.

Perhaps Collar (1997) said it best: “Taxonomy precedes conservation [...] without the formal structure of names and an agreed system of usage, there can be no understanding of what exists to be conserved.” Prior to this revision, numerous field guides, primate species books, and other primate references simply did not have enough information to determine not only what species was in a region, but also what was a male or female. One example of many are the beautiful paintings in de la Torre (2000), one of which was supposed to be a *P. aequatorialis* male, but in fact is a *P. napensis* female, and the other of a *P. monachus* male does not resemble any saki species, anywhere, and appears to be more of an amalgam of what a presumed *monachus* looks like. Worse, for both scientists working in the region and for tourists, neither *P. aequatorialis* nor *P. monachus* occur in Ecuador.

Thus, it is impossible to determine the conservation status of any of the animals identified in this monograph, except perhaps through inference in areas such as Rondônia where there is severe deforestation and exponential human population growth. A great deal of research needs to be done on existing populations, the limits of their distributions, and the human impacts they face before we can confidently report on their status. Whenever possible, I offer a ‘best guess’ conservation status, but until we update the

IUCN Red List of Threatened Species with corrected data from the field, the status previously posted stands (Version 2010.4. <www.iucnredlist.org>).

NEW TAXONOMIC ARRANGEMENT FOR GENUS *PITHECIA*

For a full history of genus nomenclature, see Hershkovitz (1979, 1987), Groves (2001), and Rylands and Mittermeier (2009). Abbreviations for all museums referenced in this monograph are in Table 5.

Genus *Pithecia* Desmarest, 1804

A thorough reanalysis of the genus *Pithecia* is presented, including species distribution maps, color illustrations of living species, historic plates, photos of type material (skin and skull), gazetteer of all reference materials (Appendix I), and measurements of type material and photos of living animals.

In this revision, there are five original species, three species elevated from subspecific rank, three historic species reinstated, and five newly described species. The total number of *Pithecia* species is 16.

Table 5. Museums and their abbreviations used throughout this publication.

Museums and abbreviations
Anthropological Institute and Museum, Zurich, Switzerland (AIM)
American Museum of Natural History, New York City, New York, USA (AMNH)
British Museum of Natural History, London, UK (BMNH)
Centro Nacional de Primatas, Belém, Pará, Brazil (CENP)
Colección Manuel Ruiz-García, Pontificia Universidad Javeriana, Bogotá, Colombia (CPUJ)
County Museum of Natural History, Los Angeles, California, USA (CMNH)
Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá, Colombia (ICN)
Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Bogotá, Colombia (IAVH)
Instituto Nacional Pesquisas da Amazônia, Manaus, Brazil (INPA)
Kyoto University Primate Research Institute, Kyoto, Japan (KUPRI)
Magyar Természettudományi Múzeum, Budapest, Hungary (MTM)
Museo Amazónico, Quito, Ecuador (AMAZ)
Museo de Historia Natural Andes, Universidad de los Andes, Bogotá, Colombia (MHNA)
Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos, Lima, Peru (UNMSM)
Museo de Zoología de Universidad Nacional de la Amazonía Peruana, Iquitos, Peru (UNAP)
Museo di Storia Naturale di Firenze, Florence, Italy (MSNF)
Museu Paraense Emílio Goeldi, Belém, Pará, Brazil (MPEG)
Museu de Zoologia Universidade São Paulo, São Paulo, Brazil (MZUSP)
Museu Nacional d'Histoire Naturelle, Paris (MNHN)
Museu Nacional Rio de Janeiro, Rio de Janeiro, Brazil (MNRJ)
Museum für Naturkunde, Berlin, Germany (BER)
Nationaal Natuurhistorisch Museum Naturalis (fmr. Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands (NNMN)
Naturhistorisches Museum Wien, Vienna, Austria (NHMW)
Naturhistoriska Riksmuseet, Stockholm, Sweden (NHRM)
Naturmuseum Senckenberg, Frankfurt, Germany (SEN)
Proyecto Peruano de Primates, Rolando Aquino Collection, Iquitos, Peru (AQ)
Royal Scottish Museum, Edinburgh, Scotland, UK (RSM)
Smithsonian Institution, Natural History Division, Washington, DC, USA (SI)
The Field Museum, Chicago, Illinois, USA (FMNH)
Universidad Politécnica Nacional, Quito, Ecuador (POLI)
University of California, Berkeley Museum of Vertebrate Zoology, Berkeley, California, USA (MVZ)
Zoologische Staatssammlung München, Munich, Germany (ZSM)
Zoologisches Forschungsmuseum Alexander Koenig (ZFMK), Bonn, Germany

WHITE-FACED SAKI

Pithecia pithecia (Linnaeus, 1766)

Synonymy

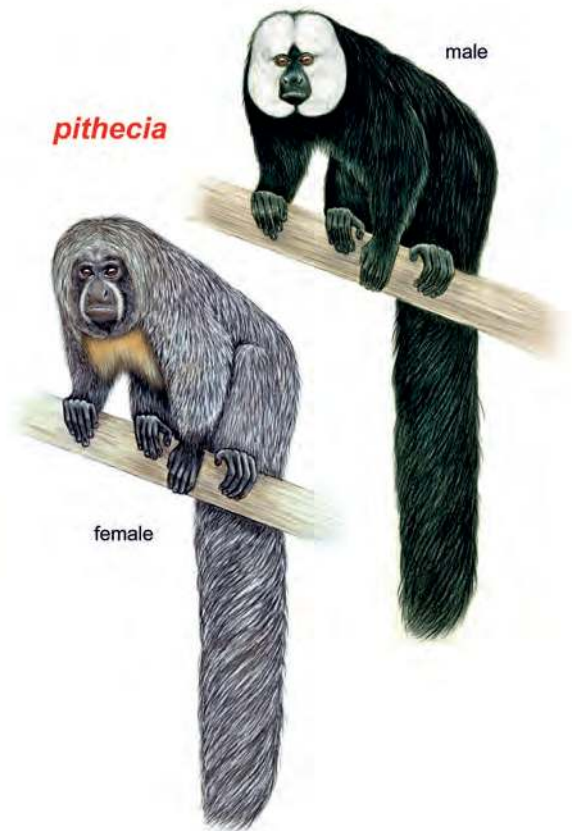
- 1766 *Simia pithecia* Linnaeus, *Systema Naturae* 12th ed. 40. Location unknown.
- 1789 L'Yarke, Buffon. *Histoire Naturelle Generale et Particuliere, a l'Histoire des Animaux Quadrupedes*, Suppl. Tome Septième, Paris: L'Imprimerie Royale. Location unknown.
- 1797 *Simia leucocephala* Audebert, *Histoire Naturelle des Singes et Makis*, 6^{me} fam., 1: 9, plate 2. French Guiana.
- 1803 *Callithrix pithecia* (Le saki ventre roux) É. Geoffroy Saint-Hilaire. *Catalogue des Mammifères du Museum National d'Histoire Naturelle, Paris*, No. 9. Type no longer exists, female. French Guiana. (see "Discussion").
- 1812 *Simia rufiventer* / *Pithecia rufiventer* É. Geoffroy Saint-Hilaire. *Recueil d'Observations de Zoologie et d'Anatomie Comparee* (Humboldt expedition), vol. 2, p.358. Type no longer exists. Female. French Guiana. *Nomen oblitum*. (see "Discussion").
- 1818 *Simia adusta* Olfers. *Journal von Brasilien*, 2: 198. Location unknown. Hershkovitz (1987) substitute name for *Simia pithecia* Linnaeus.
- 1818 *Simia nocturna* Olfers. *Journal von Brasilien*, 2: 198. No. 39097 at RNH Leiden, subadult male, French Guiana, Cayenne.
- 1819 *Pithecia saki* Muirhead. *Edinburgh Encyclopedia* 13: 400. British Guiana.
- 1820 *Pithecia rufibarbata* Kuhl. *Beitrage zur Zoologie und Vergleichenden Anatomie*, p.44. Hershkovitz (1987) notes "holotype juvenile mounted in Leiden," juvenile female. Suriname.
- 1820 *Pithecia ochrocephala* Kuhl. *Beitrage zur Zoologie und Vergleichenden Anatomie*, p.44. based on the same specimen as *Simia nocturna* Olfers, 1818, from the Temminck Voyage, subadult male. French Guiana, Cayenne.
- 1987 *Pithecia pithecia pithecia* Hershkovitz. *Am. J. Primatol.* 12: 418–419; in part.

Holotype. A type specimen is not known to exist (Hershkovitz, 1987).

Neotype. *Simia leucocephala* mount No. 452, placed in the Museum d'Histoire Naturelle, Paris in 1822 (collector appears to be S. Foiteau) is here designated as a neotype.

Type locality. Cayenne, French Guiana, for the neotype *leucocephala*.

Specimens examined. Two hundred and nine skins and skulls, and dozens of live, captive and wild photos.



Description. *Males.* Fully mature adult males are black with little or no stippling of the dorsal hair. The hands and feet are generally black with no or little hair covering them. Male facial disks are white "half moons" completely covering the circumference of the face, connected in most cases in the midline of the face by a thin black line extending from the top of the forehead to the mid-glabella. The facial skin is black. Males throughout the distribution, but particularly in Suriname and northern Brazil, show "age related" color variations (transitions), where the pelage of juveniles to subadults is similar to that of females: dark brownish to coppery dorsally with grey-brown-cream stippling on hands, feet, and backs (color depending on the location), bright orange chests (which vary in intensity per region), and shaggy, white, fringy, facial hair that becomes dense, short, and thick in full grown males (Fig. 5). *Females.* Varying throughout the distribution, fully mature females are brownish to grayish with some cream or off-white stippling in the dorsal hair, light to bright orange ventral chest hair, and black hands and feet. Females have

distinct white to buffy-orange muzzle lines. The variation in females of this species throughout the range is striking and worth further investigation.

Measurements. Since the neotype is mounted with the skull, the following two tables are generalizations of the species based on available data. Table 6 gives average measurements of adult *P. pithecia* males and females in the museum collections. Table 7 gives examples of cranial measurements for adult male and female *P. pithecia*.

Diagnosis. This saki is one of the most familiar of all sakis as it survives well in captivity, even outside of South America (ISIS 2012, <www.isis.org>). Its success in temperate climates may be due to its more northerly distribution. They are distinct from *P. chrysocephala*, in that the latter has bright orange to dark ochraceous facial disks, and obvious,

stiff white to buffy hairs along the lips. Further differentiation is seen in the transitional males of *P. chrysocephala*, which not only look like the *chrysocephala* females, but are very orange in their faces even when young, as compared to the faces of transitional male *pithecia* which are white (see "Discussion").

Distribution. Map 1. Throughout the northern South American countries of Venezuela, Guyana, French Guiana, and Suriname, and in northern Brazil in Roraima, Amapá, and parts of Pará. Those south of this region are *P. chrysocephala*. This does not reflect precise species delineations (e.g., there are cases apparently referable to *P. chrysocephala* in Guyana and to *P. pithecia* south of this initial demarcation), but at present it is not possible to determine if some of these "intermediate" populations are indeed distinct or are color variations of one or the other species (see

Table 6. Average weights and measures for *P. pithecia* adult males and females in museum collections. In parentheses, the number of specimens/range.

Country	Male Total body (mm)	Female Total body (mm)	Male Weight (g)	Female Weight (g)
Brazil*	767 (11/731–832)	748 (8/715–790)	2,057 (3/1720–2500)	1,650 (2/1550–1750)
French Guiana	781 (6/747–850)	768 (4/730–820)	1,725 (2/1649–1800)	N/A
Guyana	815 (8/740–970)	743 (4/715–790)	2,054 (3/1814–2268)	1,588 (1)
Suriname	777 (8/747–805)	730 (4/712–770)	1,925 (3/1769–2100)	1,530 (1)
Venezuela	N/A	N/A	N/A	N/A

All calculations based on available data. Only adults were calculated.

Total body is body length including the head and tail.

*All locations

Table 7. Skull measurements: examples of adult male and female *P. pithecia* in French Guiana and Brazil.

Measurement (mm)	Male* MNHN 1998-233	Female*	Male‡ MPEG 21532	Female‡ MPEG 21533
Length of brain case	76.4	73.6	79.5	78.1
Width of brain case	39.7	40.0	47.0	45.0
Zygomatic arch width	53.5	51.3	57.1	51.8
Orbits – outer	39.9	41.0	43.9	40.0
Nose bridge	5.0	6.6	6.0	7.9
L-orbit inner width	17.0	16.4	17.3	14.2
L-orbit inner height	16.5	17.5	18.2	14.8
Muzzle width	22.2	19.6	22.8	31.2
L-mandible length	50.0	47.4	51.9	47.9
L-mandible height	31.4	26.6	36.1	33.5
Total body length (mm)	750	800	780	740
Weight (g)	1640	N/A	2500	1750

*Male: Museum National d'Histoire Naturelle (MNHN), Paris, No. CG 1998-233, French Guiana, Barrage de Petit-Saut, collected by Jean Christophe Vié, 9 Oct. 1994. Female: MNHN No. CG 2001-1981, French Guiana, Association Kwata.

‡Museu Paraense Emílio Goeldi, Nos. 21532 (M) and 21533 (F), Brazil, Pará, Oriximiná, Cachoeira Porteira, collected by I.E.C.

24 March 1979 and 11 Sept. 1978, respectively. These are some of the animals in the region where the males have white faces with orange cheeks and copery/black pelage, appearing "intermediate" between *P. pithecia* and *P. chrysocephala*, and females more strongly resemble *P. chrysocephala*.



Map 1. Geographic distribution of *Pithecia pithecia* based on museum specimens and field study sites.

Venezuela

1. Botanical Garden, Orinoco
2. Lago Guri
3. El Manaco, 59 Km SE of El Dorado at Km 74.

Guyana

4. 6.966667, -58.516667
5. Demerara Coast Region
6. Bonnesique Creek (formerly Bonasika River)
7. River Supinaam (by gazetteer Stephens & Traylor 1985)
8. Kartabo (by gazetteer Stephens & Traylor 1985)
9. Kalacoon (by gazetteer Stephens & Traylor 1985)
10. Bartica
11. Rockstone
12. Demerara River
13. Kaieteur Falls
14. Rupununi River

Suriname

15. Kapoeri Creek
16. Matapi
17. Between Matapi Creek and Kabalebo River near Corantijn River
18. Kabalebo River
19. Arrawarra Creek

20. Coppename River, Lolopasi, west bank, across from Foengoe Island
21. Voltzberg area east bank Coppename River
22. Brownsberg National Park, M. Norconk study area
23. Saramacca River, Loksie Hattie
24. Bigi Poika
25. Zanderij
26. Hanover, Weg nearby
27. Paramaribo
28. Perica River
29. Wia-Wia Nature Preserve
30. SW of Moengo
31. Moengotapoe
32. Nassau Gebergte near Marowijne River
33. Brownsberg, general area for R. Mittermeier study (1970s)
34. Lely Gebergte
35. Wilhelmina Mountains, approx. West River
36. approx. 1970s Sipaliwini airstrip
37. Kayser Mountains, approx. M. van Roosmalen study area
38. Kayser Gebergte, current airstrip nearby
39. Zuid River
40. Paloemeu River and Tapanahoni River

French Guiana

41. Maroni River/Crique Maihonnii/ Marowijne River
42. approx. St. Laurent du Maroni
43. Saut Sabbat
44. St. Laurent-Kourou Road
45. Saut Tigre
46. Cayenne
47. Ipousin (by gazetteer Stephens & Traylor 1985)
48. Oiapoque
49. Arouani River

Brazil

50. Forte do Rio Branco
51. Rio Caciporé
52. Northern Rio Paru do Oeste, formerly Rio Erepecurú (by gazetteer Paynter & Traylor 1991)
53. Serra do Navio - Amapá
54. Rio Tracajutuba
55. Rio Maracá
56. Rio Jari
57. Porteira
58. Rio Paru do Oeste
59. Oriximiná
60. Obidos
61. Bravo, Lago Flexal, Edo. do Eira/Lara
62. Boiuçú (by gazetteer Paynter & Traylor 1991)
63. Patauí (by gazetteer Paynter & Traylor 1991)

“Discussion”). In Brazil, it occurs north of the Amazon and primarily east-northeast of the Rio Trombetas, extending north to Roraima, east of the Rio Branco. In French Guiana, Suriname, and Guyana, mostly along tributaries that descend to the coast, some further south into the interior at Wilhelmina Mountains, Keyser Gebergte, and Paloemeu/Tapanahoni rivers in Suriname, and the Rupununi River in Guyana. In Venezuela, as far west as Lago Guri in Bolivar State, south of the Río Orinoco. Their distribution in the Parque Nacional Canaima is unknown but likely as they are in northern Roraima. Their distribution further west and south in Venezuela is unknown.

Specific locations. Appendix I. BRAZIL. *Amapá*: Rio Jary – Tapuhy, Cachoeira de Sto. Antônio; Mazagão – Rio Maracá, Moreira, Alto Rio Branco; Terezinha – Rio Amupari, Sinturinha, Teomi, Serra do Navio; Rio Tracajatuba; Rio Villa Nova; Rio Caciporé do Ohcana; Municipality of Oiapoque – Villa Velha do Oiapoque. *Para*: Boiucú; Bravo – Edo. do Eira; Cabeceiras do Rio Paru do Oeste – Posto Tirias; Oriximiná – Rio Saracazinho, Cachoeira Porteira; Óbidos – Colônia do Veado; Lago Cuiteña; Patana; Santarém (captive). *Roraima*: Forte do Rio Branco; São Joaquim. FRENCH GUIANA. *Cayenne*: Ipousin – Rio Approuague. *St. Lamount du Maroni*: Mesmond; Saut Macaque sur la Ovaqui; Crique Arouani; Crique Maihonn; Route de Mama a Saint Sabbat. *Sinnamary*: Saut Tigre; Barrage de Petit Saut; Saisie. GUYANA. *Berbice*: Essequibo River – Rockstone. *Bonasica*: Essequibo River – Menarica Creek; Bonnesique Creek. *Demerara*: coast region; Supinaam River. *Mazaruni-Potaro*: Bartica; Kaieteur Falls; Kalacoon; Kartabo; Oko Mountains. *Upper Takutu-Upper Essequibo*: Rupununi River. SURINAME. *Brokopondo*: Sur River – Gania-Kondre-Bovenkondre; Saramacca River – Loksie Hattie, La Poule. *Marowijne*: Tapanahoni River – Paloemeu; Moengotapoe. *Nickerie*: Zuid River – Kayser Gebergte Airstrip; West River – Wilhelmina Mountains; Matapi. *Nassau Geb*: Marowijne River. *Paramaribo*: Zanderij. VENEZUELA. *Bolivar*: El Manaco – 59 Km SE El Dorado, Km 74; La Paragua – Lago Guri (Las Carolinas, Isla Redonda). *Orinoco*: Orinoco Botanical Garden.

Discussion. There has been a great deal of confusion over *P. rufiventer*. It was originally included in the *Catalogue des Mammifères du Muséum National d’Histoire Naturelle, Paris*, No. 9 (1803) by É. Geoffroy Saint-Hilaire as *Calithrix pithecia*, “Le saki ventre roux,” without a number. As of 2007 in Museum National d’Histoire Naturelle, Paris, there is no type specimen available. There is, however, a stand with a label on it in the type specimen vaults which reads: “#457, Saki a ventre roux, *P. rufiventer*, Guyane, 7-10-1836, male, C.G. 1996-2055.” Perhaps this was the stand for the original type (but if the 1836 date is the date of collection and not that of the making of the mount, then it will not be). In I. Geoffroy Saint-Hilaire’s (1851) catalogue, under “[S]aki à ventre roux, *P. rufiventer*” (1851: 55) only one specimen is listed as having been accessed prior to that date—a specimen collected in Cayenne in 1819 by M.

Martin and clearly not the type specimen. Evidently the type has either been lost, or is yet to be identified in the collection. The first use of the name “*rufiventer*” appears to be by É. Geoffroy Saint-Hilaire in Humboldt and Bonpland’s expedition manuscripts (Humboldt *et al.* 1812; p.357) as part of their expedition to the northern and western regions of South America (described as “Brasils” throughout the text, but they never were that far south; see “Introduction”). Adding to the confusion is the label on the type of *P. pogonias* in the British Museum of Natural History (No. 42.4.29.7), which is a *P. chrysocephala* female from Brazil, as: “*P. rufiventer*, Type of *Pithecia pogonias* Gray” (see *P. chrysocephala*: “Discussion”). By location alone (French Guiana, per É. Geoffroy Saint-Hilaire), I have added those *P. rufiventers* to *P. pithecia*. Most of the specimens labeled as *P. rufiventer* throughout the worldwide museum collections are *P. chrysocephala* females or subadult males from Brazil, or *P. pithecia* females from Suriname, southern French Guiana, or Amapá. Since it has not been in use as a valid taxon since 1899, under the provisions of the Code of Nomenclature (1999: Art.23.9.10), I regard *P. rufiventer* as a *nomen oblitum*.

There is a possibility of either hybrids or new species throughout the distribution of *P. pithecia* if the variations in subadult males and females (in Suriname, in particular) prove not to be simple variations within these age-sex categories of *P. pithecia* and are instead species- or subspecies-defining characteristics. It appears that further north and west to Venezuela, the females are very simple in coloration: grey stippled, shaggy dorsal body hair, orange bellies, and dark grayish-black, mostly uniform faces with white to buffy muzzle lines. In this region, the adult males are generally very black without stippling in the dorsal hairs, with clean white faces. The juvenile and subadult males can be “transitional” in that they resemble females in the grizzling of the dorsal hair and buffy to light orangish bellies, but depending on the region and the age of the individual, the juvenile males can be black with little or no stippling, resembling full adult males.

Moving east and south brings out interesting variations: in areas of Suriname the females are reddish brown and not particularly stippled dorsally; whereas, the subadult males are very stippled with bright orange bellies and white shaggy faces. In contrast to the very white mask of *P. pithecia* males or the dark orange mask of the *P. chrysocephala* males, the sakis in Suriname and southern French Guiana appear intermediate, where males often have more orange in the lower halves of their white facial disks as buffy to orangish “cheeks,” or the disk is occasionally entirely light orange in color. Additionally in French Guiana, the animals are smaller and males have distinct lines separating an “outer disk and inner facial disk”, similar to that shown in the original illustration for *P. pithecia* (Fig. 4). Many females, juveniles, and subadult specimens from Suriname were described originally as distinct species, as *P. nocturna* and *P. ochrocephala*, but until further work is done on wild

populations to genetically determine if they are distinct in any way or if these specimens are simply off-type coloration from aged curation, they are rolled into *P. pithecia*.

In Brazil, the females more closely approximate those of *P. chrysocephala* than those of *P. pithecia*, and the subadult males are more similar to the Suriname subadult males in coloration. However, in Roraima adult males more closely resemble the *P. pithecia* type. It is interesting to note that Gray (1870) says *P. leucocephala* was from Brazil and that “the forehead is yellow when fresh and white when faded

by exposure. M. Geoffroy thinks the colour depends on the size of the specimen” (p.59). This is another of the taxonomic confusions early on where they had *P. chrysocephala* and *P. pithecia* transitional males standing as types, mixed in with adult males of true species. This reinforces the importance of seeing these animals in the wild. Even with such a well-studied group such as *P. pithecia*, we have more work to do.



Figure 4. Likely a painting of the original type, now lost. Original title: “Fox-tailed Monkey, *Simia pithecia*.” Plate facing p.169 of *Museum Leverianum: Specimens from the Museum of the Late Sir Ashton Lever*, by George Shaw. Published by James Parkinson, proprietor, 1792–1796.

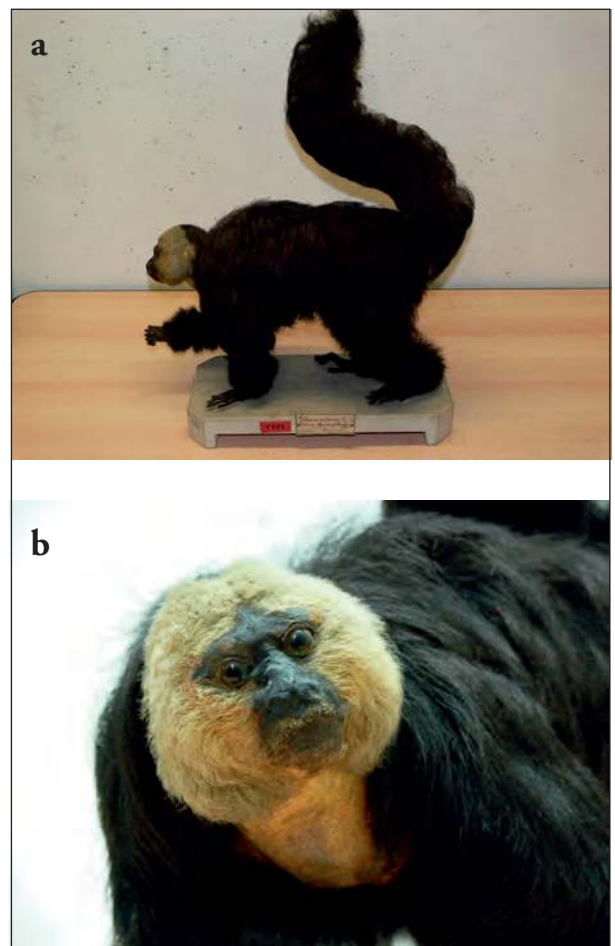


Figure 5. (a) Adult male neotype of *Simia pithecia*, and holotype for *Simia leucocephala*, mount No. 452, Museum d’Histoire Naturelle, Paris. (b) Adult male neotype mount, detail of face.



Figure 6. Wild *Pithecia pithecia* in Venezuela. (a) male, photo by K. E. Glander, and (b) female, photo by M. A. Norconk. Used with permission, all rights retained by Springer Publishers.



Figure 7. Juvenile transitional male. Living captive animal, photo by T. Gregory, Suriname (with permission of T. Gregory).



Figure 8. Juvenile transitional male mount, Leiden Naturalis No. 39097, type specimen for both *Pithecia nocturna* and *Pithecia ochrocephala*, photo by L. K. Marsh.

GOLDEN-FACED SAKI

Pithecia chrysocephala
(I. Geoffroy Saint-Hilaire, 1850)

Synonymy

- 1823 I. Geoffroy Saint-Hilaire. *Description Pithecia capillamentosa* Spix. *Simarium et Vespertiliarum Brasiliensis Species Novae* [...] *Le Voyage dans l'Interieur du Brasil*, Monaco, Species Novae p.16, pl. 11. Holotype registered by Kraft (1983) at ZSM. This same mount had many determinations, including *P. rufiventer* É. Geoffroy Saint-Hilaire, *P. leucocephala* É. Geoffroy Saint-Hilaire, *Simia pithecia* and *P. pithecia* L. (Townsend); ZSM No. 1, juvenile male (fmr. female). Brazil. *Nomen dubium* (see "Discussion").
- 1842 *Pithecia pogonias* Gray. *Ann. Mag. Nat. Hist. Series 1*, 10: 256. BMNH No. 42.4.29.7, female. Brazil. *Nomen oblitum* (see "Discussion").
- 1850 *Pithecia chrysocephala* I. Geoffroy Saint-Hilaire. *Comptes rendus hebdomadaires des séances de l'Academie de sciences*, Paris 31: 875, Brazil.
- 1850 *Pithecia chrysocephala* I. Geoffroy Saint-Hilaire. *Description des Mammifères Nouveaux ou Imparfaitement Connus de la Collection du Museum d'Histoire Naturelle, et Remarques sur la Classification et les Caractères des Mammifères, Second Memoire: Singes Americains*. Pp.557–559, pl. XXIX of type, Brazil.
- 1852 *Pithecia chrysocephala* I. Geoffroy Saint-Hilaire. *Catalogue de Primates du Museum d'Histoire Naturelle, Paris*, pl. XXXI, p.876, Brazil.
- 1925 *Pithecia monachus lotichiusi* Mertens. *Senckenbergiana* 7(1/2): 17. No. 6692, labeled adult female, fmr. adult male. Holotype, Brazil, Manacapurú.
- 1925 *Pithecia pithecia lotichiusi* Mertens. *Senckenbergiana* 7(3/4): 74. Brazil, Manacapurú.
- 1939 *Pithecia monacha monacha* Tate. *Bull. Am. Mus. Nat. Hist.* 76: 221. Brazil, Amazonas, Jamundá.
- 1987 *Pithecia pithecia chrysocephala* Hershkovitz. *Am. J. Primatol.* 12: 417; in part.

Holotype. *P. chrysocephala* plate XXIX in I. Geoffroy Saint-Hilaire's original *Description des Mammifères Nouveaux* for the collection at the Museum d'Histoire Naturelle, Paris (1850) is accepted here and by Hershkovitz (1987) from I. Geoffroy Saint-Hilaire's 1852 publication. I. Geoffroy Saint-Hilaire co-types, mounted skins—one male, one undetermined—reportedly acquired in 1850 by the Museum National d'Histoire Naturelle, Paris, were not there during Hershkovitz's visit (1987), nor were they there as of November 2007.

Neotype. RMNH Leiden (No. 1845(a)): adult male, mount and skull; collected on 15 August 1924 (by unknown), catalogued on 25 May 1930, acquired from the dealers Schlüter & Mass in Halle an der Saale, Germany (C. Smeenk, pers. comm.).



Key specimens. *Pithecia p. chrysocephala* RMNH Leiden (No. 1845(b)): labeled adult female, likely a subadult male, mount and skull; collected on 27 July 1924 (by unknown), catalogued on 25 May 1930, acquired from the dealers Schlüter & Mass in Halle an der Saale, Germany (C. Smeenk, pers. comm.); Manacapurú, Amazonas, Brazil. *Pithecia pogonias* holotype, adult female, skin and skull, British Museum of Natural History (No. 42.4.29.7), Brazil. *Pithecia (m., p.) lotichiusi* holotype at the Senckenberg Museum, Frankfurt (No. 6692), labeled adult female, likely subadult, collected by W. Ehrhardt, 4 July 1924 from Manacapurú "nake Manaos [sic] mittlerer Amazonas, Brazil."

Type locality. I. Geoffroy Saint-Hilaire stated that the holotype was from "le Brésil, sur les bords du fleuve des Amazonas." Neotype from Manacapurú, Amazonas, Brazil.

Specimens examined. One hundred and twenty-three skins and skulls; photos of living wild and captive animals.

Description. *Males.* Overall body coloration is black as are hands and feet, similar to *P. pithecia*, but the facial disk is entirely deep orange or reddish brown. Facial skin is black, bare

around eyes, nose, and chin. Upper lip has thick, stiff cream to light orange hairs. Large juvenile to subadult males in some regions are similar to *P. pithecia* in the same age group where they resemble females (agouti dorsally, including arms, legs and hands, with bright orange chests). Subadult males are more grayish, very mottled compared to females with grey or grey-white agouti, more than just grizzling to make the whole body grayish, but faces are orange to light orange, not fully defined in a disk as they are in adult males. In older juveniles, this facial hair can be quite shaggy to adpressed. The facial pattern can be indistinct and resemble females more closely than males, particularly in younger animals. **Females.** Dorsal pelage with black to brownish base hairs and some streaking overall, but with tan to buffy arms, legs and tail. The agouti pattern is darker and less extreme than subadult males. Hands and feet are black. The skin around the eyes, nose, and chin is bare and pinkish to grey. Facial hair is in a black horseshoe ring meeting at the top in either a white or orangish to buffy star, and the crown hair over the forehead is whitish or pale and distinct from the dorsal pelage. Orange muzzle lines extend from under the eyes. Their chest and belly is dull to bright orange.

Diagnosis. *Pithecia chrysocephala* differs from *P. pithecia* in that males always have bright to dark orange-ochraceous facial disks with contrasting light lips. Females are similar in many ways to *P. pithecia* females, but tend to be distinct with dark to black facial hair, bright orange malar lines, an orange stripe down the forehead in juveniles and a white star in the center on adults. There are similar females in Guyana *P. pithecia* populations.

Measurements. See Table 8.

Distribution. Map 2. Only in Brazil, north of the Rio Amazonas, both sides of the Rio Negro, especially in the lower reaches near Manacapurú, east to Faro along the Rio Nhamundá, where populations on the east side appear to be a mix of both *chrysocephala* and *pithecia* (see “Discussion”). One specimen in the Berlin collection (BER No. 91313) is clearly an adult male, but is written on both tag and skull to be from the Rio Içá, collected by Lako. If this is true, it is much further west than originally thought. However, this skin was probably collected in the 1920s, and it is unclear if *P. chrysocephala* still occurs in the region, or if it ever did. The boundaries of *P. pithecia* and *P. chrysocephala* are unclear further north in the states of Amapá, Roraima, and Pará, and need further investigation.

Specific locations. Appendix I. BRAZIL. Amazonas: Rio Ica; Rio Negro – Manaus (Km 165, 170, 190), Apuaú - Bocabau Chueiro/Cuieiras, Acajutuba, Porto Mauá, Igarapé do Bolivia, Yavanari, Iauari, Tabocal; Kastuaría Mirim - Rio Purus(?); Iranduba; Itacoatiara; Itapiranga; Rio Solimões - Manacapurú; Rio Itabani nee Atabani; Rio Uruba; Silves; Uatumã - UHE Balbina, Vista Alegre, São Sebastião; Aniba - Igarapé Zinho, Rio Augusta; Lago do Serpa; Lago do Canary. Pará: Rio Ereperurú - Cachoeira

Table 8. Measurements for *P. chrysocephala* neotype and key specimens. Adult male and subadult male in Nationaal Natuurhistorisch Museum, Leiden (NNML), and adult female in Naturmuseum Senckenberg, Frankfurt (SEN). All collected originally in Manacapurú, Brazil.

Measurement	Male NNML 1845‡	Sub-adult male NNML 1845a‡	Female SEN 6692
Skull (mm)			
Length of brain case	73.5	76.9	71.6
Width of brain case	41.3	40.7	40.1
Zygomatic arch width	45.6*	50.1	46.1
Orbits – outer	39.0	40.9	38.5
Nose bridge	0.47	0.52	0.50
L-orbit inner width	17.3	16.5	15.7
L-orbit inner height	17.8	16.9	15.4
Muzzle width	19.9	23.0	19.8
L-mandible length	43.5	48.9	44.0
L-mandible height	28.7	32.1	29.4
Post-crania (cm)			
Head/body	42	47	44
Tail	37	39	38

*Estimated, right side broken

‡ Numbers assigned by LKM; no mount numbers assigned at time of study (November 2007) at NNML.

do Tronco; Rio Amazonas - Faro, Rio Piratucu, Serro do Espelho, Nhamundá.

Discussion. The confusion in this species lies with females and juvenile/subadult males. Females in both *P. chrysocephala* and the Suriname *P. pithecia* have exaggerated genital swellings with a distended clitoris (see “Introduction: Females”). In preserved skins and mounts this tends to have the appearance of a scrotum and a small penis.

Pithecia capillamentosa. The type of *P. capillamentosa* Spix in the Zoologische Staatssammlung München, Munich, Germany (ZSM, No. 1) is either a small juvenile male *P. chrysocephala* from Brazil, or possibly a juvenile male *P. pithecia* from eastern Brazil, state of Amapá, or even French Guiana as some taxonomists have determined. There are multiple tags on the type in the ZSM: 1) *P. capillamentosa* Spix, *Simia pithecia* Lin., *P. leucocephala*, female or male juv.; 2) *P. leucocephala* Geoff., Brasilien Spix; 3) *P. capillamentosa* Spix, Typus, Cayenne, ?sex; 4) *P. pithecia* L. (Townsend), (?viewed in July) “*Saki pithecia* (J. Saki Lajuru?—hard to read German script), Catalog J. Akademie, 1816; 5) *P. rufiventer* Geoff. (hard to read German script, name of journal) Suppl. I, v. 222, Suppl. V, 101, Annal I, Adult female; 6) *P. capillamentosa* Spix, *Simia. Bras.*, sp. nov. 1823, v. 16, Tab. XI; and 7) a hard to read ZSM tag with what appears to be reference to a (Wagler B- T- hard to read German name), *J. Amphib.* v. 6, ann. 4, v. 7 with no species det. *Pithecia capillamentosa* remained a valid taxon and was referenced by

several authors Elliot (1912), Cabrera (1957), Hill (1960), and Napier and Napier (1967)), but as it is clearly a juvenile and thus a confusing specimen, given the difficulty of distinguishing juveniles of *P. chrysocephala* and *P. pithecia*, the name is best ranked as a *nomen dubium* (as suggested by C.P. Groves, pers. comm.).

Pithecia pogonias. The type of *P. pogonias* in the British Museum (Natural History), London (BMNH 42.4.29.7) is an adult female *P. chrysocephala* resembling those throughout most of the range in Brazil. It is a good specimen, representative of females, with skull, but since the name has not been in use for a valid taxon since 1899, under the provisions of the Code of Nomenclature (1999: Art. 23.9.10), it ranks as a *nomen oblitum* (as noted by C.P. Groves, pers. comm.). It remains, however, a key specimen as an example of a *P. chrysocephala* female.

The type of *P. lotichiusi* in the Naturmuseum Senckenberg, Frankfurt (NMSF 6692), is an adult/subadult female

(based on the robustness of the skull), and was named later than *P. chrysocephala*, and thus ranks as a junior synonym. It is retained here as a key specimen.

The original determination for this species per the holotype set forth by I. Geoffroy was as *P. chrysocephala*. Hershkovitz (1987) and others considered it to be a subspecies (*P. p. chrysocephala*) to fit into the two-group scheme. I re-elevate it to species as it is distinctly different from *P. pithecia* in phenotype, skull morphology, and range. There may be hybrid zones throughout the northern range and into Suriname and the Guianas per discussion in the *P. pithecia* section.

The Faro sakis appear to be a mix of both *chrysocephala* males and *pithecia*; it is interesting that there are also some larger juveniles that appear to have whiter, shaggier faces in the collection from that site with very orange-faced adult males. More work in this region needs to be done to determine if these animals are hybrids, a separate subspecies, different species, or color morphs of *chrysocephala*.



Figure 9. Plate XXIX of *Pithecia chrysocephala*, adult male holotype per I. Geoffroy Saint-Hilaire (1850) in *Description des Mammifères Nouveaux ou Imparfaitement Connus de la Collection du Museum d'Histoire Naturelle, et Remarques sur la Classification et les Caractères des Mammifères, Second Memoire: Singes Americains*.



Map 2. Geographic distribution of *Pithecia chrysocephala* in Brazil.

- | | | |
|------------------------|-------------------------------------|-----------------------------|
| 1. Iauari | 8. 105 km north on BR 174 (approx.) | 15. Lago Canaçari |
| 2. Manacapuru | 9. Balbina | 16. Rio Itabani |
| 3. Acajutuba (approx.) | 10. Itacoatiara | 17. Rio Uatumá |
| 4. Iranduba | 11. Lago Serpa | 18. São Sebastião do Uatumã |
| 5. Manaus | 12. Igarapé Aniba (approx.) | 19. Rio Piratucú |
| 6. Igarapé do Bolivia | 13. Silves | 20. Faro |
| 7. Rio Apuaú | 14. Tabocal | |



Figure 10. Hand-colored lithograph from a drawing by Benjamin Waterhouse Hawkins (1807–1889) of "*Pithecia pogonias* (*P. chrysocephala* female) and the head of *Pithecia leucocephala*", but here depicted as a *P. chrysocephala* male.

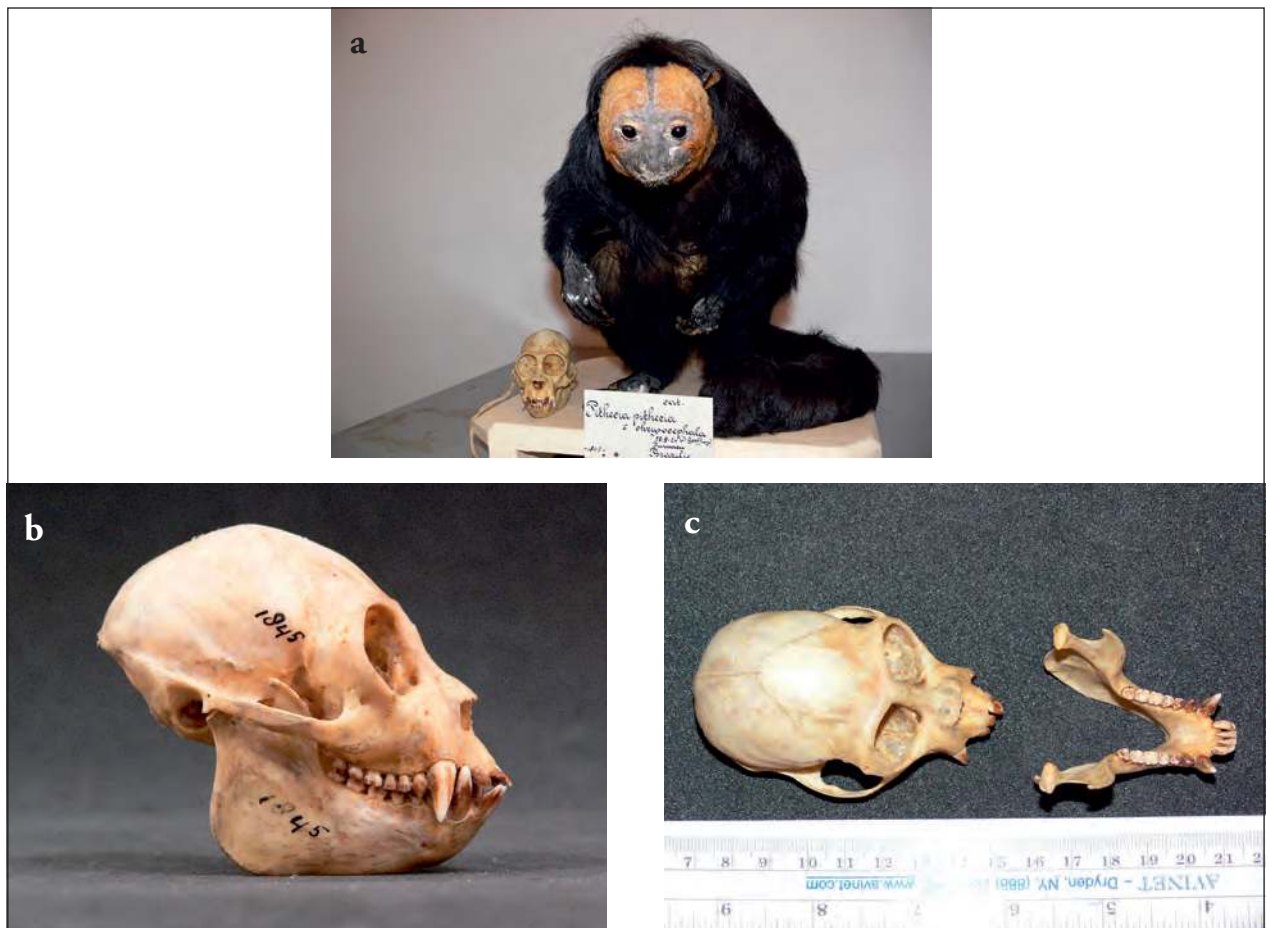


Figure 11. Mount of adult male neotype of *Pithecia chrysocephala*. (1845) at Naturalis Museum, Leiden, with skull (a) and two aspects of the skull (b and c). Photos by L.K. Marsh.



Figure 12. Adult male *Pithecia chrysocephala* in the wild and captivity. Photos (a and b) by L.C. Marigo and (c) R.A. Mittermeier, all Brazil (photos used with permission).

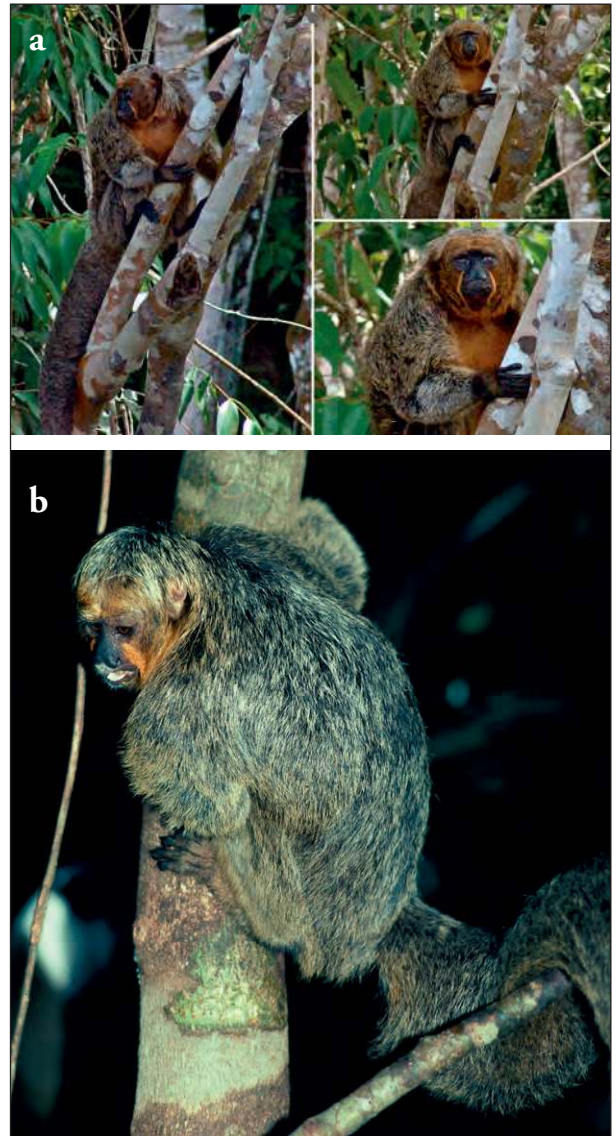


Figure 14. Transitional, large juvenile to subadult *Pithecia chrysocephala*, all near Manaus, Brazil. (a) Subadult male, photos by J. C. Serio Silva, and (b) juvenile male, photo by R.A. Mittermeier (photos used with permission).



Figure 13. Female *Pithecia chrysocephala*. (a) subadult, photo by J.M. Ayres, (b) young adult, Manaus, photo by J. White, and (c) adult, São Paulo Zoo, São Paulo, photo by L.K. Marsh (photos used with permission).

HAIRY SAKI

Pithecia hirsuta (Spix, 1823)**Synonymy**

1823 *Pithecia hirsuta* Spix, J. B., von. *Simiarum et Vespertilionum Brasiliensium Species Novae*. F.S. Hübschmann, Munich, pp.14–15, pl. 9. *Pithecia hirsuta*, p.14.

Holotype. Adult male mounted specimen with skull intact (No. 19) at the Zoologische Staatssammlung München (ZSM), Munich, Germany, placed by Spix (1823), and as illustrated in the *Simiarum*. Currently labeled as “syntype” by ZSM.

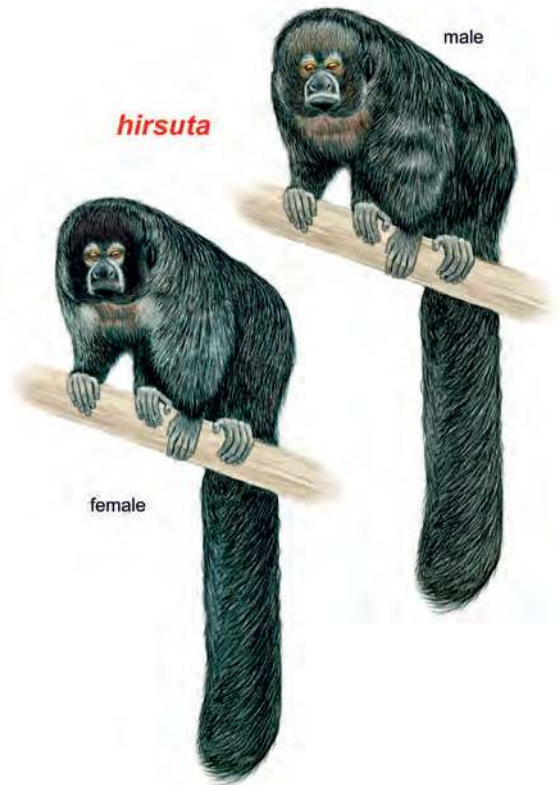
Syntypes. Mounts at ZSM placed by Spix (1823), Nos. 15, adult male, and 14, juvenile female. Described currently by the ZSM as “syntypes.”

Type locality. The forests between the Rio Negro and the Rio Solimões, Amazonas, Brazil. As for all Spix types a region is reported, not a specific location.

Key specimens. Skins and skulls for adult males, BMNH Nos. 27.3.6.3 and 27.8.11.23 collected by W. Ehrhardt, 29–30 September 1926 (tag note on 27.8.11.23: “Topotype of *P. inusta* Spix”, which is incorrect (cf. *P. inusta* types), and adult-subadult females BMNH Nos. 34.6.14.4 and 34.6.14.5. Subadult male from the Rolando Aquino collection (AQ 29.1.82) now in the Museo de Historia Natural, Lima, Peru (UNMSM).

Specimens examined. Sixteen skins and skulls, including photo references of living animals in Brazil and Colombia. Localities of BMNH adult male specimens: Brazil, near the rios Solimões (Tabatinga, on the frontier with Colombia) and Negro, along the Rio Tonantins (possibly near where the original Spix types were collected). BMNH adult females were collected in Brazil, Rio Içá, “Lago do Caroiara” (an oxbow lake on the south side of the river, in the upper reaches, as per Paynter and Traylor [1991]; likely it has a different name today). Rolando Aquino collected a subadult male north-east of the Río Napo, along the left side of the Río Tamboryacu, northern Peru (now in the UNMSM).

Description. The most uniform and the plainest of the sakis with very little dichromatism between adult females and males. Males and females are similar in coloring, where the pelage is black with some stippling, but in most cases the whitish stipple is short and not as abundant as in other species. Both have very white hands, and the tail is longer than the head and body. *Males.* Males with dominantly blackish agouti to brown-agouti head, blackish to brownish



chest hairs, and a black chest ruff. The upper section of the chest from the neck to the ruff is obviously bare where the scent gland is positioned. The lips and malar stripes are clearly visible, white to cream and thick. Small bare spots of pinkish to light-colored skin can be seen above the eyes where the rest of the facial skin is predominantly black. Defler (2004) adds, “Males are slightly larger with longer tails, and have a black scent gland or thickened “bulbous sack” under their necks. Males have black testicles and a bright pink penis.” (This accurately describes features of many of the species in *Pithecia* as the penis is pink, the testes are black, and the scent glands can vary in distinctiveness). *Females.* Females have more pelage stippling in general than males, but compared to other sakis it is sparse. Females have the white malar stripes as in males, but lack the white hairs across the lips so evident in the males. The hair around the face is blacker than agouti and not as short and tight against the face as in males. The skin on the face is pinkish around the eyes and above the muzzle and the chin, which is black as it is in the males.

Measurements. See Table 9 for Spix’s measurements of the holotype, and Table 10 for two adult male key specimens in the British Museum of Natural History (BMNH).

Table 9. Original measurements of *Pithecia hirsuta* holotype from Spix (1823).

Morphology	Original (in)	mm
Trunci (body)	1'5 ¼"	438.2
Capitis (head)	3½"	88.9
Facici	1½"	38.1
Caudae (tail)	1' 6⅓"	465.7
Humeri	4"	101.6
Ulnae	3¼"	82.6
Palmae (hand)	3"	76.2
Femoria	6"	152.4
Tibiae	5¼"	133.4
Plantae (foot)	4½"	108.0
Angulus Facialis	47°	–
Angulus Cerebralis	44°	–

Table 10. Measurements for key specimens of adult male *P. hirsuta* at the British Museum of Natural History, London.

Measurements	Male BMNH 27.8.11.23	Male* BMNH 27.3.6.3
Skull (mm)		
Length of brain case	78.0	–
Width of brain case	44.4	–
Zygomatic arch width	56.4	–
Orbits–outer	43.9	–
Nose bridge	0.68	–
L-orbit inner width	17.7	–
L-orbit inner height	16.9	–
Muzzle width	24.3	–
L-mandible length	50.04	–
L-mandible height	–	–
Post-crania (mm)		
Head/body	500	480
Tail	430	410
Hindfoot	–	120
Ear	–	31

* Skull available, but was not measured.

Diagnosis. *Pithecia hirsuta* is distinct from *P. monachus* in that it is quite plain, something *monachus* got the reputation for probably because of É. Geoffroy Saint-Hilaire's simplistic and cryptic original description (cf. *P. monachus*). Whereas *P. monachus* adult males have adpressed brown hairs that cover the entire face, and in juvenile males the face can be whitish, *P. hirsuta* juvenile males have a dense agouti ring with contrasting white malar strips and obvious

white lips, nearly resembling the adults. The females of the two species are distinct as well: those of *P. hirsuta* have very black facial disks and nearly resemble the male *hirsuta*, only lacking in the white lips, but the female *P. monachus* has soft, shaggy brown and white facial hair with white malar lines.

Distribution. Map 3. *Pithecia hirsuta* is distributed in the “wedge” of rivers formed by the Rio Negro to the east in Brazil, north of the Rio Solimões in Brazil and Peru, north of the Rio Napo in Peru, and south of the Río Caquetá in Colombia (the Rio Japurá in Brazil). It is not known how far west they occur or where the boundary with *P. milleri* is, although *P. milleri* is found in La Paya National Park, Colombia, and probably the Zona Reservada Güepipi in Peru. *Pithecia milleri* appears in the Cuyabeno-Aguarico region in Ecuador to the exclusion of *P. hirsuta* (L.K. Marsh, pers. obs.). In Colombia, it occurs in the national natural parks of Amacayacu, Puré, and Cahuinari for a total of 1,868,380 ha (Defler, 2004 originally referenced as *P. m. monachus*). In Brazil, it is found south of the Rio Japurá and north of the Rio Solimões-Amazonas, but how far to the Rio Negro in the east they are found is unclear as Spix's type locality is imprecise, suggesting only they are from the swathe between the rios Negro and Solimões.

Specific locations. Appendix I. BRAZIL. Amazonas: Rio Negro/ Solimões – Tabatinga, Rio Tonantins; Rio Içá – Lago do Caraira. COLOMBIA. Amazonas: Río Igara-Paraná – La Raicilla Ravine, La Chorrera; Amacayacu National Natural Park; Río Cahuinari; Bravo Ravine; Río Cotuhe; San Jose del Encanto. Puré National Park: Caño Mateo, Caño Arapa, Caño Esperanza, Quebradón El Ayo; Curare–Los Ingleses Indigenous Reserve: Caño Curare, Caño Agua Blanca, Caño Zumaeta; Camaritagua Indigenous Reserve / Vereda Madroño: Caño El Boliviano. PERU. Loreto: Río Napo (north) - Río Tamboryacu.

Discussion. The Spix specimens are losing hair, but their corresponding illustrations were drawn when the types were fresh are useful as combined type information. All of the Defler (2004) information used for *P. monachus monachus* accurately describes *P. hirsuta*. *P. monachus* does not occur north of the Amazon River (cf. *P. monachus*). AMNH 71802, collected by A.M. Olalla on 21 November 1925 is credited with the location of “Boca Río Curaray,” as part of the expedition that was indeed in the area in previous months. It is likely, as it appears to be a *P. hirsuta* male, that it was collected on the other side of the Rio Napo near that location.



Figure 15. Spix (1823), plate IX, *Pithecia hirsuta* holotype and corresponding museum mount (ZSM No. 19). Images courtesy R. Kraft, ZSM.



Map 3. Geographic distribution of *Pithecia hirsuta*.

Peru

1. Río Tamboryacu
2. Olalla brothers collection area (approx.), Nov. 1925

Colombia

3. Río Igará-Paraná, La Chorrera, 20 km downstream of La Raicilla Ravine (approx.)
4. Río Cahuinari
5. Amacayacu National Park
6. Río Cotuhe, Bravo Ravine (approx.)
7. Río Cara-Paraná
8. Río Cotuhe, Tarapaca

9. 2°08'S, 69°48'W Caño Mateo, Puré National Park
10. 2°19'S, 69°44'W Caño Arapa, Puré National Park
11. 1°50'23"S, 69°43'39"W, Caño Esperanza, Puré National Park
12. 1°35'S, 69°30'W, Quebradón EL Ayo, Puré National Park
13. 1°20'5"S, 69°49'22"W, Caño Curare, Curare-Los Ingleses Indigenous Reserve
14. 1°19'36"S, 69° 46'02"W, Caño Agua Blanca, Curare-Los Ingleses Indigenous Reserve

15. 1°24'42"S, 69°34'58"W, Caño El Boliviano, Camaritagua Indigenous Reserve / Vereda Madroño
16. 1°22'19"S, 69°58'04"W, Caño Zumaeta, Curare-Los Ingleses Indigenous Reserve

Brazil

17. Río Tonantins
18. Tonantins
19. Lago do Caruará (location by Hershkovitz 1987)
20. Tabatinga



Figure 16. *Pithecia hirsuta* Spix, Schwarzbärtiger Mönchaffe, hand-painted plate by Johann Andres Fleischmann (1835) for the Royal Bavarian Art Institute of Private Piloty & Löhle, Munich, and corresponding syntype mount (ZSM No.15). Images courtesy of R. Kraft, ZSM.

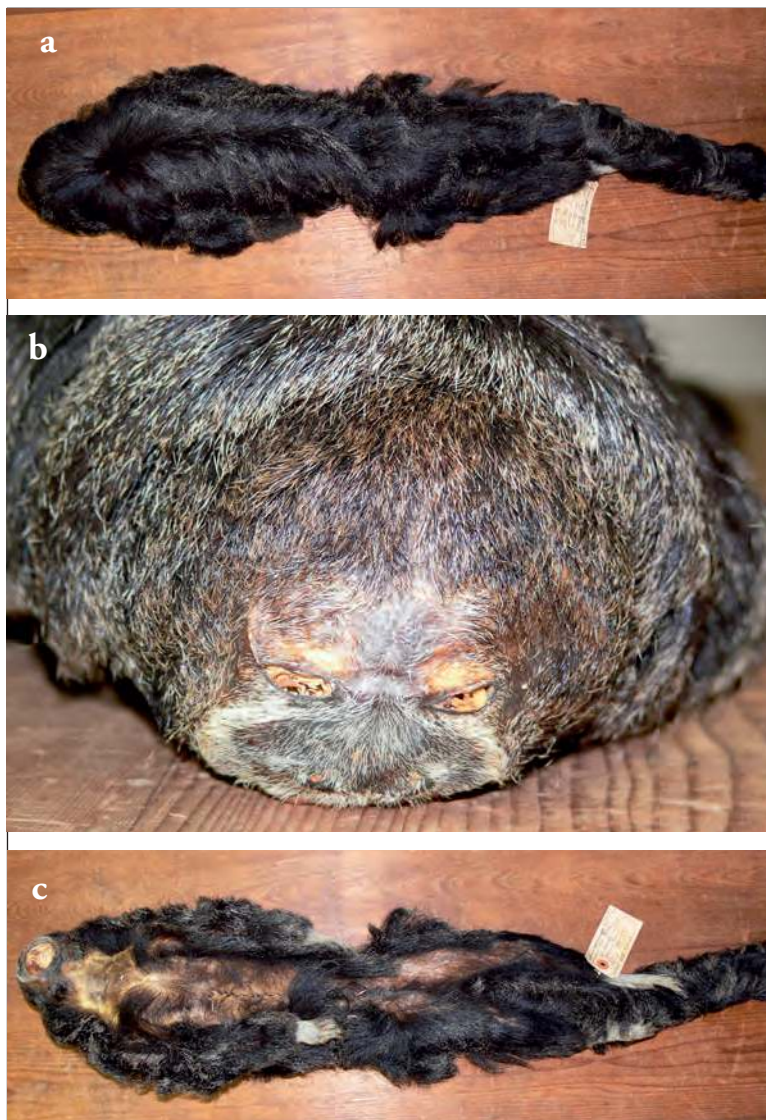


Figure 17. Adult male key specimen, full body and details, BMNH No. 27.8.11.23. Photos by L. K. Marsh.



Figure 18. Living male and female *Pithecia birsuta* from Colombia. (a) adult male, photo by R.A. Mittermeier, (b) adult female pet in Amacayacu National Natural Park, 2009, photo by X. Carretero. Photos used with permission.

MILLER'S SAKI

Pithecia milleri (J. A. Allen, 1914)**Synonymy**

1914 *Pithecia milleri*. J.A. Allen, New South American Monkeys. *Bull. Am. Mus. Nat. Hist.* 43: 650.

1987 *Pithecia monachus milleri* Hershkovitz. *Am. J. Primatol.* 12: 424–425, in part.

Holotype. Adult male in the American Museum of Natural History, New York, USA, No. 33876 collected by Leo Miller, 8 July 1912 (Collection No. 878), for whom the species was named (Allen, 1914).

Topotype. Juvenile male, No. AMNH 33877, collected and designated by Leo Miller, 9 July 1912, determination by J.A. Allen.

Type locality. Colombia, Department of Caquetá, near Morelia (alt. 700 ft) at the head of the Río Fragua.

Key specimens. Adult male, FMNH No. 70635, collected by P. Hershkovitz, 3 Jan. 1952, determination by Hershkovitz as *P. m. milleri*, Colombia, Caquetá, Florencia, Montañita, 400 m. Adult female, IAVH No. 0601, collected by H. Chiriví and J. A. Mora, 8 March 1973 from Colombia, Putumayo, Puerto Leguizamo, Caucaya stream, Miguel Velásquez farm, jungle entering by Limoncocha, north-west of Puerto Leguizamo. Note: “Breast with milk, infant capture. Group of five individuals in a swamp area.”

Specimens examined. Thirty-five skins and skulls, wild and captive photo references including those observed and photographed by L. K. Marsh in Cuyabeno, Ecuador.

Description. In overall pelage, males and females are more grizzled than *P. hirsuta*, and females in particular are noticeably grayer in the face and pelage. *Males.* As per Allen’s (1914) description of the male type: “Upperparts, limbs and tail black, the hairs with long pale yellowish [white] tips; face sparsely clothed with short whitish hairs; front half of head mars brown, the hairs short and course; underparts thinly haired, foreneck naked; hairs dark brown with whitish tips on the throat and belly and with yellowish brown tips over the pectoral region; hands yellowish white, feet whitish grizzled with black.” Subadult and juvenile males have the soft, very brown “mars” coloration of the type as described by Allen, but it is more adpressed in adults making a denser brown band around the face. Males have white hairs along the malars and lips as in *hirsuta*, but also have white under the eyes and often above as well, which is present in *hirsuta* but not as obvious. Overall pelage is much more grizzled than in *hirsuta*, including



darker “sleeves” on the forearms where there are patches of brown infused in the black; likewise in the “cuffs” of the hindlimbs. The ruff is not obviously brown or lighter, but can range, as in *hirsuta*, from a lighter tan to black. *Females.* Faces are shaggier and whiter in general, sometimes with a distinct white band across the forehead. Longer, shaggier white malar lines, and indistinct white across the lips. Also with whitish hands and feet, less distinct in general than *hirsuta*.

Diagnosis. Males and females are dichromatic and more distinct from one another than *P. hirsuta* males and females. *Pithecia milleri* is distinct from *P. hirsuta* with males much more grizzled throughout the pelage, and much browner faces and forearms than *P. hirsuta*. *Pithecia milleri* females are grayer overall than *P. hirsuta* females, but particularly gray in the face contrasting with the very black *P. hirsuta* female faces.

Measurements. See Table 11, including original measurements from Allen (1914).

Distribution. Map 4. In Colombia, *Pithecia milleri* is distributed from the foothills up to 500–700 m surrounding Florencia, east to the area of La Macarena, and south of the Río Caquetá to at least Puerto Leguizamó. It is unclear where the boundary with *P. hirsuta* lies beyond Mecayá. According to Deffer (2004), it occurs in La Paya National Natural Park (422,000 ha), Colombia. South of the Río Putumayo it extends into Ecuador north of the Río Napo, but it is unclear how far it occurs east between the Napo and Putumayo. It is possible since Miller's sakis have been recorded in Cuyabeno, Ecuador, that they could be found across the border west into Peru in the Zona Reservada Güeppí, north of the Napo. To date, there have been no records of them in that region.

Specific locations. Appendix I. COLOMBIA. *Caquetá*: Río Peneya; Río Caquetá - El Infierno - Puerto Santander; La Murelia; Florencia - Montañita; La Tagua - Tres Troncos. *Meta*: La Macarena National Natural Park. *Putumayo*: Cau-caya Stream - Puerto Leguizamó - Miguel Velasquez Farm/Limoncocha; San Antonio - Mocoa; Puerto Limón - Indigenous Reservation El Picudo - Villa Garzón; Río Mecayá;

Caquetá River - El Hacha Stream (between Putumayo and Caquetá). ECUADOR. *Sucumbios*: Río Aguarico - Lagarto Cocha; Shushufindi; Cuyabeno - Laguna Garza, Laguna Grande, lodges, Río Cuyabeno.

Discussion. *Pithecia milleri* was described as a distinct species separate from *P. monachus* by Allen, but Deffer (2004) and Hershkovitz (1987) treated it as a subspecies of *P. monachus*. It is here elevated back to a species. An Olalla specimen, AMNH (No. 71816) collected 25 January 1926, was misplaced by Hershkovitz (1987) as being a female from Peru at “Boca Lagarto Cocha”, and perhaps he was the one who changed the tag on the specimen from “Ecuador” to “Peru.” While it is not entirely incorrect to place it in Peru as the location is near the border with that country, with further investigation, Wiley (2010) discloses: “The Río Lagarto Cocha is a small tributary of the Río Aguarico, itself a tributary of the Napo. The current international boundary between Ecuador and Peru follows the lower Aguarico and the Lagarto Cocha. [...] Carlos Olalla's letter stated that it took three days to canoe up the Río Aguarico to reach the Lagarto Cocha. [...] Carlos had nothing to say

Table 11. *Pithecia milleri* holotype AMNH 33876, topotype AMNH 33877, and key specimens FMNH 70635 and IAVH 0601.

Measurement	Male AMNH 33876	Male* AMNH 33876	Male FMNH 70635	Female** IAVH 0601
Skull (mm)				
Total length	81.9	82.7	85.7	76.4
Breadth of braincase	43.3	43.7	46.9	41.0
Occipitonasal length	–	75.7	–	–
Basal length	–	63	–	–
Zygomatic breadth	55.5	57	56.9	–
Orbital breadth	43.0	43.2	42.8	–
Nasal breadth mid- orbit	6.3	–	7.5	5.0
Nasals	–	16 × 15	–	–
Postorbital breadth	–	35	–	–
L-orbit inner width	16.6	–	15.8	16.8
L-orbit inner height	17.7	–	19.6	17.6
Breadth of rostrum at canines	26.4	26.0	25.5	–
Palatal length	–	25	–	–
Breadth of palate at M1	–	14	–	–
Maxillary tooth rows	–	19.6	–	–
L-mandible length	52.2	–	61.3	55.6
L-mandible height	41.7	–	41.8	–
Post-crania (mm)				
Total length	880	730	819	825
Head-body	480	330	361	420
Tail	400	400	458	405
Hind foot	120	110	120	117.2
Ear	–	–	34	31.5

* Reported in Allen, J.A. 1914. New South American Monkeys. *Bull. Am. Mus. Nat. Hist.* 43: 650.

‡ Juvenile male topotype does not have its associated skull, only basic body measurements.

^ Adult Male FMNH 70637, same location as key specimen male FMNH 70635, but without skull. FMNH 70635 without body measurements.

**Wt. 2102 g. Data on IAVH 0601 from Xyomara Carretero.

about where his party camped or collected at the mouth of the river. Lagarto Cocha, despite its name (“cocha” means lake in Quechua), is a small black-water river, less than 50 m wide that meanders southward through hilly terrain. Recent satellite photos show the mouth of the river at 0°39'18"S, 75°15'41"W, but it appears that this mouth is recent, formerly having been about 2 km SW" (Wiley, 2010, p. 37). While males north-east of the Río Orteguaza

appear to be *P. milleri*, the females, at least in museum collections, almost resemble *P. hirsuta* with blacker faces than the more typical *P. milleri* of Ecuador and southwestern Caquetá. As with many saki species, it is possible that the colorations change according to age. Thus, more research is needed on these populations to determine the boundaries with *P. hirsuta*.



Map 4. Geographic distribution of *Pithecia milleri*.

Colombia

1. La Macarena National Park, Meta
2. Caucaýá Airport, Puerto Leguízamo
3. Quebrada Caucaýá, Limoncocha, Miguel Velásquez Farm (approx.)
4. Between Leguízamo and La Tagua (approx., K. Watanabe Expedition 1973–74)
5. Tres Troncos (approx.)
6. La Tagua
7. Quebrada El Hacha (approx., Caquetá River Expedition 1960)
8. Río Caquetá, Puerto Santander, El Infierno Farm
9. Montañita
10. Morelia, Caquetá
11. Mocoa
12. Puerto Limón, Villa Garzón, El Picudo Indigenous Reservation
13. La Solita Creek, Solita
14. Vereda La Leona, Valparaiso
15. Río Peneya

Ecuador

16. Río Aguarico, Boca Lagarto Cocha (by gazetteer, Paynter 1993)
17. Cuyabeno National Park, all points within, including Laguna Garza Cocha
18. Cuyabeno Lodge
19. Río Aguarico
20. Sushufindi



Figure 19. Holotype specimen, adult male, full body and details, AMNH 33876. Photos by L.K. Marsh.



Figure 20. Holotype AMNH 33876, skull. Photos by L.K. Marsh.



Figure 21. Adult male *Pithecia milleri* in Cuyabeno National Park, Ecuador. Photos by L.K. Marsh.



Figure 22. Adult female *Pithecia milleri* in Cuyabeno National Park, Ecuador. Photos by L.K. Marsh.

MONK SAKI

Pithecia monachus
(É. Geoffroy Saint-Hilaire, 1812)

Synonymy

- 1812 *Simia monacha* É. Geoffroy Saint-Hilaire. *Rec. Obs. Zool. Anat. Comp.* (Humboldt expedition). Vol. 2, p.359.
1813 *Pithecia monachus*. É. Geoffroy Saint-Hilaire. *Ann. Mus. Hist. Nat. Paris* 19: 116.

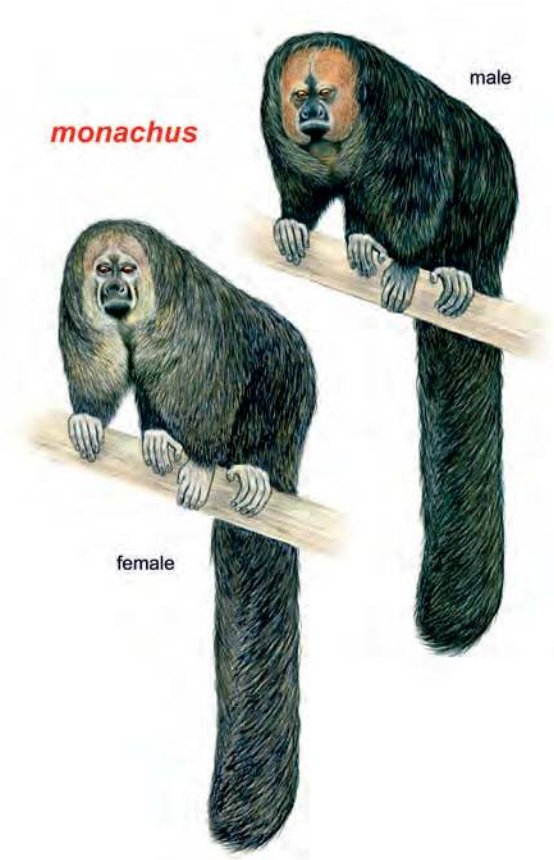
Holotype. Skull-in mount MNHN No. 447, Type 92, 2005-928, juvenile male. Other information on mount: "Cabinet de Lisbonne, Brasil 1808. É. Geoffroy St.-Hilaire 1812, *Ann. Mus. Hist. Nat. Paris* 1. XIX, p.116."

Key specimens. *Males:* AMNH No. 11132, collection no. 210, adult male, skin and skull, collected by D. W. Fleck, 1995-1996 from Peru, lower Río Galvez, eastern side, at Nuevo San Juan. FMNH No. 87002, adult male, skin and skull, C. Kalinowski, January 1957 from Peru, south of the Río Amazonas, Río Maniti, east side, at Santa Cecilia. MPEG No. 1828, adult male, skin and skull, skin and skull, J. Hidasí, November 1960 from Brazil, Río Javari, Estirão do Ecuador. *Females:* MNHN No. 448, catalogue no. 1664, subadult female, skull-in mount, collected on the Castelnau et Deville Expedition, 1867 (which could be the mount date, not the expedition date as it was much earlier) from Peru, Río Yavari, no specific site. FMNH No. 88861, adult female, skin and skull, collected by C. Kalinowski, September 1957, from Peru, Río Yavari-Mirim, no specific location. AQ 04.6.82, juvenile female, skin only, collected by R. Aquino, 4 June 1982 from Peru, upper Río Orosa on the west side near the confluence of Río Chontay. BMNH No. 27.3.6.4, adult female, skin and skull, collected by W. Ehrhardt, 10 September 1926 from Brazil, upper Solimões, at Santa Rita, likely present-day Santa Rita do Weil.

Type locality. Geoffroy Saint-Hilaire's (1813) type description says, "Habite...le Brésil?" (p. 117). Others have placed it with Spix's *Pithecia hirsuta* north of the Río Solimões, but the type specimen itself has an indeterminate locality.

Specimens examined. Eighty-one specimens, skins, skulls, and photos of living animals from Peru: ríos Yavari-Mirim, Lago Preto, Tamashiyacu-Tahuayo by M. Bowler, Quebrada Blanco, Río Tahuayo by E. W. Heymann, ríos Tapiche and Tahuayo by various tourists; in Colombia, Leticia area by Juan Manuel Renjifo Rey and Glenn Perrigo, and captives or pets by R. Aquino, L. K. Marsh, and tourists in area of Iquitos.

Description of holotype. Because of the vast confusion about this specimen in particular, I here give detailed



information about it for future investigators. Geoffroy Saint-Hilaire (1813) wrote: "Pelage varié par grandes taches de brun et de doré: poils bruns en grande partie et des l'origine, et roux-dorés vers l'estremité: chevelure rayonnante de l'occiput et aboutissant au vertex" (p. 116). He did not provide measurements of this animal, nor an illustration in his publication of it. His description can be applied to several species of *Pithecia*, both male and female, but mysteriously does not describe the type that was presumably placed by him. The original text from Kuhl (1820) repeats in Latin basically what Geoffroy Saint-Hilaire described, but it too in no way describes the specimen that is there now. It does, however, read like it might describe the subadult "transitional" males (see Description, below): "Pilis longissimis, densissimis, ab apice inde bruneis, apicibus tantum extimis ochraceis; ad capitis latera autem et sin-ciput adpressis, paucioribus, pallide cinerascens ochraceis; in fronte media longitudinaliter haud divisus, occipitis radiantibus, confertissimis. Manuum pilis brevibus, adpressis. Species omnium minima. In Museo Parisiensi" (p. 45). And Gray in 1870 describes *monachus* in the catalogue for the BMNH as black, grey-washed; hairs very long, harsh,

white-tipped; head and crown of male yellow, of female white" (p. 59), which is significantly closer (but see Discussion, below).

If the type specimen is used as the definitive reference, then the one presently in the Paris vaults is quite different from all original references. Gray (1860) refers to the *P. monachus* type as "from a very young specimen in bad shape" (p. 230) and in 1870 Gray repeats: "The specimen described by Geoffroy was young and in very bad shape," which sadly does correctly reflect the current type. However, J.A. Allen (1914) vaguely described *P. monachus* as having a "forehead and crown white," which approximately agrees with the type as it appears today.

Thus, the problem with the Paris type is many-fold: it is a small juvenile, it was in poor condition as far back as 1860, over time it faded from sunlight hitting the front of the specimen possibly changing the defining coloration (previous curation had the types in clear glass cases for public viewing without regard to natural light or protection from fading, C.P. Groves, pers. comm.), and it could be a female. Hershkovitz (1987) cited the type as "MNHN Paris, No. 447, sex indeterminable, mounted specimen, skull in skin" (p. 423). If the type is in fact from Brazil, there are juveniles with a white band around the face within the *monachus* range. The confusion remains as far as the type is concerned as there are both young juvenile males and females in that region with white bands around their faces. As an example, MPEG 30768 from Atalaia do Norte, Rio Javari, Brazil, is labeled "male", but it is a juvenile female (Figure 33). It is clear from this study that the holotype has value for historical purposes only, not for taxonomic reference.

Description. There is a great deal of variation in the color of the juveniles, both male and female, and the adults. It appears, based on skull morphology, that these sakis in particular live a long time, and their coloration changes over time. In particular, older adult males tend to have some of the most pronounced sagittal crests of all the saki species.

Males. Adult male dorsal pelage is black with very little stippling overall. The forearms and across the chest tend to have longer whitish tips, with the chest ruff having dark roots, but light tan to orangish tips. Juvenile and subadult males are more grizzled in general, with the ruff more obvious and stippling across the arms at chest height make the ruff seem more extensive. The hair from the whorl on the nape of the neck does not extend as far forward over the face as in some sakis, and is darker with less stippling, especially in subadult males. Both adult and juvenile males have black wrists. The hands and feet are mottled black and white, growing whiter with age, but the hairs are subterminally black. The adult males' faces are very brown, and are darker the older they get. The hair is adpressed especially in older animals, with a definite crease up the forehead ending in a star or "pit" between and just above the eyes. In the skulls of older animals, there is a pronounced sagittal crest.

Malar lines are white and vary in width depending on age as the white below the cheek line can blend to the malars. There are fine white hairs along the upper lip as well. The facial skin of the muzzle is black with fine whitish hairs sometimes present. In subadult males, the face is white with only a band of brown up the centerline of the forehead. As these animals age, they are similar to adult female *P. inusta*, and become "two-tone" where the top band of their faces is brown and the bottom white. In some males, the white diminishes to just wide malar lines, and in others it remains white at the lower part of the face. Juvenile males, depending on age, have a white head-band with some brown forming down the center. In very young males, the brown can be nearly across the forehead with the rest of the face white. One of the striking features in older males is the multi-folded glandular throat sack, which is more pronounced in this species than any other saki. *Females.* The overall pelage of females is similar to that of males in that it is black with some stippling throughout. Females in general tend to be slightly more grizzled, especially in the forearms. The hair of the nape whorl extends forward further than in males, but gradually so, it is not as noticeably abrupt as in males. Young, breeding age females can have very loose brownish to whitish mottled faces. Older females have soft, loose dark brown foreheads with shaggy white below, looking "two-toned". Malar lines are shaggy and white and in older females can blend in with the white lower cheek hair. The ruff on females is darker brown or black, with occasionally lighter tips, that are less extensive than in males. They have less extensive throat glands. In older females, hands and feet are whiter than those of males.

Measurements. None for the type specimen. Table 12 for key specimens of the species.

Diagnosis. Unlike *inusta*, older adult male facial hair appears more as a band around the face, with some hair filling in toward the muzzle, rather than the face finely covered entirely in hair. Also distinct is the glandular throat sack, and clearly bifurcated forehead muscles on either side of a notable sagittal crest seen in the skulls of some individuals. Faces are much darker brown overall in adult males in *P. monachus* than *P. inusta*, and adult female *monachus* tend toward the brown-topped forehead with the white below, as opposed to the nearly entirely white of adult female *inusta*.

Distribution. Map 5. In general found in the interfluvial areas between the rios Solimões, lower to middle Ucayali, and lower Yavari in Peru extending south to at least Sarayacu/Serra do Divisor, and the lower reaches of the rios Javari to Juruá in Brazil. In Peru: Río Tahuayo region including the Reserva Comunal Amishiyacu-Tahuayo and Quebrada Blanco, north to Río Maniti and Río Orosa, Río Yavari-Mirim and Río Yavari region, including, Quebrada Esperanza, Río Galvez, north-east to San Fernando, and Leticia/Tabatinga. Tourist photos and specimens of sakis in the rios Tahuayo and Tapiche are possibly of subadult males or even of *P. inusta* males. If these animals prove different, it

may be because of introgression from *P. inusta* in the Río Ucayali watershed coming up from the south (cf. “Discussion” below). In Brazil: Benjamin Constant, Santa Rita do Weil, Atalaia do Norte, and Estirão do Equador.

Specific locations. Appendix I. BRAZIL. Amazonas: Rio Javari – Estirão do Equador, Atalaia do Norte; Benjamin Constant – Mata Esperança do Município, Rio Quixito – Seringal, Boa Vista (Gondino), José Veiga; Santa Rita; Tabatinga. PERU. Loreto: Río Yavari; Río Yavari Mirim – Mariscal Ramon, San Fernando, Quebrada Esperanza, Lago Preto; Río Maniti – Maynas, Santa Cecilia; Pebas; Río Amazonas – Orosa, Río Chontay; Río Galvez - Nuevo San Juan; Río Tahuayo – Quebrada Blanca, Tahuayo Lodge, Tamashiyacu; Río Tapiche – Puerto Punga, San Salvador; Iquitos.

Discussion. The “*Monachus* Mess” has been snowballing for almost 200 years. I read all available early references regarding the description of *monachus*, including É. Geoffroy (1812, 1813), Kühl (1820), Spix (1823), Gray (1860, 1870), Elliot (1913), J.A. Allen (1914), Lönnberg (1938), and Tate (1939). All of them were confused and conflicting about what Geoffroy meant. Spix (1823) simply ignored *monachus* altogether, clearly naming and referencing *hirsuta* and *inusta*, animals that can still be identified today (cf. *P. hirsuta* and *P. inusta*). Gray (1870) was not only displeased with the Paris type, but he was also confused about what *monachus* was by rolling it into synonymy, among others: I. Geoffroy’s description of *monachus* from the Castelnau Expedition, Spix’s *P. hirsuta*, Poepig’s *P. guapa* and Lesson’s two *P. nocturna* (both of which are *P. pithecia* transitional juvenile males), and his own *P. irrorata* saying, “the [specimen] in the British Museum, figured in the ‘Voyage of the Sulphur,’ has the face quite bald. This is now shown to be

accidental, as the others, more lately received, have white hairs on the face” (p. 59). We know now that he was right about *irrorata*, that there actually are bare-faced animals, it is not that the hair has been rubbed off (cf. *P. irrorata*).

Lönnberg understood the problems best, and tried to give an historic rationale: “*P. monachus* was named in 1812 by É. Geoffroy St. Hilaire (*Ann. Mus. Nat. Paris* XIX, p. 116). Although the general characteristics of this monkey are indicated, it has not been sufficiently clear which of the existing races or subspecies is to be considered as the typical one. In consequence of this the specific name quoted has sometimes been used in a rather collective sense, and several new names have also been published. Spix introduced two new names 1823 (*Sim et Vesp Bras*), the types of which were fully described and also pictured on plates, so that they with full certainty may be recognized *vs. hirsuta* (i.e., p. 14, Pl. IX) and *inusta* (i.e., p. 15, Pl. X). Both these subspecies are represented in the present collection, and as it is not proved, whether any of these can be regarded as identical with the typical *monachus*, the names of Spix are used.”

Like Spix, Lönnberg never attaches any specimens to *monachus*, instead he accurately supports Spix’s clearly defined species (and adding a new one of his own, cf. *P. napensis*) leaving us to believe that while Geoffroy indeed was looking at a saki monkey, which saki monkey has been bantered about for generations. Complicating this issue is the fact we have no record of who actually selected the Paris type, nor where it was actually collected. It is exactly as Lönnberg described; that *monachus*, up to this publication, has been used in a “collective sense,” a dumping ground, of unknown or unnamed sakis. And based on Hershkovitz’s last saki work, he fell prey to the same condition. Hershkovitz (1987) stated, “Consistent size and cranial or dental

Table 12. Measurements for *P. monachus* key specimens.

Skull Measurements (mm)	AMNH 11132 Male	FMNH 87002 Male	MPEG 1829 Male	FMNH 88862 Male	FMNH 88861 Female
Length of brain case	81.6	84.8	86.3	86.9	80.0
Width of brain case	36.8	46.0	44.0	48.2	42.6
Zygomatic arch width	53.0	58.0	57.4	56.8	51.0
Orbits-outer	38.9	41.3	46.2	42.1	39.8
Nose bridge	6.1	7.15	7.0	7.2	6.2
L-orbit inner width	17.5	16.2	17.4	15.6	16.1
L-orbit inner height	18.5	19.4	19.3	18.3	18.4
Muzzle width	24.2	25.4	25.5	26.4	22.8
L-mandible length	52.1	59.1	57.6	61.0	56.5
L-mandible height	38.0	39.1	41.0	40.7	38.1
Post-crania (mm)					
Total	–	875	–	8	864
Tail	–	457	–	4	404
Hind foot	–	126	–	1	118
Ear	–	33	–	3	32



Map 5. Geographic distribution of *P. monachus*.

Brazil

1. Estimated location Rio Juruá (E. Garbe Expedition 1901–02)
2. Santa Rita do Weil
3. Benjamin Constant
4. Atalaya do Norte
5. Rio Quixito
6. Estirão do Equador

Peru

7. San Fernando
8. Boca Río Yavari Mirim
9. Quebrada Esperanza (approx.)
10. Río Orosa
11. Orosa
12. Río Orosa (R. Aquino collection)
13. 3°26'S, 72°46'W
14. Río Maniti, Río. Cecilia
15. Pto. Indiana
16. Quebrada Blanco
17. Tahuayo Lodge
18. Río Tahuayo, Tamashiyacu
19. Río Yavari Mirim
20. Río Galvez, Nuevo San Juan
21. Río Tapiche, San Salvador
22. Boca Río Punga, Puerto Punga
23. 6°14'S, 74°01'W
24. Sarayacu

differences between species of the *P. monachus* group have not been found” (p. 410). This problem for him likely arose from the fact that he lumped several different species and sex/age classes into not only the “*monachus* group,” but into the *monachus* species itself (cf. Table 2 “Introduction”).

The clearest, earliest example of what adult *P. monachus* looks like is Plate 3 in Castelnau *et al.* (1855) depicting an adult male holding an infant with a portrait of a ‘female’ although the female here is so vague it appears to be more similar to a transitional subadult male or a *P. inusta* female (Figure 23). The animals depicted in it are from Peru. It is of note that Étienne Geoffroy Saint-Hilaire’s son, Isidore, is credited with the species determination in this image and was a member of the expedition into Peru and Brazil. It is

this image that allowed *P. monachus* to remain as a recognizable species, and is what I used to determine adult key specimens.

One of the distinctive characteristics in the *P. monachus* adult males is their conspicuous, multi-folded glandular throat sack (Figure 28b). It is unclear whether the throat sacks on both males and females are used for scent marking for territory or sexual signaling, although as compared to other New World primates, sakis are not particularly strict territory defenders (pers. obs.). *Pithecia* sexual behavior has been studied (Setz and Gaspar, 1997; Lehman *et al.*, 2001; DiFiore *et al.*, 2007; Norconk, 2006; Thompson and Norconk, 2011; Thompson *et al.*, 2011), but there are no studies on the size of the glandular areas or excretion rate/

volume of male glands in relation to sexual advantage, if there is one. Furthermore, while it is clear that at least some sakis signal mates using lingual gestures (tongue moving rapidly in and out of the mouth; Figure 30) similar to other New World primates (for example, *Alouatta*, pers. obs. for *A. pigra*, Jones [2002] for *A. palliata*), it is unclear whether subadults of *P. monachus* (or any sakis for that matter) initiate sexual partners more frequently with visual cues, such as lingual gestures, as compared to older males with extensive throat glands who may predominantly use scent to attract mates. The function of both visual and olfactory cues in saki sexual behavior needs further investigation in all species.

The deep confusion over *P. monachus* was not just over its appearance, but its location, as Geoffroy confusingly gives us “Le Brésil?” without any further details, and, as has been mentioned, other authors (including Hershkovitz) simply presumed that he meant what Spix later reported for *P. hirsuta*. Hershkovitz (1987) was another in a long line who placed *monachus* thus: “Amazonian region in Ecuador, in Peru the basins of the ríos Huallaga, Ucayali, and Purus in the departments of Amazonas, eastern Huanuco, Pasco, Loreto, and Ucayali, then east into Brazil to the west (left) bank of the Rio Juruá in western Amazonia and Acre; altitudinal range between 50-1500 m above sea level” (p. 423). And while he at least got the right species within those boundaries, other authors presumed this location information to mean that *monachus* was also in Colombia (Defler 2004) and worse, throughout Ecuador, Peru, Bolivia, and Brazil, all the way to the Rio Tapajós (BDGEOPRIM 2002). It is no wonder we have such divergence in genetic results, and in any kind of comparative anatomy for projects involving “*P. monachus*.”

With more extensive analysis and considerably more data, it may be shown that *P. inusta* and *P. monachus* are the same species with a huge variation in pelage coloration and skull morphology. Likewise, it may be shown that there are even more species in the Ucayali/Yavarí/Juruá region. The sakis in the lowermost Ucayali, in particular in the ríos Tahuayo and Tapiche, are included in *monachus* for now, although it is unclear if these animals, photographed by tourists in the region, are subadult *monachus* males or are adult *inusta* males. If *inusta* occurs primarily in the Ucayali drainage and *monachus* in the Yavarí/Javarí, there could be a “mixing point” somewhere in the north as well as somewhere around Sarayacu/Serra do Divisor in the south. Regardless, the designations of *P. inusta* and *P. monachus* as distinct in this publication represent an understanding that there are differences in the sakis of that region, that we need to be careful about creating a new “dumping ground” of species such as *monachus* was historically, and that “something is going on” in these populations that is worthy of further research.



Figure 23. *Pithecia monachus* depicted in Plate 3 of Castelnau et al. (1855).



Figure 24. *Pithecia monachus* holotype MNHN No. 447. Photos by L.K. Marsh.



Figure 25. Full mount and detail of MNHN No. 448, subadult female, from Río Yavari, collected on the Castelnau et Deville Expedition, 1867. Photos by L.K. Marsh.



Figure 26. Adult female key specimens, full body and details of: (a) Brazilian *Pithecia monachus*, BMNH 27.3.6.4 from Santa Rita, Solimões, and (b) Peruvian *Pithecia monachus*, FM NH 88861, adult female from Río Yavarí-Mirim. Photos by L.K. Marsh.



Figure 27. Adult male key specimens, full body and details of: (a) Brazilian *Pithecia monachus*, MPEG 1828 from Estirão do Equador on the Rio Javari, and (b) Peruvian *Pithecia monachus*, FMNH 87002, adult male from the Río Maniti. Photos by L.K. Marsh.



Figure 28. (a–c) Wild adult male *Pithecia monachus*, (d) captive adult male, Iquitos Zoo. Photos by Mark Bowler.

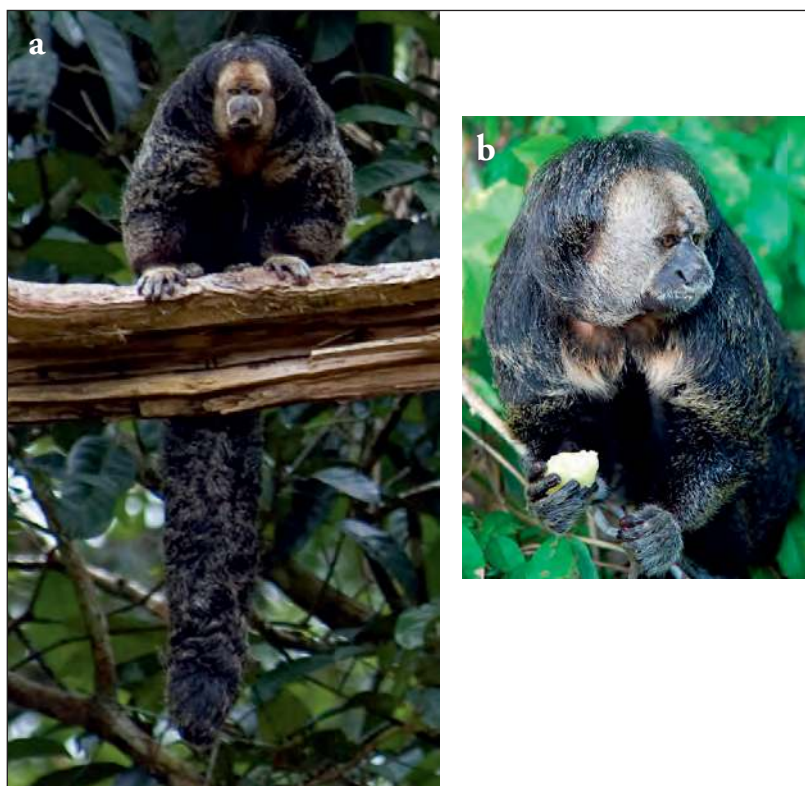


Figure 29. Subadult male *Pithecia monachus* (or possibly adult male *P. inusta*; cf. Discussion) from the Río Tahuayo region. (a) wild male, photo by Mark Bowler; (b) provisioned male, photo by John Agnew.



Figure 30. Subadult male *Pithecia monachus* sexually gesturing to a female. Photo by Sally Kneidel.

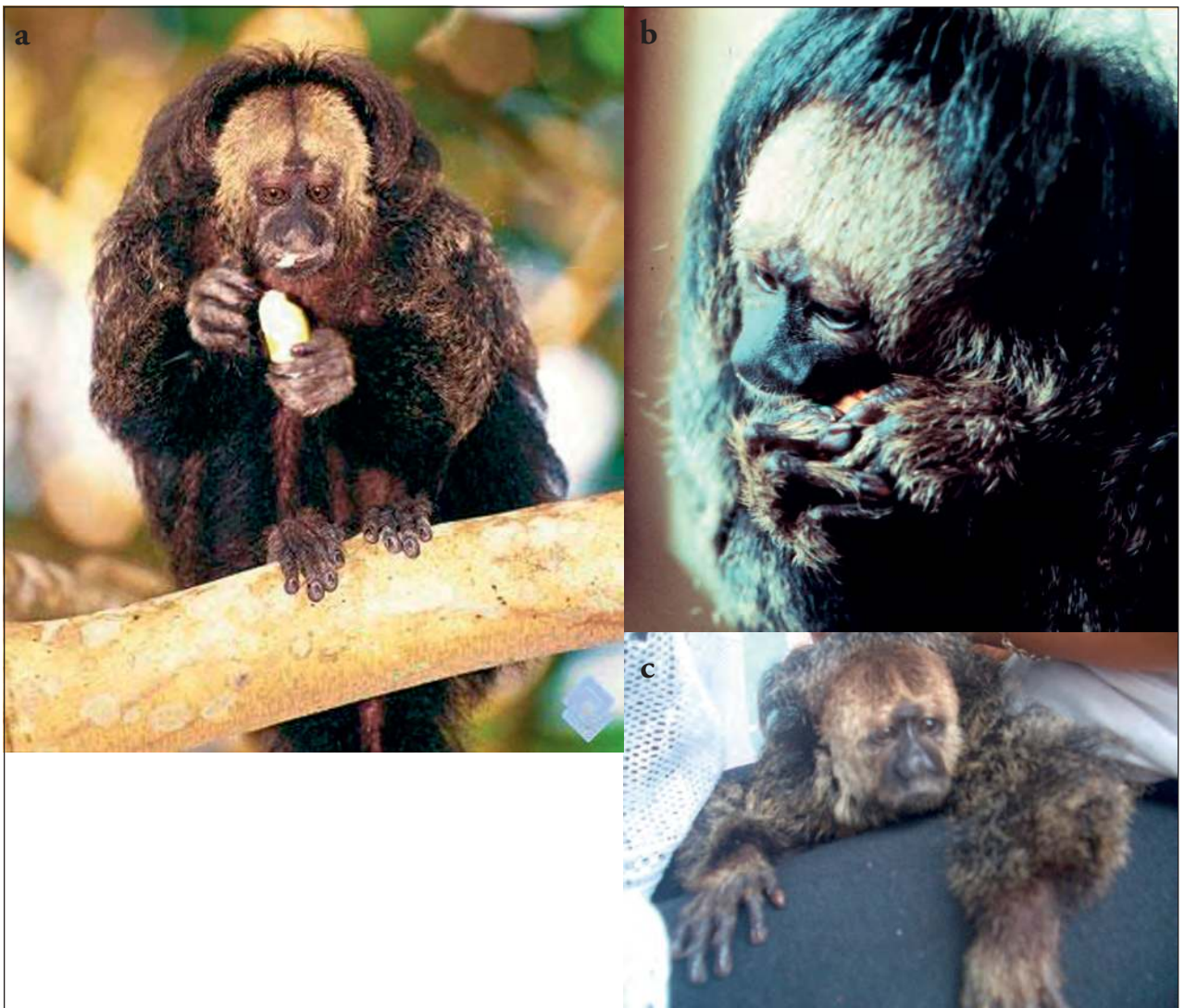


Figure 31. Different ages of transitional males: (a) Living juvenile male *Pithecia monachus* near Leticia, photo by Juan Manuel Renjifo Rey; (b) pet in Quebrada Blanco, Río Tahuayo, Peru, photo by U. Bartecki; and (c) pet in Iquitos, Peru, photo by R. Aquino.

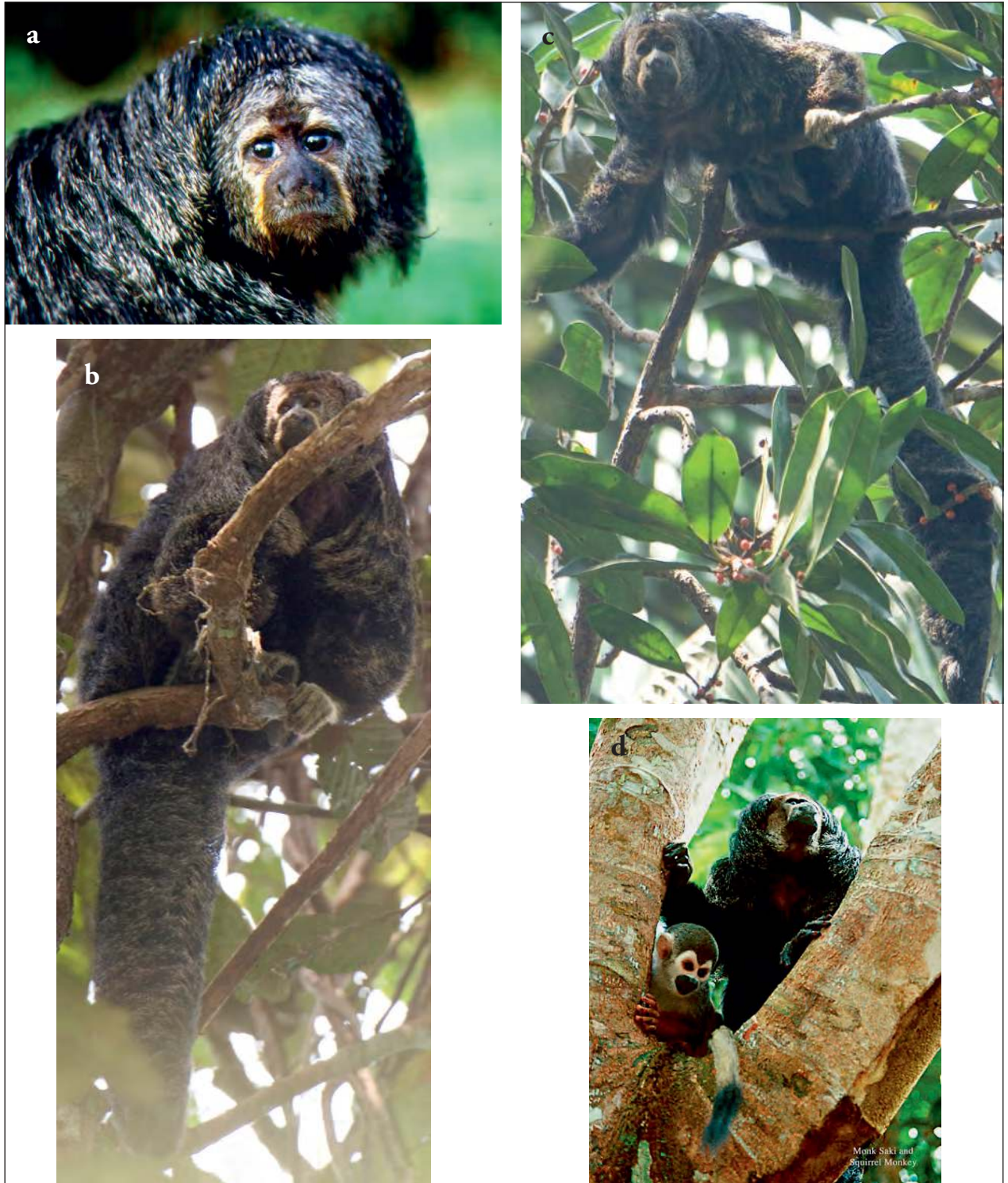


Figure 32. (a) Juvenile female *Pithecia monachus* in the Tamashiyacu-Tahuayo region, photo by E.W. Heymann; (b) adult female *P. monachus* (with squirrel monkey), rescue center near Río Selva, Tabatinga, photo by Glen Perrigo; (c-d) wild *P. monachus* in Peru, breeding (subadult) female, near Boca Río Yavarí-Mirim, photos by M. Bowler.



Figure 33. Various aspects of *Pithecia monachus*, juvenile female, MPEG 30768, from Atalaia do Norte, Brazil.

BURNISHED SAKI

Pithecia inusta (Spix, 1823)**Synonymy**

1824 *Pithecia inusta* Spix, J. B. von. *Simiaram et Vespertilionum Brasiliensium Species Novae*. 1823. F. S. Hübschmann, Munich, p. 15–16, pl. 10.

1987 *Pithecia monachus monachus* Hershkovitz, *P. Am. J. Primatol.* 12: 422–424, in part.

Holotype. Plate only (Figure 1), original mounted specimen has been lost or destroyed (R. Kraft, ZSM, pers. comm. 2007).

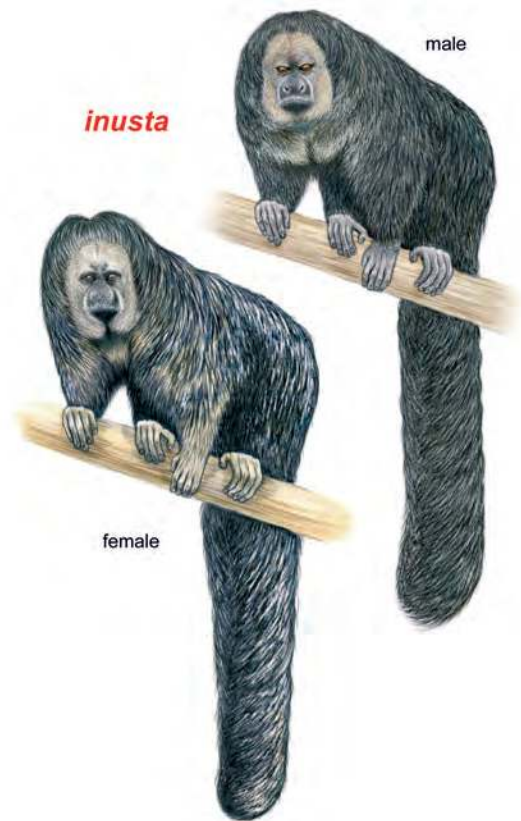
Type locality. Spix (1823) does not specify where the mounted type was collected, not even by country, in his original publication (cf. Discussion below).

Key specimens. MNHN No. 449, subadult male, skull in mount, is similar to the original holotype, this one collected by Castelnau and Deville in 1867 as part of their South American expedition. UNMSM No. 29, skin only, collected by Koepecke in 1949, Peru, near Huanuco, Río Lullapichis, Estación Biológica Panguana. BMNH No. 28.5.2.42, adult male, skin and skull, 18 September 1927, from Peru, upper Río Ucayali, Chicosa, and No. 28.5.2.43, subadult female, skin and skull, 3 August 1927, from Peru, upper Río Ucayali, Cumeria. Both collected at 1500 feet above sea level (457.2 m), and on the Godman-Thomas Expedition (Thomas (1928: 253). And AMNH No. 239853, adult male, skin and skull, collected 28 June 1963 by M. D. Tuttle from Peru, Pasco, Oxapampa Province, Nevati, Mission, 900 feet above sea level (274.3 m).

Specimens examined. Forty-nine specimens, skins and skulls, photos of living sakis by R.A. Mittermeier, J. Vermeer, L.K. Marsh, and tourist photos in the region.

Description. The classic tight, adpressed white faces seen in older museum mounts are confusing at best, as some may be young males and others adult females, the two being very similar. Thus, the following description takes into account the full range of variability among not only adults of this species, but of the females and juvenile age classes. Both males and females have a “diamond” in the center of their foreheads just above the eyes, but in the adult female it tends to be more distinct and less haired than it is in the males.

Males. Dorsal pelage is black with light stippling across the back in juveniles to subadults, more overall in older animals, where the grizzling is short and light initially and increases in length and volume in older males. The ruff is darker brown at the base with light tan tips in younger



animals, but can become brighter with buffy-tannish or nearly orange tips in older males. The chest is otherwise sparsely covered in black hair. The forearms in males are sparsely covered in a pattern that for some looks like a triangle up the arm, where half or more is not stippled at all. Wrists tend to be black or without grizzling. The hands and feet are white, and hind feet can have a distinct dark ‘V’ on the older animals.

In adults, the face is entirely covered in short, closely pressed tan to off-white hairs with white, short-haired muzzle lines that are more or less distinct as they blend with the rest of the facial hair. The muzzle is bare, with dark skin, and there are scattered short white hairs along the lips. The transitional males have a very tightly pressed white face and this look can last into subadult ages such that quite large animals appear to have solid white faces like older adult females. All older males in general appear to have a line up the forehead likely caused from muscles beneath the skin forming an indented “line”. Subadults in the northern reaches of the range (Río Tahuayo/Río Tapiche) have whitish faces with a tan line down the center of the forehead,

over the “indent” (cf. *P. monachus* Discussion); whereas, individuals in the south appear to be more uniform in their burnished color as they get older. There is evidence in some skins that this tan line “spreads out” over the face over time making it the tan-white-burnt color of adults.

Lönnerberg (1938) agreed with the original Spix’s (1823) description of *P. inusta* saying: “The crown and the forehead, the cheeks from below the eyes and the sides of the head are densely covered with short, very stiff erect hairs which are directed somewhat forwards, or so on the sides more or less downwards, but are not adpressed. The colour of these hairs is somewhat variable, in some the crown is more pale brownish and others more greyish, and in both cases the

color fades downwards and on the sides to more or less whitish [...] Mustache always whitish, short white hairs on lips” (p.8).

Females. The dorsal coloring in adult females is very grizzled, often with a light tan colored ruff, and a mostly white to tannish face, similar to males. Forearms tend to be densely covered with white grizzling and white wrist cuffs (lacking in the males). Faces of adult females are similar to males, although they are longer overall and whiter in general. They also do not tend to have the strong muscular indentations up the forehead as in males. Juvenile females have many transitional “looks” from shaggy, loose hair covering the face that is greyish to brownish to turning shaggy white and eventually a closer white/tan that covers the face similarly as in males. The whorl of hair on the nape of the neck extends longer and in more “bangs” in the females than in males, where it appears to be mostly drawn back and not coming as far forward over the face.

Table 13. Original measurements of *Pithecia inusta* holotype by Spix (1823).

Morphology	Original (ft/in)	mm
Trunci (body)	1'4"	406.4
Capitis (head)	3"	76.2
Facici	1¼"	31.8
Caudae (tail)	1'7"	482.6
Humeri	3¼"	82.6
Ulnae	3⅞"	79.4
Palmae (hand)	2¼"	57.2
Femoria	4⅞"	104.8
Tibiae	6"	152.4
Plantae (foot)	4"	101.6

Measurements. See Tables 13–15. A mounted, skull-in specimen, UNMSM No. 54E is an interesting example of an adult female (based on the genitalia of the mount), which looks very similar to Paris 449, a mounted, skull-in subadult male. Canine length on UNMSM 54E is: upper left = 7.8 mm and upper right = 7.9 mm.

Diagnosis. The species most similar to *P. inusta* is *P. monachus*, which likely shares part of the northern limits of the range, particularly between the ríos Amazonas/Yavari in the north-eastern corner of Peru. *Pithecia inusta* is clearly

Table 14. Measurements for *Pithecia inusta* in Peru and the Brazil, Rio Juruá[‡] sakis.

Skull (mm)	BMNH 28.5.2.42 Adult male	AMNH 239853 Subadult male	NHRM 2219 [‡] Adult male	NHRM 2375 [‡] Subadult male	NHRM 2472 [‡] Adult female	NHRM 2328 [‡] Subadult female
Length of brain case	86.0	85.0	90.0	84.0	86.0	86.0
Width of brain case	43.0	45.1	47.0	43.0	45.0	44.5
Occipitonasal length	–	–	78	72.5	76	76.5
Condylbasal Length	–	–	74	65	70	67
Zygomatic arch width	59.3	57.5	61	50	56.5	52
Orbits – outer	43.0	37.6	45.5	40	43	40
Least postorbital width	–	–	34	34	35	35
Nose bridge	6.4	6.1	–	–	–	–
L-orbit inner width	15.5	16.5	–	–	–	–
L-orbit inner height	16.4	18.4	–	–	–	–
Palatal Length	–	–	31	26.5	28.5	25.5
Breadth of palate insideM1	–	–	14	13.5	13	11
Muzzle width	25.1	26.7	27.5	22.5	22.5	23.5
L-mandible length	54.6	50.1	–	–	–	–
L-Mandible height	–	39.4	–	–	–	–
Length of maxillary row of cheek teeth	–	–	19	20	19	19

[‡] Measurements reported by Lönnerberg (1938).

distinct from *monachus* and all other sakis in the ontogeny of the juveniles, both females and males. Juvenile male *inusta* have closely pressed white faces that cover all of the face, and juvenile females have gray-black, sometimes brownish, faces that become white, whereas juvenile male and female *monachus* tend to be two-toned brown and white, with adult female *P. monachus* often retaining that coloration.

Distribution. Map 6. In Peru, mostly in the Río Ucayali watershed, where collections appear to have been from both sides of the river from Sarayacu south, especially in the upper reaches where it narrows toward the Río Urubamba/Río Tambor split. They are in the foothills along the Río Pachitea below Oxapampa, particularly east of the Pachitea along the Río Llullapichis, Monte Alegre, Puerto Victoria, and Nevati/Mission. See “Discussion” below for sakis in the upper Río Juruá region in Brazil and the upper Río Pachitea in Peru. Population may reach as far north as the ríos Tahuayo and Tapiche in the lower Ucayali watershed (cf. Discussion, below).

Specific Locations. Appendix I. BRAZIL. *Amazonas*: Río Juruá – Igarapé do Gordão, Igarapé Grande, João Pessoa. *Acre*: Upper Río Juruá – Porongaba, Porto Saids. PERU. *Huanaco*: Río Pachitea - Monte Alegre, Tabalosos, Pachitea. *Pasco*: Oxapampa - Nevati Mission, Puerto Victoria; Río Pachitea - Panguana, Río Llullapichis, Río Santiago. *Loreto*: Río Ucayali - Sarayacu; Contamana - Cerro Azul; Cumeria; Masisea - Tushemo; Chicosa. *Ucayali*: Río Ucayali; Río Pisqui; Río Urubamaba; Via Utuginia; Río Inuya; Lagarto.

Discussion. “*Inustus*” in Latin means “burned,” and is an apt description of the adult males with their burnished tan-white faces.

Elliot (1913) was the first to include *P. inusta* and *P. hirsuta* as synonyms for *P. monachus* using the Spix locale of *P. hirsuta* for all three, even though neither Spix nor Geoffroy give location information for either *inusta* or *monachus*: “The type of *P. inusta* Spix is in the Munich Museum and can in no way be separated from *P. monacha*. It is full grown in good condition and came from the forests of the Tonantins affluent of the Solimões River near Tabatinga” (p. 290) (see “The Monachus Mess,” in *P. monachus*). And now that there are more data, both from living wild and captive

animals and more museum specimens, it is clear the original Spix type is of a large juvenile to subadult male, not an adult. Lönnberg (1938) kept the incorrect location placement, but allowed that *P. inusta* was indeed a true species based on Spix’s type and description. Hershkovitz (1987) and others placed it incorrectly with the *P. hirsuta* location as described by Elliot (1913). Likewise, there is no specific location indicated for the Castelnau mounted MNHN No. 449 other than Peru, although from his expedition notes it is clear he was never north of the Río Amazonas (Castelnau *et al.*, 1855).

Specimens from the Río Juruá, Eirunepé (Igarapé do Gordão and Igarapé Grande) in Brazil are included here as part of *P. inusta* (as per Lönnberg 1938), although further investigation needs to be conducted in this region. In the northern reaches of the Río Juruá is the much browner, distinctly colored *P. monachus*. But in the southern reaches of the upper river are these provisional *inusta* with the older adult males exhibiting heavy skulls, flares on their zygomatic arches, and large sagittal crests, which are closer to *monachus* than *inusta* skulls except for the heaviness. The older upper Juruá adult males tend to have faces that are intermediate between *P. inusta* and *P. monachus*. The juvenile females tend to be browner than *P. inusta* juveniles of roughly the same age class, but the adult females are most similar to *P. inusta* females, not *P. monachus*. The animals in this region may prove to be subspecies of *P. inusta* or *P. monachus*, a distinct species, or color morphs of either.

Sakis in the Río Pachitea region, particularly in the upper reaches (Puerto Victoria and south to Nevati/Mission) are different from the type, where adult males have a softer “medium brown” (intermediate between *monachus* and *inusta*) face with white below, and females have blacker faces in general. These are possibly different species, subspecies or color variations, but as there are also animals in the region that are very similar to the type (for example, AMNH 239853), thus they are provisionally included in *inusta*.

An additional specimen worth mentioning is also provisionally included in *P. inusta*: SEN No. 16605, skull only, with the compelling label information of “*Pithecia monacha* Geoffr. M *hirsuta* Spix, F *inusta* Spix, location W. Brasilien. Get. 1826 München Mus. gegen Ruppell’s Dubl.” Is this

Table 15. *Pithecia inusta* post-cranial measurements for Peru and Brazil, Río Juruá[‡] sakis.

Post-crania (mm)	BMNH 28.5.2.42 Adult Male	AMNH 239853 Subadult Male	BMNH 28.5.2.43 Subadult Female	NHRM 2219 [‡] Adult Male	NHRM 2375 [‡] Subadult Male	NHRM 2472 [‡] Adult Female	NHRM 2328 [‡] Subadult Female
Head-body	425	401	396	410	370	420	375
Tail	488	305	375	500	465	545	470
Hind foot	121	135/137	121	130	117	132	125
Ear	29	37	33	–	–	–	–

[‡] Measurements reported by Lönnberg (1938).

the skull belonging to Spix's type in ZSM? Is it one of the Rio Juruá sakis? And it is interesting especially with Rüppell's name associated with it as he was apparently ill and laying low in Africa in 1826, returning to Europe in 1827 (http://en.wikipedia.org/wiki/Eduard_R%C3%BCppell). It could also easily be *monachus* or something else entirely. The skull appears to be subadult and likely female.

The sakis in the lowermost Ucayali, in particular in the area of the ríos Tahuayo and Tapiche, are included in *monachus* for now, although it is unclear if these animals, photographed by tourists in the region, are subadult *monachus* males or are adult *inusta* males. If *inusta* occurs primarily in the Ucayali drainage and *monachus* in the Yavarí/Javarí, there could be a "mixing point" somewhere in the north as well as somewhere around Sarayacu/Serra do Divisor in the south. Regardless, the designations of *P. inusta* and *P. monachus* as distinct in this publication represent an understanding that there are differences in the sakis of that region, that we need to be careful about creating a new "dumping ground" of species such as *monachus* was historically, and that "something is going on" in these populations that is worthy of further research.



Figure 34. *Pithecia inusta* holotype, Plate X from Spix (1823).



Figure 35. Key specimens of *Pithecia inusta*: (a–b) MNHN No. 449, subadult male, full mount and detail, and (c–d) UNMSM No. 54E, adult female, full mount and detail. Photos by L.K. Marsh.



Figure 36. Key specimen, UNMSM No. 29, adult male skin only, full body and detail, from the Río Lullapichis, Peru. Photos by L.K. Marsh.



Figure 37. Key specimen, *Pithecia inusta*. BMNH No. 28.5.2.42, adult male, skin and skull. Photos by L.K. Marsh.

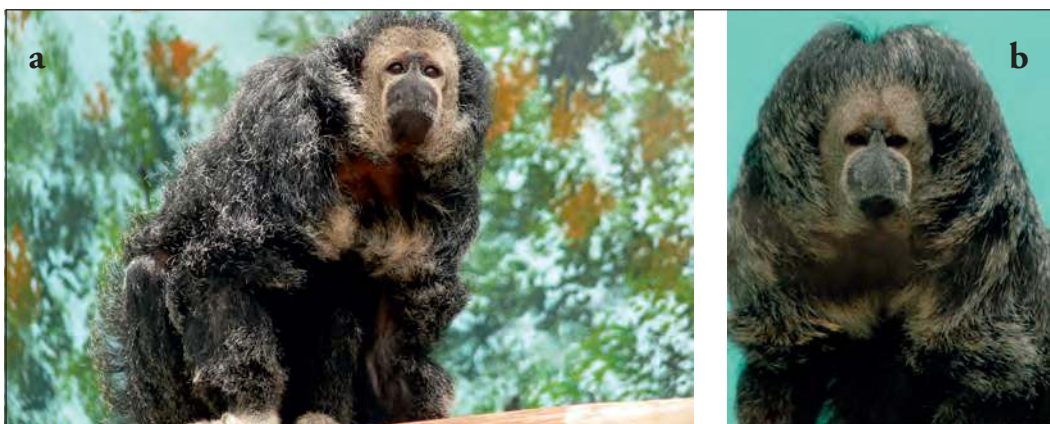


Figure 38. Captive (a) adult male and (b) female *Pithecia inusta* at Leyendas Zoo, Lima, Peru. Photos (a) L.K. Marsh and (b) R.A. Mittermeier.



Figure 39. Captive (a) juvenile male and (b) juvenile female *Pithecia inusta* at Leyendas Zoo, Lima, Peru. Photos by J. Vermeer.



Map 6. Geographic distribution of *Pithecia inusta*, including populations in the Río Pachitea, Peru and Río Juruá, Brazil.

Brazil

1. Río Juruá, Igarapé do Gordão
2. Río Juruá, Igarapé Grande
3. Río Juruá, formerly João Pessoa (presumed; Olalla 1936 Expedition)
4. Porto Saids, Acre
5. Porongaba, Acre

Peru

6. Tabalosos
7. Sarayacu, Olalla camp May-June 1927
8. Sarayacu, Olalla Camp Mar-5 May 1927
9. Sarayacu, Olalla camp Aug 1927
10. Bomba/Río Bomba
11. Cerro Azul?
12. Contamana
13. Río Pisqui
14. Pucallpa
15. Maisisa
16. Tushemo
17. Boca Río Pachitea

18. Montealegre (approx.)

19. Río Lullapichis
20. Río Lullapichis, Est. Biol. Panguana
21. Río Utiquirena
22. Puerto Victoria
23. Pto. Pachitea
24. Cumeria
25. Río Pichis (right bank), Nevati Mission approx.
26. Chicosa
27. Lagarto (approx.)
28. Boca Río Urubamba
29. Río Inuya

CAZUZA'S SAKI

Pithecia cazuzai sp. nov.**Synonymy**

1987 *Pithecia irrorata* Hershkovitz, *P. Am. J. Primatol.* 12: 42426, in part.

Etymology. The name was selected for a respected, world-renowned Brazilian primatologist, Dr. José de Sousa e Silva-Júnior (“Cazuza”), who has worked many long years at the Museu Paraense Emílio Goeldi in Belém, now as the Curator of Mammals, where he continues to contribute significantly to South American mammalogy and taxonomy.

Holotype. Subadult male, Museu Paraense Emílio Goeldi No. 37127, skin and skull. Collected by J. Urbechi in *várzea*, 30 June 2004. Prepared by Arlindo Jr., J. Muniz, and R. R. Silva.

Paratypes. Adult female MNRJ 21055 skin and skull, 28 July 1948, no collector information, but was part of a yellow fever study, “MES Serviço de Estudos e Pesquisas sobre a Febre Amarela.” Large juvenile female MNRJ 3312, skin only, collected by C. Lako, 20 Sept 1927.

Type locality. Holotype. Uarini, “margem esquerda médio rio Solimões, comunidade Barroso – Reserva de Desenvolvimento Sustentável Mamirauá.” Paratypes. Fonte Boa, Rio Solimões, Amazonas.

Specimens examined. Three (holotype and paratypes), and a photo of a living captive adult male taken in Brazil by www.tatamazonstock.com and wild adult male by Filipe Ennis.

Description. Both males and females are very plain in their overall pelage with very short, light to absent white grizzling on the tips of their dorsal hairs.

Males. Dorsal hairs black with just the tips dotted in white. Slightly more grizzling over the shoulders and arms, with the white being slightly longer and more extensive. The chest is bare with sparse black hairs, including a minimal black ruff under the bare throat patch. Belly appears to be without pigmentation in the prepared specimen (subadult). The arms have brown cuffs at the wrists extending in a brownish ‘V’ down the backs of the hands. On the ankles, there is also a brown cuff ring on top with a less extensive brown ‘V’ down the feet. The hands and feet are off white, largely because they are grizzled with brown/black hairs. The skin on the face of the adult male is black; in the subadult it is black over the nose and muzzle under the chin with a black diamond in the center, otherwise the skin is unpigmented or possibly pinkish. White hairs form



a loose arch over the forehead and down the sides of the face. It does not appear adpressed (based on the live photo), but nonetheless is still sparsely haired and the skin (black or unpigmented) shows through it. In both subadults and adults, there is a distinct line through the centerline of the forehead, in adults it is black skin and in subadults it is unpigmented or pinkish. White malar lines are likewise sparse and thin, but the hair continues up under the eyes. The hair on the lips is white, stiff, and quite thick.

Females. The dorsal pelage is similar to that of the males in that it is black with only sparse white grizzling throughout and only on the very tips of the hairs. Older females may be slightly more grizzled, in particular on the forearms and upper shoulders. The hands and feet are white with only very slightly brownish cuffs on the wrists, without a ‘V’ onto the backs of the hands, but with a slight ‘V’ on the feet. The undersides are barely covered in fine black hairs, with a short dark brown ruff with tannish tips. The hair on the head is in a white arch, and while slightly denser and longer than in males, it is still sparse enough to see the facial skin beneath it. The white band dips a bit above the eyes making a diamond in the forehead showing off the

bare skin in the middle. The arch tapers out below the ears where it is black and white along the sides of the face. The facial skin is black, except for the area just above the eyes where either eyelids or the skin is unpigmented or pinkish. Malar lines are thick, white, and obvious. Lips are lined in white hairs like the males, but are not as dense. Sub-adult/juvenile females are slightly transitional in that they are more grizzled dorsally, have a lighter tan/brown ruff, have a whiter facial arch that covers most of the face to the chin, obvious malar lines as in adults, but pinker or less pigmented facial skin overall.

Diagnosis. These distinct sakis differ from *P. pithecia* in that the males are not silky black, they are coarsely black with very light tips of white throughout, a short, dark black ruff, and faces with such a diffuse white ring that they are easily distinguished not only from *P. pithecia*, but from all others with white facial hairs, especially *P. aequatorialis* which is very grizzled and with a bright orange ruff. They share thick lip hairs with *P. hirsuta* and *P. chrysocephala* to the north and northeast of the Rio Amazonas, but differ significantly from both of those species in that they lack the agouti faces of *P. hirsuta* males and the orange/ochre faces of *P. chrysocephala*. The females of this new species are unlike any others in the region, including *P. monachus* and *P. albicans*, where *P. monachus* females have brown-white shaggy faces and *P. albicans* have distinct orange pelage and very short white adpressed hairs covering their faces.

Measurements. See Table 16.

Distribution. Map 7. Appendix I. Not well known, more information is needed. Only in Brazil, and so far only in very northern sections south of the Rio Solimões on either side of the Rio Juruá at Fonte Boa and Uarini.

Discussion. It is never an easy decision to add a new species based on so few specimens. However, upon discovering what is evidently a living representative, I was compelled to call out these unusual animals as distinct.

Table 16. Measurements of the holotype and paratypes: skin and skulls.

Measurement	Male MPEG 37127	Female MNRJ 21055	Large juv. female MNRJ 3312
Skull (mm)			
Length of brain case	83.5	82.3	–
Width of brain case	43.6	43.2	–
Zygomatic arch width	60.9	52.6	–
Orbits – outer	45.7	43.0	–
Nose bridge	6.7	6.7	–
L-orbit inner width	18.6	15.2	–
L-orbit inner height	18.3	16.4	–
Muzzle width	26.5	23.3	–
L-mandible length	52.0	50.6	–
L-mandible height	36.3	37.8	–
Post-crania (mm)			
Head-body	600	350	480
Tail	300	430	490
Hind foot	115	–	–
Ear	34	–	–
Weight (g)	3200	2750	–



Map 7. Geographic distribution of *Pithecia cazuzai*.

Brazil

1. Fonte Boa
2. Urini
3. Mamirauá Reserve



Figure 40. *Pithecia cazuzai*, holotype subadult male MPEG 37127.



Figure 41. *Pithecia cazuzai* skull of holotype MPEG 37127.



Figure 42. *Pithecia cazuzai*. Photo of a living male (www.tatamazonstock.com).



Figure 43. *Pithecia cazuzai* adult female MNRJ 21055 full body and detail.



Figure 44. *Pithecia cazuzai*. Adult female MNRJ 21055 skull.



Figure 45. Wild (a) male and (b) female *P. cazuzai* in the Mamirauá Reserve for Sustainable Development, north of the Rio Solimões, Brazil. Photo by Felipe Ennes.

EQUATORIAL SAKI

Pithecia aequatorialis (Hershkovitz, 1987)**Synonymy**

1987 *Pithecia aequatorialis* Hershkovitz, *P. Am. J. Primatol.* 12: 429.

Holotype. FMNH No. 86992, adult male, skin and skull, collected by C. Kalinowski, 3 October 1956.

Topotype. FMNH No. 86994, adult female, skin and skull, C. Kalinowski,

9 October 1956.

Paratypes. Three males: adult FMNH No. 86991, adult FMNH No. 86993, and subadult FMNH No. 86996, skins and skulls, all collected by C. Kalinowski in October 1956.

Type locality. Peru, Loreto District, Río Nanay, Santa Luisa, 160 m; for holotypes and paratypes.

Specimens examined. Twenty skins and skulls; captive photo references from M. Bowler and R.A. Mittermeier; wild photo references from R. Aquino, F. Cornejo, and tourist photos online; and observations in the wild by L.K. Marsh (Monkey Island and Pilpintuwasi, Iquitos, Peru).

Description. Males and females are dichromatic (cf. details in Hershkovitz, 1987).

Males. Have a black pelage overall with long grizzled white tips to the hairs, and chest hair bright orange to ochraceous extending below the armpits and along the sides in a ruff. The hands and feet are white. The faces of the males are black with a dense white horseshoe band of hair around face. The band is adpressed in the holotype, but appears much thicker on living animals. There are two often distinct, white patches above each eye that connect to the white band around the face. They have white malar lines around the muzzle and white lip hairs. Juvenile and infant males have very distinctly white heads with the adult coloration apparent even when very young.

Females. Overall pelage grizzled grayish over black producing an overall grey look. They have an orange ruff that can be as distinct as males, even in juveniles, but not as extensive. Forearms have short brown hairs amongst the black and white. Hair around the face is in a loose grayish white band, shaggier and less formed than in males, with distinct white muzzle lines. The skin of the nose and muzzle is black. Hands and feet are white.



Diagnosis. *Pithecia aequatorialis* males are distinct from *P. napensis* and *P. isabela* sp. nov. in the retention of a dense, fully white arch around the face and a very bright, extensive orange ruff on the chest in addition to the grizzled general body pelage. In *P. napensis*, the white of the face is only as eyespots above the eyes and as a "headband" between the ears over the crown. In *P. isabela* sp. nov. the white is focused primarily on the eyespots alone. While both *napensis* and *isabela* have varying degrees of orange ruffs, in neither is it quite as extensive as that of *P. aequatorialis*. Females of *aequatorialis* are distinct from females of both *napensis* and *isabela* in that they are far more white in the ring about the face and much greyer overall than either of the other two species. Juvenile males of all three are quite distinct from each other, with *P. aequatorialis* being the most obvious at a young age (Figure 51).

Measurements. See Table 17.

Table 17. Measurements for *P. aequatorialis* paratypes and topotype with body measurements for holotype.

Measurement	Male FMNH 86991	Male FMNH 86993	Male FMNH 86996	Female FMNH 86994
Skull (mm)				
Length of brain case	82.9	86.0	78.1	81.2
Width of brain case	46.9	47.9	45.0	45.8
Zygomatic arch width	57.5	57.7	51.7	54.7
Orbits – outer	41.9	42.7	42.6	42.1
Nose bridge	6.5	6.8	8.0	7.6
L-orbit inner width	16.9	18.5	16.8	15.8
L-orbit inner height	18.4	18.1	15.8	18.1
Muzzle width	24.0	24.2	22.1	23.1
L-mandible length	51.7	56.8	47.2	53.2
L-mandible height	33.23	37.6	32.3	36.8
L-canine length	13.3	11.0	10.9	10.8
Post-cranial (mm)				
Head-body	888	900	844	853
Tail	474	460	450	448
Hind foot	131	124	121	122
Ear	30	32	28	31
Holotype Male* FMNH 86992				
Head-body	870			
Tail	405			
Hind foot	121			
Ear	30			

* Skull measurements not available, cf. Hershkovitz (1987), Tables V, VIII, and XI.

Distribution. Map 8. *Pithecia aequatorialis* is found only in Peru, south of the Río Napo and south (left side) of the Río Curaray to the Río Tigre in the west (right bank). The northernmost border with *P. napensis* in this region is unknown. It occurs on both sides of the Río Amazonas at Iquitos, but those on the east side (right bank) are primarily rescues, pets, or escapees at or near Monkey Island Tourist Site or Pilpintuwasi Rescue Center. Additional living photo references are needed to confirm the location in Curaca Corriente in the Reserva Nacional Allpahuayo-Mishana, as the only reference photo to date is of a pelt made into a hat.

Specific Locations. Appendix I. PERU. Loreto: Puerto Indiana; Iquitos; Maynas – Río Nanay – Santa Luisa; north of Río Tacshacurary – boca Río Machete; Río Napo – Río Tutapisco; Curaca Stream; Reservado Allpahuayo Mishana.

Discussion. All of the *P. aequatorialis* specimens referenced by Hershkovitz (1987) in Ecuador are *P. napensis*, except for AMNH No. 98468 from Bassler that Hershkovitz incorrectly assigned to the Río Coca, a northern tributary of the Río Napo in Ecuador. The original label says northern Peru and with further investigation this proved correct. Bassler's expedition was in northern Peru, January–December 1924,

and this specimen was obtained between “Guamathra and [“S. Q.”] Tutapischea”, now Tutapisco. This information was obtained from the original expedition records transcribed by Schwartzer at AMNH (unpubl. data).

Aquino *et al.* (2009) studied *P. aequatorialis* in north-eastern Peru in the Río Itaya basin (Yanayacu, Seis Unidos, Nauta, Blanquillo), Río Tigre basin (Patria Nueva, Posayo, Coconilla), and the Río Curaray basin (Quebrada Arabela, Sector Curaray). Their observations extend the range of *P. aequatorialis* in Peru further south-west to between the ríos Tigre and Corrientes, and correctly exclude the area to the north between the ríos Curaray and Napo. I do not dispute their findings; however, they did not take any photographs or samples of the animals throughout their study making it difficult to corroborate this definitively—*Pithecia isabela* sp. nov. occurs west of the Río Tigre and south of the Río Marañón, and *Pithecia napensis* extends all the way south from Ecuador to north of the Río Marañón, and likely occurs also west of the Río Tigre watershed (cf. *P. isabela* sp. nov. and *P. napensis*).

The phenotypes of *P. aequatorialis* have seemingly changed over time as well. If one examines the specimens collected

by Kalinowski in the 1950s (and there are no other specimens that quite resemble these) with animals alive today, the types are more gracile with closely pressed facial hair; whereas, the present day animals appear to be heavier bodied, bulkier like *P. napensis*, with the white facial ring not closely adpressed as in the original specimens, but dense and thick and up off of the face—much more like the facial rings on *P. napensis*, only their white coloration is diffuse and only distinct on the crown (cf. *P. napensis*). At least per this study, it appears that those animals referred to *P. napensis* cover a very large territory; this of course may prove to be an artifact of needing more data on where to draw the lines between potential subspecies or color morphs, but *P. napensis* and *P. aequatorialis* probably have a hybrid zone somewhere that likely includes the region

north of Iquitos/Puerto Indiana. Perhaps this is where we now get the bulkier, thicker white faces of *P. aequatorialis* today, or the more gracile, adpressed-faced animals of Kalinowski are distinct and will prove to be a separate population if they still exist.



Map 8. Geographic distribution of *Pithecia aequatorialis*.

- | | | |
|---|---|---|
| 1. Puerto Indiana | 5. Río Nanay | 8. Santa Luisa (exact location unknown. Lower Río Nanay near Río Marañón; Stephens & T aylor 1983). |
| 2. Mazan | 6. Reserva Nacional Allpahuayo-Mishana | |
| 3. Río Tutapisco | 7. Nauta (approx. collection site near Nauta) | |
| 4. Río Tacshacurary/Río Machete boca (approx.). | | |



Figure 46. Vintage plate XXXII, 236 × 186 mm, of *Simia pithecia* Linnaeus (*Pithecia aequatorialis*) by Jacques de Seve in Schreber (1775), and (b) *Pithecia aequatorialis* original painting by Zorica Dabich and Philip Hershkovitz, through the courtesy of Field Museum of Natural History.



Figure 47. Skin, whole body and detail, of adult male holotype *Pithecia aequatorialis*, FMNH 86992.

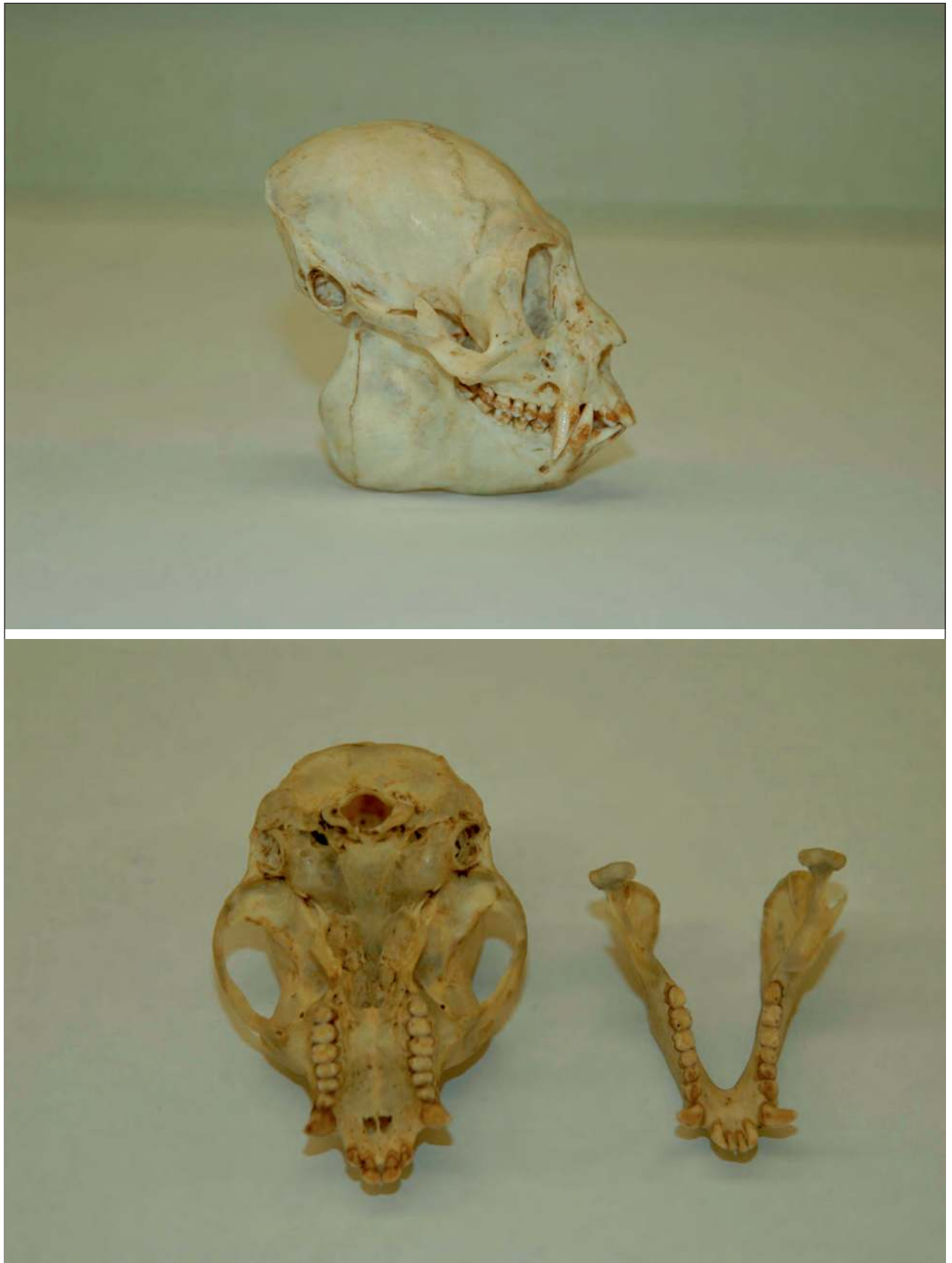


Figure 48. Skull of adult male holotype *Pithecia aequatorialis*, FMNH 86992.

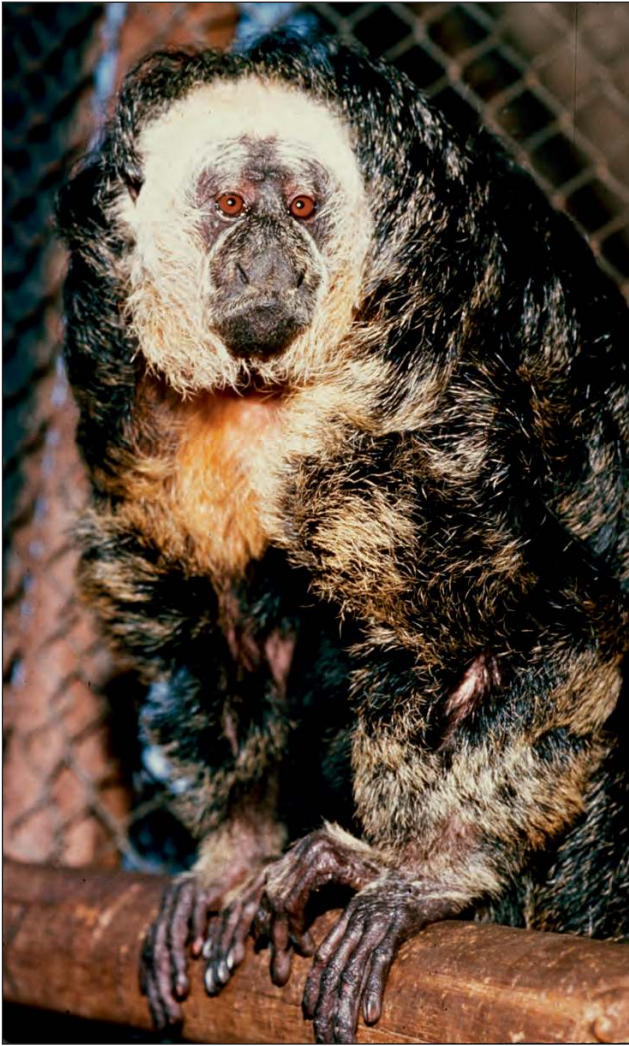


Figure 49. Captive male *P. aequatorialis*. Photo by R.A. Mittermeier.



Figure 50. Captive female *Pithecia aequatorialis*. Photo by M. Bowler.



Figure 51. Captive (a) juvenile female and (b) infant/juvenile male *Pithecia aequatorialis*. Photos by M. Bowler.

NAPO SAKI

Pithecia napensis (Lönnerberg, 1938)**Synonymy**

1938 *P. monachus napensis* Lönnerberg, E. *Arkiv f. Zoologi* 30A(18): 9.

1987 *P. monachus monachus* Hershkovitz, P. *Am. J. Primatol.* 12: 423-424. In part.

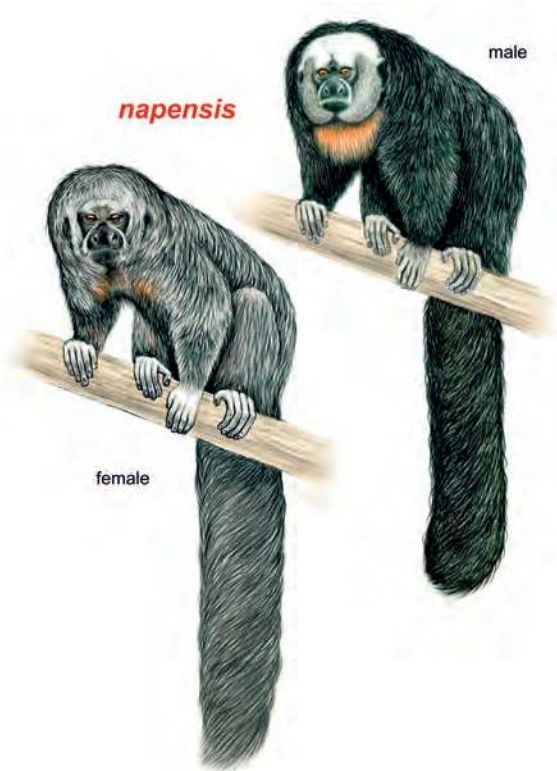
Holotype. Royal Natural History Museum, Stockholm (RNHM), No. A60-1921, subadult male, skin and skull, collected 13 January 1921 by L. Soderstrom.

Type locality. According to Lönnerberg (1938), the type was collected in “Ecuador at Napo river at an altitude of 2000 feet [810 m a.s.l.]” which concurs with Hershkovitz’s (1987) information (p. 424). However, the current label reads, “near Napo River and Curaray rivers, west below Macas, approx. 2000 ft, eastern Ecuador” which does not make sense as Macas is in the eastern foothills and the ríos Napo and Curaray are in the north-west. Male key specimen AMNH No. 36468, however, is reported from Baeza, Ecuador, at 3000 feet (914 m), which is not far from the upper reaches of the Río Napo (Allen, 1916), and perhaps is more like the original type.

Key specimens. Adult male, AMNH No. 36468, skin only, collected by W. B. Richardson 1912–1913, purchased from a native collector. Adult male, FMNH No. 41500, skin and skull, collected on 11 February 1922 by R. Olalla from Ecuador, Pastaza, Río Bobanaza, near Montalvo (250 m). BMNH No. 80.5.6.4 adult male, skin and skull, and BMNH No. 80.5.6.5 adult female, skin and skull. Other members of the same group and/or others from the same locale in Ecuador, Río Copataza, 80 miles south-east of Sarayacu: BMNH No. 80.5.6.6 small juvenile male; BMNH No. 80.5.6.7 small juvenile female; BMNH No. 80.5.6.8, large infant male; and BMNH No. 80.5.6.9 small infant male. All BMNH specimens were collected by C. Buckley between December 1877 and February 1878.

Specimens examined. Fifty-eight specimens, including skins and skulls, photographs of living animals from Ecuador and Peru, and observed in the wild in Ecuador by L. K. Marsh.

Description. Males. The most striking feature in the males is that the crown of the head is densely covered with short white hair. The facial disk of dense hair forms a partial disk of white that extends no further than the ears. The disk “fades” into white and gray-black stippling at the bottom. The males have white eyebrow patches leading into the crown that may be more or less distinct and typically blend into the solid white crown on older adults. The skin of the face is unpigmented except for the black nose and muzzle,



and appears it could be pinkish in some specimens, but is darker in living animals. Male *P. napensis* are large and “bulky” with white stippled pelage. They have an enlarged scent gland under the chin that is ringed on the upper chest to the armpits with noticeably bright orange to rusty hair. This coloration of the ruff is conspicuous even at a distance (pers. obs). Male dorsal body hair is black and grizzled with white tips. The amount and length of grizzling varies, but in general is longer on the tail than on the back or arms. Hair on the arms and legs is softer and shorter, and is grizzled on the arms, but not the legs. The hands and feet are white to off-white with hands typically whiter than the feet. The ventrum is mostly naked with sparse grayish-black hair that is light and wispy as it is in most saki species. Subadult males can appear at a distance to only have the white eyespots, but the haloing of the white headband between the ears is present.

Females. The dorsum of the females is black and stippled as in males, but appears grayish overall. The hands and feet are whitish to off-white as in males. The ruff on the females is dark brown with light tan to buffy tips. The facial hair is not short and dense forming a ring as it is in males, but is fine and covers the face, growing mostly downward. The

amount of white on and around the face varies with the age of the female, but is never as distinctly organized in a ring as it is in *P. aequatorialis* females. The facial skin is darker in general than in males, with areas of unpigmented, lighter skin. As in the males, there are distinct white malar lines from under the eyes that follow the curve of the muzzle and continue under the chin to form a half circle.

Diagnosis. Hershkovitz assigned this species to *P. hirsuta* in 1979 and *P. monachus* in 1987. Here, I elevate it to species rank. It was correctly described by Lönnberg (1938), although, because of the tenor of the times, he assigned it as a subspecies of *monachus* as *P. m. napensis*. However, it is nothing like *P. monachus* where the adult male faces are brown and not white. And while it is distinct from *P. aequatorialis*—which is not as bulky in the body, has a far more extensive orange ruff, has a clearly fully white, dense horseshoe ring around the face, and whose juvenile males and females are distinctly different than *P. napensis*—were *napensis* to be allied with another species, it would be this one. *Pithecia napensis* is most similar to *P. isabela* sp. nov., and sometimes the subadult males of *P. napensis* can look similar to adult males of *P. isabela*. But as in the differences in the juveniles of *P. aequatorialis* and *napensis*, the *isabela* juvenile males appear distinct from the others as well (cf. *P. isabela* sp. nov.). See also “Discussion” below.

Measurements. See Table 18.

Table 18. Measurements for *Pithecia napensis* holotype and key specimens.

Measurement	RNHM 1921 Male	RNHM 1921 [‡] Male	FMNH 41500 Male	MHN 1932-2817 SA Female
Skull (mm)				
Length of brain case	80.0	84	85.3	82.1
Width of brain case	44.2	45	48.4	43.5
Occipito-nasal length	–	75	–	–
Condylbasal length	–	65	–	–
Zygomatic arch width	52.0	52	58.4	57.0
Orbits – outer	42.5	43	45.3	43.4
Nose bridge	5.7	–	7.2	--
L-orbit inner width	16.0	–	16.5	16.5
L-orbit inner height	17.7	–	18.5	17.2
Muzzle width	21.6	23	25.1	23.9
Maxillary row of cheek teeth length	–	21	–	–
L-mandible length	48.9	–	43.0	54.5
L-mandible height	35.5	–	35.1	36.7
Canine length	–	–	12.5	–
Post-crania (mm)				
Head-body	–	–	870	840
Tail	–	–	440	478
Hind foot	–	–	122	128
Ear	–	–	37	38

[‡] Measurements reported by Lönnberg (1938).

Distribution. Map 9. In Ecuador, they are found south of the Río Napo from Coca in the west into Yasuní National Park to the east. The distribution along the Napo further east is not known although likely as populations have been sampled north of the Río Curaray as far south as the mouth where it meets the Río Napo. In the west, specimens have been collected in the foothills west of the Río Coca and west of the Río Napo in Baeza at 914 m and Estribaciones at 1500 m, south to the ríos Bobanaza, Copataza, Pastaza, and Macas in the Pastaza and Morona Santiago provinces.

In Peru, specimens are from the north bank of the mouth of the Río Curaray at the Río Napo. One was photographed by R. Aquino near the Ecuador border on the north bank of the Río Curaray and the left bank of the Río Nashiño. If a specimen from Parinari Caño is from Peru near present day Parinari, north of the Río Marañón (SEN No. 5305, collected on the Bluntschili and Peyer Expedition 24 September 1913, locally called “hirapu”), then *P. napensis* may extend all the way south to that river. And until there is further data to clarify, animals collected north of the Río Marañón and west of the Río Tigre will be classified as *P. napensis*, while those to the south will be grouped with *P. isabela* sp. nov. However, there are samples collected along the Marañón labeled with villages just north that may actually be *P. isabela* (cf. *P. isabela* sp. nov.). Sakis collected at the mouth of Río Santiago (right bank, along with

Puerto Melendez) will be likewise listed as *P. napensis* until further data are obtained.

Specific locations. ECUADOR. *Napo*: Baeza; Río Pastaza. *Orellana*: Estribaciones; Río Napo; Río Curaray; Macas; Río Cononaco; Yarina; Pamiwa Cocha – Estirão do Ecuador south Villa Yuca; Río Shiripuno; Yasuní National Park; Napo Wildlife Center; Tiputini Biodiversity Station; Río Maccas. *Pastaza*: Sarayacu; Río Bobanaza; Montalvo; Río Copataza. *Morona Santiago*. PERU. *Loreto*: Boca Río Curaray; Puerto Melendez; Río Tigrillo; Río Maraón. *Amazonas*: Río Santiago; Río Caterpiza – Villa Huambisa.

Discussion. Heymann *et al.* (2002) report on their survey results from the Río Curaray: “We saw [...] *Pithecia monachus* only north of the Curaray [...] and *P. aequatorialis* only south of the Curaray. The two species of *Pithecia* differ in the distribution of white hair in adult males. In *Pithecia aequatorialis*, the forehead and lateral parts of the face are completely white; in *P. monachus*, white hair is restricted to irregularly formed patches on the forehead, more similar to the individual in Fig. 16 of Hershkovitz (1987), than to the holotype in his Figs. 22 and 23.” (p.195). This confusion from Hershkovitz is now corrected with this publication (also see “Introduction, Table 2”), where north of the Curaray we have *P. napensis*, and south *P. aequatorialis*; *P. monachus* is far to the east (cf. *P. monachus*).

There is a mounted specimen in the Museo Amazónico, Quito, Ecuador, that appears intermediate between *P. aequatorialis* and *P. napensis*. It was collected by Shur/Achuar Indians, reported to be from Ecuador, southern Morona Santiago Province. This male has a diffuse white facial ring and less defined eyebrow spots, and is large and bulky, more like *P. napensis*. As there are few similar specimens, it is unclear if this race is a variation of either *P. napensis* or *P. aequatorialis*, is a subspecies, true species, or simply a color variation of *P. napensis* as the males age where the white becomes more extensive (as it is here presumed). More research on animals in this region is needed.

Subadult male *P. napensis* can appear very similar to adult males of *P. isabela* sp. nov. It will be particularly important to sort out animals in the northern Río Maraón, the lower Río Tigre (left bank), and west to Río Santiago to determine where *P. napensis* and *P. isabela* sp. nov. share a border, if they do, north of the Río Maraón. Animals from the Río Santiago region, including those from the Río Caterpiza (MVZ Nos. 157794, 1557795) appear to be closer to *P. isabela* sp. nov. than *P. napensis*, in particular in the females. They may prove to be different species or subspecies, or included in either *P. isabela* sp. nov. or *P. napensis* as color variations.

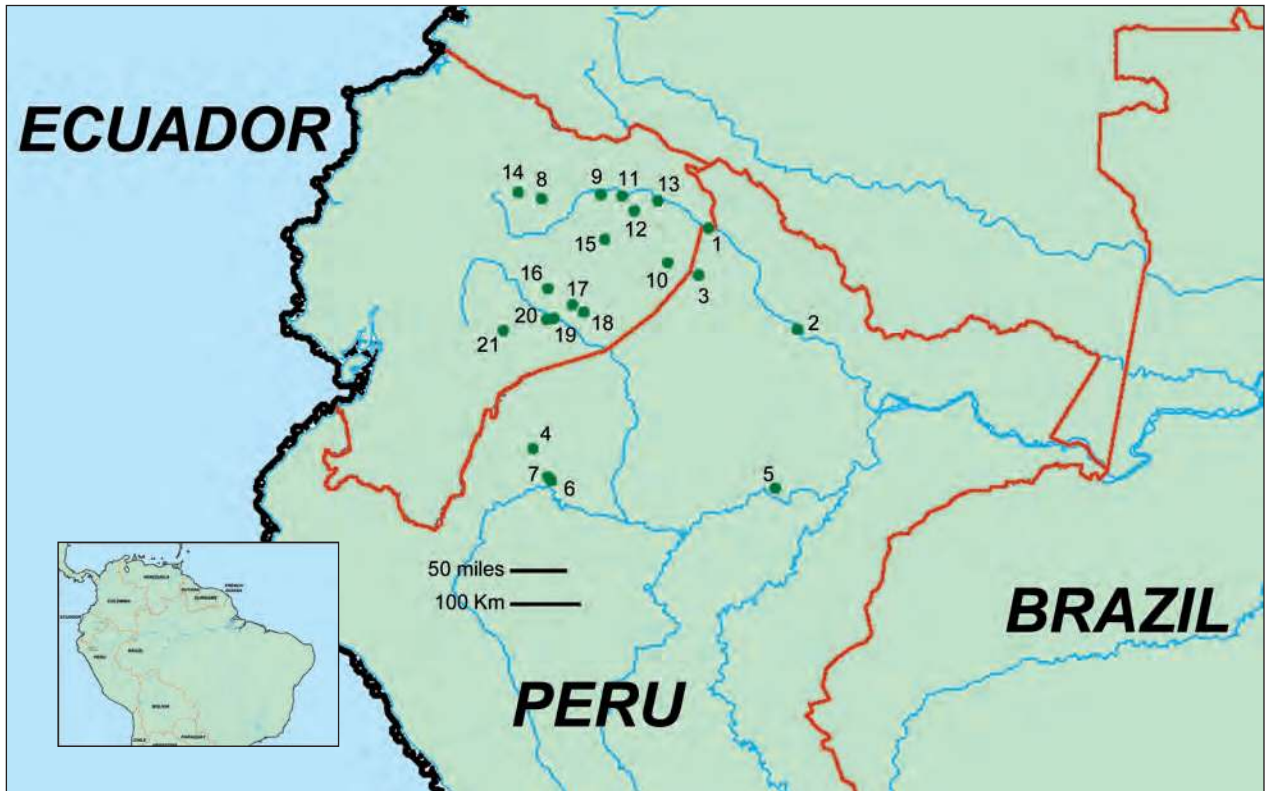
Hershkovitz (1987) included a specimen (AMNH No. 71817) collected by “Olalla y hijos, 19 January 1926, from Ecuador, Boca Lagarto Cocha” (labeled Peru, but it is right on the border so could be either) in *P. aequatorialis*, but

it is a specimen of *P. napensis*. What is curious about this specimen is exactly where the Olallas may have collected it. Credited with the same location, AMNH No. 71816, is a juvenile male *P. milleri*, (cf. *P. milleri*, “Discussion”). North of the Napo and certainly north of the Río Aguarico is *P. milleri* territory, and no other *P. napensis* specimens have been cited there (per this study). As the Olallas were coming up from the Boca Curaray collection site around that time (Wiley 2010) and had another *P. milleri* in tow (AMNH No. 71802), it is possible they collected it en route on the southern side of the Napo, or it is possible there are *P. napensis* at the confluence of the ríos Napo and Aguarico near the Peru border. More data needs to be gathered in this region.

There is a Bassler Collection specimen: AMNH No. 98472, an adult male *P. napensis* without location data on the label. However, per his collection records and the number, it is likely to be an animal he collected near the mouth of the Río Santiago (unpubl. Bassler Collection records, AMNH). But that location is another “collector’s catch-all” of species making it unclear where the specimen was actually from.



Figure 52. *Pithecia napensis* holotype skin, whole and detail, RNHM (Stockholm) No. A60-1921, subadult male.



Map 9. Geographic distribution of *Pithecia napensis*.

Peru

1. Near Nashiño (R. Aquino sighting)
2. Río Curaray, Boca Curaray
3. Between ríos Curaray and Nashiño (R. Aquino sighting)
4. Río Caterpiza
5. Parinari (unknown if correct location for "Parinari Cano," Bluntsali-Peyer Expedition 1913)
6. Puerto Melendez
7. Bazea

Ecuador

8. Estribaciones
9. Yarina Eco Lodge
10. Río Cononaco, Yasuní National Park
11. Napo Wildlife Center
12. Tiputini Biodiversity Station, Yasuní National Park
13. Yuturi Tourist Lodge
14. Río Santiago, Boca Río Santiago
15. Shiripuno Lodge

Brazil

16. Sarayaku
17. Río Bobanaza
18. Montalvo
19. Río Copataza
20. Río Pastaza
21. Macas



Figure 53. *Pithecia napensis* holotype skull, RNHM (Stockholm) No. A60-1921, subadult male.



Figure 54. Key specimens: (a) AMNH No. 36468, adult male, and (b) adult female (top) No. BMNH 80.5.6.4 and adult male (bottom) No. BMNH 80.5.6.5.



Figure 55. *Pithecia napensis* males: (a) wild in the Napo Wildlife Center, Yasuní National Park, Ecuador, photo by Carol Foil; and (b) captive in Ecuador, photo by R.A. Mittermeier.



Figure 56. (a) Subadult female *Pithecia napensis* pet at the Añangu Community village near the Napo Wildlife Center, Ecuador. Photo by Max Feingold and (b) wild large juvenile male *Pithecia napensis* at Tiputini Biodiversity Station, Ecuador. Photo by L.K. Marsh.

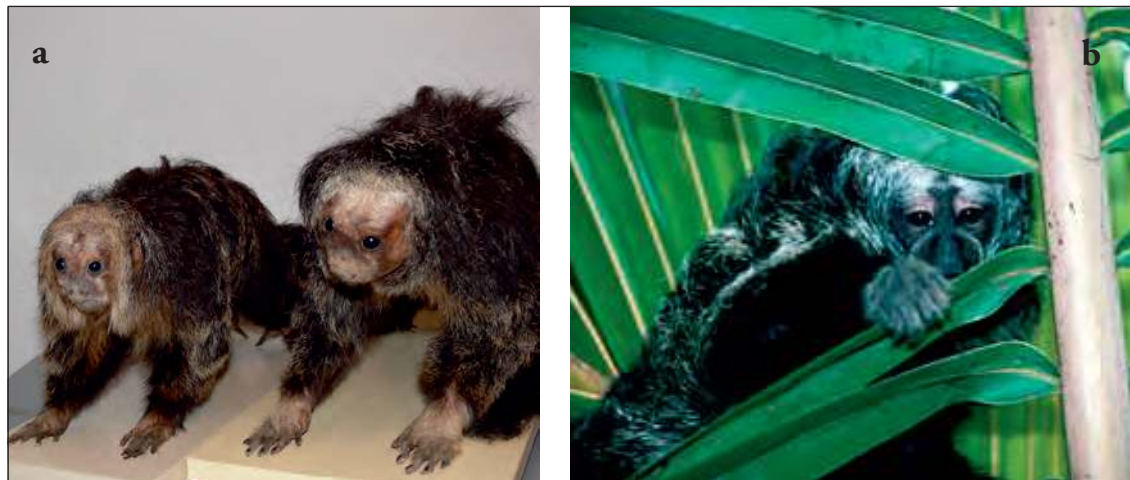


Figure 57. Juvenile male *Pithecia napensis*: (a) mounted specimens, NNNM, Leiden collected by C. Buckley, 1880, Río Copataza, Ecuador, photo by L.K. Marsh, and (b) living rescued juvenile male, photo by B. Junek.

ISABEL'S SAKI

Pithecia isabela sp. nov.**Synonymy**

1987 *P. monachus monachus* in Hershkovitz, *P. Am. J. Primatol.* 12: 422–424. In part.

Holotype. FMNH No. 87001, adult male, skin and skull, collected by C. Kalinowski on 25 November 1956.

Paratypes. Subadult male, skin and skull, FMNH No. 122796, collected by P. Hershkovitz, 24 November 1980. Adult male, skin and skull, SEN No. 5304, “Uapu”, collected by Bluntschili and Peyer, 27 August 1912. Adult female, skin only, FMNH No. 86999, collected by C. Kalinowski, 24 November 1956. Subadult female, FMNH 122797, collected by P. Hershkovitz, 30 November 1980.

Etymology. The species is named for an aristocratic colonial Peruvian (*recte* Ecuadorian) woman named Isabel Grameison Godin des Odonais (Isabel Godin). In 1768, after a 20-year separation from her husband Jean Godin, a cartographer on Charles Marie La Condamine’s historic expedition to measure the equator, she mounted an expedition to French Guiana to rejoin him. Her Indian porters, personal African slaves, young Quichua handmaidens, two brothers, a seven-year old nephew, and other travelers amounting to a total of 41 people struck out to cross the Amazon starting from the Río Bamba in the Andes. In less than a month, all of the members of her party either abandoned her or died leaving Isabel alone to struggle in the rainforest for 28 days. She was eventually found by Quichua Indians, who nursed her to health and took her downstream to Andoas, where the priests sent her through the mission system via the ríos Marañon and Amazon. She eventually reached her husband in French Guiana, where they had a happy reunion. Isabel’s story of courage and strength is an amazing piece of South American history that absolutely needed proper recognition.

Type locality. The holotype is from Peru, Loreto, along the Río Samiria at Santa Elena (130 m above sea level). The paratypes are all from the region of the Río Samiria with FMNH Nos. 122798 and 122797 in the Reserva Nacional de Pacaya-Samiria (Base Atun and Biological Station “Pithecia”) and FMNH No. 86999 from Santa Elena.

Specimens examined. Ten skins and skulls, photos of live sakis from M. Bowler, and photos by tourists along the Río Samiria and in the Reserva Nacional de Pacaya-Samiria.

Description of male holotype. Overall the pelage is black with very light, short white stippling. The “hood” that forms in all sakis with the whirl of hair at the base of the



neck is black with little or no stippling. The hands and feet are white with a distinct black “V” extending from the wrists and ankles down the backs of the hands/feet. The forearms have scant to light stippling, but more than on the hind limbs, which are nearly without stippling. The tail is lightly stippled in the manner of the dorsum. The facial disk is dense and dark agouti black to dark brown, with scant white throughout. The eyespots are long, more like stripes, and diffuse with a distinct line between them extending to the dark facial disk. There are white malar lines with some white hairs covering the nose. The skin of the face is black. The ruff is short, orange-ochre, and directly under the throat gland, which is not as distinctly colored as it is in other saki species.

General characteristics. Males. The pelts of some specimens appear coppery almost shiny. The dorsal hairs are black with light, diffuse, short stippling on the back and forearms, very little on the hind legs. The ventrum is sparsely covered with black hairs, the short ruff is on the upper chest right under the throat scent gland and is a dark rusty orange, often very dark, and not appearing more than brown. The hands and feet are white to off-white. White malar lines trace either side of the muzzle. The skin of the face is black, in both, dried specimens and living animals.

The facial ring is dark black in adult males and agouti brown in young males, with some light white sprinkled throughout in older animals, but the grizzling varies in intensity or is absent and is mostly sparsely restricted to the forehead if it occurs at all. The facial disk as a whole is dark at the base with light grizzling of whitish or grayish throughout, but lacks a distinct band of white as is seen in *P. napensis* or *P. aequatorialis* (cf. “Diagnosis”). The facial hair is short, dense, and straight, and is clearly separate from the hair on the head, with white eyebrow spots over each eye that vary from simple “dots” directly above the eyes (as seen in wild animals at present) to longer stripes up to the darker facial band (as in the holotype), to very diffuse, nearly patternless whitish patches above the eyes.

Females. Overall pelage is similar to males in that it is black, coppery almost in some specimens, with short, light grizzling throughout. There is slightly more grizzling in females than males, but distinctly less than in neighboring *P. napensis* or *P. aequatorialis*. The ruff is black with dark brown tips, also right under the throat, but females have a less distinct scent gland. The muzzle lines are thick and distinct and the facial skin is black. The facial disk is black and silky in young females, tighter and black-agouti brown in older females. Adults can have white possible in the facial disk, and with tiny white eyebrows and a small white star just above the eyes. The face is less white than in *P. aequatorialis* and *P. napensis* females.

Diagnosis. *Pithecia isabela* is most similar to *P. napensis*, with which it shares white patches above the eyes, but

differs consistently in the amount of white on the forehead—where *napensis* is clearly dense and white on the crown and grizzled white throughout the facial disk, *P. isabela* is vastly more diffuse, with spots smaller and closer to the eyes, and little to no white grizzling around the rest of the face. *Pithecia napensis* is bulkier, larger, and has a brighter and more extensive orange ruff, whereas *P. isabela* has a shorter, darker brown-orange ruff that is occasionally a brighter shade. The males in particular are far less grizzled overall in *P. isabela*, and, in some cases, the grizzling appears nearly absent. *Pithecia isabela* obviously differs from *P. aequatorialis* to the north of the Río Marañón in that males have dense, fully white half-circles around their faces with extensive orange ruffs on their chests. Juvenile and subadult males are distinctly different from either *P. napensis* or *P. aequatorialis* of the same age. In *P. isabela*, the faces are plain except for the small white eyespots above the eyes and some diffuse white haloing along the crown. There is no obvious ruff color in the young animals and the grizzling across the back is nearly absent.

Measurements. See Table 19.

Distribution. Map 19. The species occurs only in Peru. The paratypes and most other specimens are from the Pacaya-Samiria region. The paratype was collected along the Río Samiria at Santa Elena. Additional specimens were collected similarly along the Río Samiria at the Base Atun and Estación Biológica “Pithecia.” Mark Bowler reported the species along the Río Yanayacu. Tourist photos show them

Table 19. Measurements for *P. Isabela*, including holotype and paratypes.

Measurement	FMNH 87001 Male	FMNH 122796 Male	SEN 5304 Male	FMNH 86997 SAM	FMNH 86998 SAM	FMNH 86999 Female	FMNH 87000 SAM
Skull (mm)							
Length of brain case	79.7	79.0	83.7	84.1	79.2	80.3	78.8
Width of brain case	44.1	45.1	43.1	47.6	46.1	44.0	42.8
Zygomatic arch width	57.1	57.9	54.3	59.1	38.6	54.6	50.0
Orbits – outer	37.8	42.4	45.5	42.1	49.8	42.7	38.3
Nose bridge	6.5	7.3	0.72	7.5	5.9	6.8	5.9
L-orbit inner width	16.9	17.1	16.4	18.1	17.8	16.7	17.7
L-orbit inner height	17.8	17.4	17.3	19.4	17.8	17.6	16.9
Muzzle width	23.4	24.5	23.8	24.4	21.4	24.4	21.5
L-mandible length	50.9	49.9	52.0	53.3	44.9	50.8	49.8
L-mandible height	37.1	34.2	37.5	34.4	31.2	34.8	33.4
L-Canine Length	12.4	11.6	–	9.9	10.6	11.3	9.4
Post crania (mm)							
Total body	920	765	–	862	796	853	867
Tail	486	400	–	450	433	445	448
Hind foot	131	121	–	122	122	124	124
Ear	30	33	–	31	30	30	30

at Quebrada Sapote near the Ucayali, and collections by R. Olalla suggest they are near Sarayacu on the west side.

Specific distribution. Appendix I. PERU. Loreto: Río Samiria – Santa Elena, Biological Station “Pithecia”, Base Atun; Pacaya-Samiria National Park; Río Yanayacu; Río Ucayali – Sarayacu.

Discussion. This species was originally recognized as distinct and suggested as a new species in 2002 at the Tiputini Biodiversity Station, Ecuador (Marsh, 2004), prior to research for taxonomic revision. In the course of time, the discovery of this new species led to a revision of the genus, and later to placing those in Ecuador with *P. napensis* upon review of the type specimen in Stockholm.

The Pacaya-Samira National Reserve has become a popular destination for tourists, particularly on riverboats out of Iquitos (for example, Dawn of the Amazon: <http://www.dawnontheamazon.com> or La Amatista, a boat run by International Expeditions: <http://www.ietravel.com/central-south-america/amazon-river-cruises>). As a result, numerous lodges have sprouted up, some with sakis as free-ranging pets. There is some photographic evidence per tourist photos in the region, particularly in the upper reaches of the Pacaya-Samiria near the south side of Nauta, that *P. aequatorialis* and perhaps *P. napensis* have been brought from the north side of the Río Marañón. It is unclear if these animals ever leave the facilities they were captured for, but if they do, there may be some interesting ramifications for the *P. isabela* in the area as time goes on.

In some photos by M. Bowler, females seem to be more similar to *P. napensis*, where overall pelage appears greyish with more stippling than males. Forearms and chest appear tan, mixed in with the greyish-black, and the hands and feet are white. Faces appear more gray, or at least, with more white mixed into the hair surrounding the face. It is possible it is the lighting or the way in which they were photographed that makes them look closer to *P. napensis* females as compared to the specimens. Bowler’s photos were along the Río Yanayacu, very near to the Río Marañón. It will be important to study animals throughout the Pacaya-Samiria to determine whether or not *P. napensis* has in fact established on both sides of the Río Marañón, and where the border with *P. isabela* lies.



Figure 58. *Pithecia isabela*. Holotype adult male, skin, FMNH 8700 I.



Map 10. Geographic distribution of *Pithecia isabela*.

Peru

- | | | |
|-----------------------------|---|-------------------------|
| 1. Río Samiria, Santa Elena | 4. Río Samiria, Biological Station "Pithecia" | 7. Quebrada Sapote |
| 2. Yanayacu | 5. Río Samiria, Base Atun | 8. Sarayacu – left bank |
| 3. Nauta -- right bank | 6. Reserva Nacional Pacaya - Samiria | |



Figure 59. *Pithecia isabela*. Holotype adult male, skull, FMNH 87001.



Figure 60. *Pithecia isabela*. Adult female, skin, FMNH No. 86999.



Figure 61. Wild adult male *Pithecia isabela* in the Reserva Nacional Pacaya-Samiria: (a) photo by J. Vermeer, (b) photo by Wilderness Classroom.com.



Figure 62. Juvenile male *Pithecia isabela*, Reserva Nacional Pacaya-Samiria, Peru. Photo by Rick Thomas.



Figure 63. Adult female *Pithecia isabela*: (a) Río Yanayacu, photo by M. Bowler, and (b) Reserva Nacional Pacaya-Samiria, photo compilation by TrekNature.

BUFFY SAKI

Pithecia albicans (Gray, 1860)**Synonymy**

- 1860 *Pithecia albicans* Gray, J. E. *Proc. Zool. Soc. Lond.*, p.231, pl.81.
 1863 *Pithecia albicans* Bates, H. W. *The Naturalist on the River Amazons*, vol. 1, Figs. p. 306, 314.
 1987 *Pithecia albicans* Hershkovitz, P. *Am. J. Primatol.* 12: 431, for further synonymy.

Holotype. British Museum of Natural History, No. 60.4.16.3, adult male, collected by H. W. Bates, 1862.

Paratypes. Hershkovitz (1987) reports “syntypes” of skins and skulls at BMNH of a male, a female, and “young”, but it is unclear which numbers are assigned as none are designated as such currently. Specimens available: Nos. 27.8.11.17 (M), 34.6.16.10 (F), 26.5.5.6 (F), 26.5.5.5 (F), 26.5.5.3 (M), 26.5.5.4 (F), 26.5.5.2 (M), 27.8.11.18 (M), 26.5.5.1 (M), collected by W. Erhardt between 1925 and 1927. All are undisputed representatives of the species, and can be accepted as types per this taxonomy. Additional specimens from Erhardt’s expedition are in the Museum für Naturkunde, Berlin (Nos. 35768, 35769, 35770, 35308, 35767, 46146).

Type localities. Holotype: Rio Tefé, Tefé Lake, south bank of the Rio Solimões, Amazonas, Brazil. Syntypes: Amazonas, Rio Solimões, Rio Purus, Ayapuá.

Specimens examined. Forty-two museum specimens, skins and skulls; wild photo references from A.D. Johns, and photos of captive sakis by R.A. Mittermeier; and observation of a captive specimen by L.K. Marsh (São Paulo Zoo, São Paulo).

Description. These sakis are the most distinct in the genus due to the obvious coloration and larger size. Males and females are very similar, with predominantly orange to blonde pelage, which in adults is lighter dorsally and darker ventrally on the heads, arms, legs. Ventral chest/belly hairs are sparse. The back is black extending from the nape of the neck to the tip of the tail. The tail is entirely black. The wrists often have black short hairs, the hands are off-white, and the feet off-white. Adult males and females have large throat scent-gland patches ringed in a light orange ruff that is more pronounced in males.

Males. The facial skin is mostly black, with small “bare” pinkish skin patches above the eyes, distinct white to cream eyebrows, and stiff white to cream upper lip hairs. The muzzle has dispersed whitish hairs, not in a distinct line. Ventrally, adult males have testicles that are light cream to buffy, often with black speckles, and on their kneecaps,



what appear to be calluses (obvious on intact specimens both living and stuffed, Fig. 70).

Females. The facial skin is black, also with white to cream eyebrows but with white malar stripes that often extend out in short white to cream hairs to the cheeks. Older females have more white covering the face than juveniles or sub-adults, and may include a short ring of white to off-white hairs around the outside of the face, making the face in some cases appear to be nearly entirely covered in white hairs.

Diagnosis. *Pithecia albicans* is the “most derived” (*sensu* Hershkovitz [1987], p.431) of all saki species in that they are the most distinct in pelage. They share some of the buffy characteristics of *P. vanzolinii*, but as Hershkovitz (1987) notes, “the differences in coloration [...] are wide, and the gap between the incompletely known geographic ranges of the two taxa are also wide” (p. 431).

Measurements. See Tables 20 and 21.

Distribution. Map 11. *Pithecia albicans* occurs only in Brazil. Hershkovitz (1987) places it between the lower Rio Purus and Rio Tefé, south bank tributaries of the upper Rio Solimões-Amazonas, Amazonas, Brazil. Per the specimen localities studied for this revision, this distribution is accepted specifically noting collections near Lago Tefé, Lago Ayapuá, Lago de Boia, and Jaburú on the left bank of the Rio Purus. Johns (1985, 1986) observed *P. albicans* in terra firma forest on both sides of the Rio Tefé, and principally at the Ponta da Castanha (3°32'S, 64°58'W) on the eastern side of the lake. They also occur along the Rio Bauana, a

tributary entering the lake on its eastern shore (A.B. Rylands, pers. comm. in Johns 1986). Peres (1997) observed *P. albicans* west of the Rio Tefé, at a locality called Vai Quem Quer, in terra firma on the right bank of the lower Rio Juruá, 3°19'S, 66°01'W.

Specific locations. Appendix I. BRAZIL. Amazonas: Rio Purus – Lago Ayapuá, Ayapuá town, Jaburú; Rio Tefé; Tefé town; Lago de Boia; Lago Tefé – Ponta da Castanha.

Table 20. General measurements for syntypes (BMNH, London) and other specimens of *Pithecia albicans* from NHRM, Stockholm. All measurements in mm.

Specimen	Location	Age/sex	Total	Tail	Hind
BMNH 27.8.11.17	Lago Ayapuá	M	920	430	–
BMNH 34.6.16.10	Lago Ayapuá	F	880	–	–
BMNH 26.5.5.6	Lago Ayapuá	F	980	460	–
BMNH 26.5.5.5	Lago Ayapuá	F	1050	530	–
BMNH 26.5.5.3	Lago Ayapuá	M	1030	460	–
BMNH 26.5.5.4	Lago Ayapuá	F	1030	490	–
BMNH 26.5.5.2	Lago Ayapuá	M	930	420	–
BMNH 27.8.11.18	Lago Ayapuá	M	860	400	–
BMNH 26.5.5.1	Lago Ayapuá	M	1070	510	–
NHRM A62-0158	Lago Ayapuá	F	460	420	103
NHRM A62-0178	Lago Ayapuá	M	510	500	132
NHRM A62-0293	Lago Ayapuá	F	990	490	–
NHRM A63-0169	Lago Ayapuá	M	890	–	–
NHRM A62-1202	Jaburú	Juvenile F	795	405	120
NHRM A63-1205	Jaburú	Subadult M	820	416	120
NHRM A62-1207	Jaburú	Subadult F	810	440	115
NHRM A62-1213	Jaburú	Subadult F	820	415	120
NHRM A62-1215	Jaburú	Juvenile F	805	440	100
NHRM A62-1236	Jaburú	M	850	455	125
NHRM A62-1240	Jaburú	Juvenile F	820	455	125
NHRM A63-1212	Jaburú	F	800	415	110

* All locations are: Brazil, Amazonas, west of the Rio Purus, south of the Rio Solimões.

Table 21. Skull measurements of example specimens of *Pithecia albicans* from NHRM, Stockholm.

Skull Measurements (mm)	Male NHRM A62-0178	Male NHRM A62-1236	Subadult female NHRM A62-1240
Total length	84.3	81.1	80.9
Breadth of braincase	43.9	42.6	42.8
Zygomatic breadth	56.6	53.9	53.7
Orbital breadth	45.0	43.9	43.0
Nasal breadth mid-orbit	0.71	0.58	0.75
L-orbit inner width	17.0	17.4	18.2
L-orbit inner height	16.4	17.7	18.4
Breadth of rostrum at canines	24.8	24.3	23.4
L-mandible length	53.0	51.7	48.3
L-mandible height	44.1	38.0	36.6

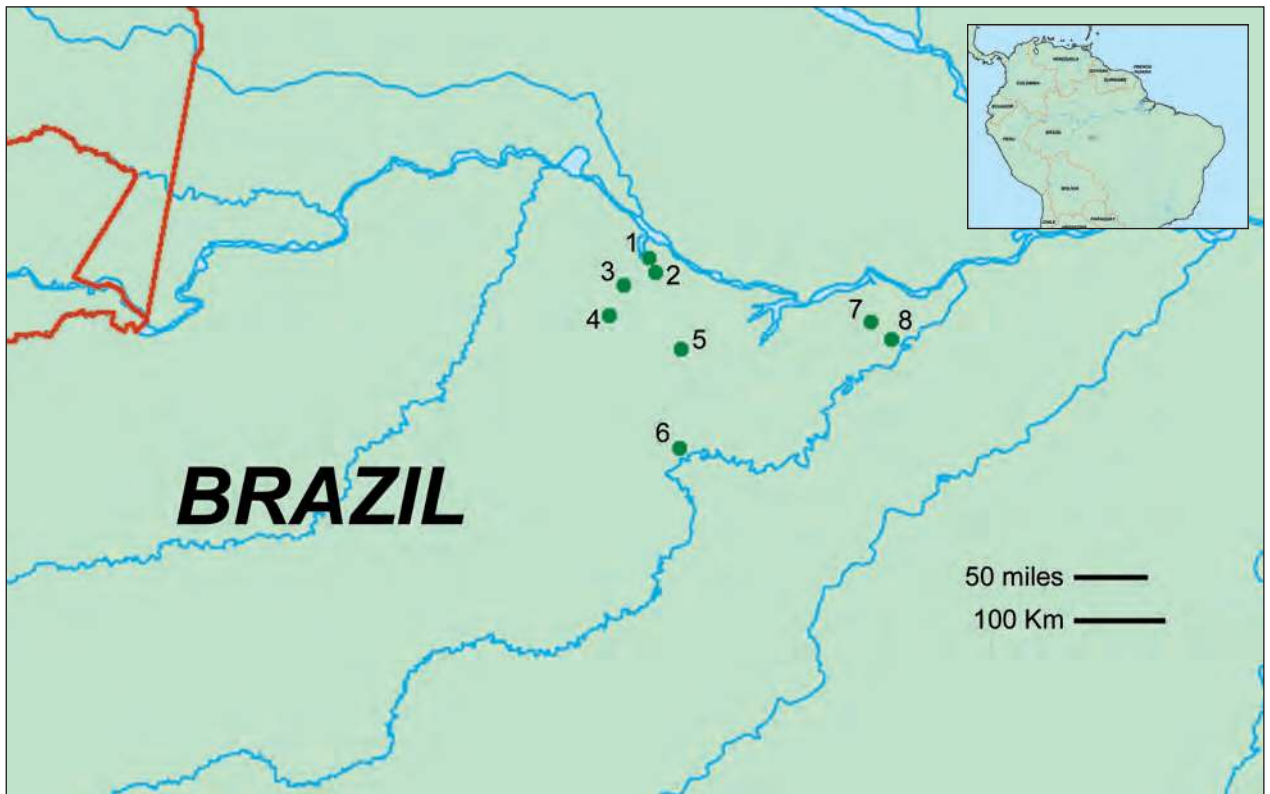
Discussion. Hershkovitz (1987) and others use the term “buffy” to mean white, off-white, cream, and tan. The definition used here and throughout this text for buffy is based on the original tanned hide definition of “yellow brown” or blonde. Thus, the buffy saki is one which is principally blonde in color, a yellowish brown, not white nor cream *per se*.

It will be interesting to study the relationship with *P. irrorata* in the northern reaches of its range in Brazil (west of the Rio Purus and west of the Rio Juruá), *P. albicans* throughout its range, and *Cacajao calvus calvus* as a possible evolutionary explanation for why *P. albicans* is so derived. Strictly from an armchair observation, it seems as though *C. c. calvus* at some point in time may have bred with the *Pithecia* in the area. Likewise for *P. vanzolinii* further south, it will be interesting to study whether the “in between” resemblance of *P. irrorata* and *P. albicans* has anything to do with a long ago cross-breeding event or if this extremely different color variation was just a fluke of genetics.

In 2008, *Pithecia albicans* was classified as Vulnerable (VU) on the *IUCN Red List of Threatened Species* (Viega *et al.*, 2008). In 1993, Peres reported the population of *P. albicans* in the upper Rio Urucú to be 8.8 individuals/km². In 2005, Haugaasen and Peres reported an average of 2.2 individuals/km² in the lower Purus watershed at Lago Uauaçú with slightly higher results for terra firma (3.3 individuals/km²) and igapó (4.6 individuals/km²), but lower for várzea (0.8 individuals/km²). By all accounts, the population is low if not drastically declining. Research is needed for all areas where *P. albicans* occurs.



Figure 64. Original plate LXXXI of *Pithecia albicans* from Gray (1860).



Map 11. Geographic distribution of *Pithecia albicans*.

- | | | |
|--------------------------------|---------------------------|--|
| 1. Lago Tefé | 4. Lago de Boia (approx.) | 7. Lago Uauacú (approx. location of Coari) |
| 2. Ponta da Castanha (approx.) | 5. Rio Uruçú | 8. Lago Ayapuá |
| 3. Rio Tefé | 6. Jaburú (approx.) | |



Figure 65. *Pithecia albicans*. Holotype skin, adult male, BMNH 60.4.16.3. Photos by L.K. Marsh.



Figure 66. *Pithecia albicans*. Holotype BMNH 60.4.16.3 skull. Photos by L.K. Marsh.



Figure 67. *Pithecia albicans*. Adult female syntype BMNH 26.5.5.4. Photos by L.K. Marsh.



Figure 68. Captive adult male *Pithecia albicans*. Photo by R.A. Mittermeier.

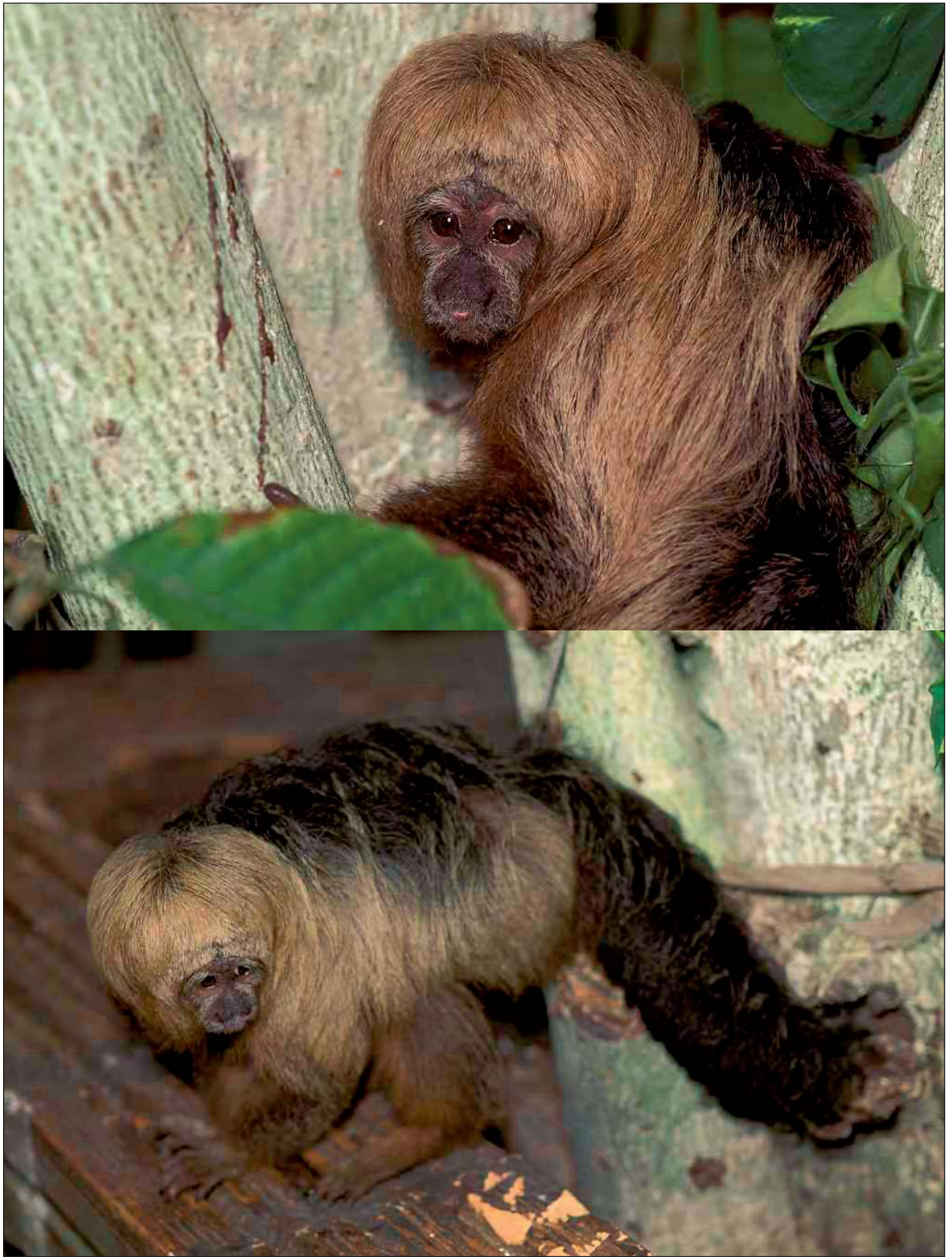


Figure 69. *Pithecia albicans* juvenile female pet in the town of Tefé, Amazonas State, Brazil. Photo by L.C. Marigo.



Figure 70. *Pithecia albicans*, adult male underside, showing “calloused knee caps,” BMNH No. 26.5.5.1. Photo by L.K. Marsh.

GRAY'S BALD FACED SAKI

Pithecia irrorata (Gray, 1842)**Synonymy**

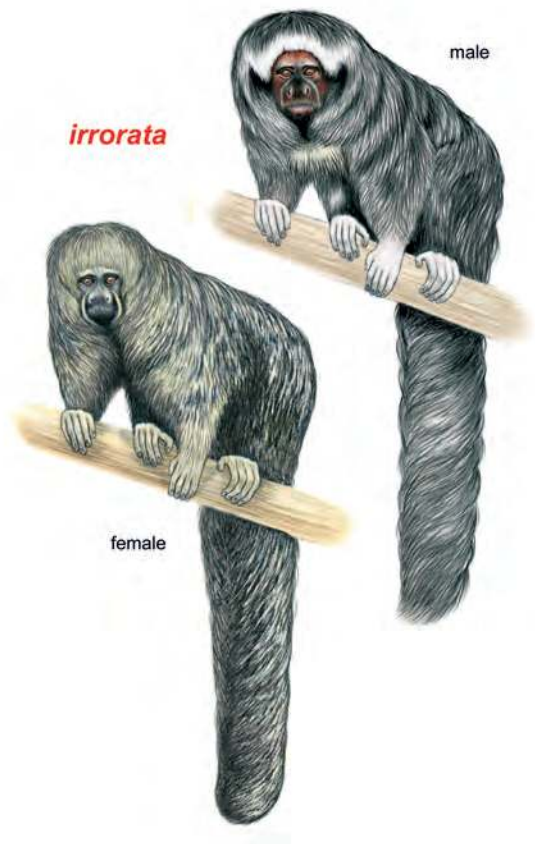
- 1842 *Pithecia irrorata*. Gray, J. E. *Ann. Mag. Nat. Hist., 1st series*, 10: 256.
- 1844 Gray, J. E. "The Yarke." *List of the Specimens of Mammalia in the Collection of the British Museum*, p.14, pl. 3.
- 1976 *Pithecia irrorata*. Napier, P. H., *Catalogue of Primates in the British Museum (Natural History), Part 1: Families Callitrichidae and Cebidae*. British Museum (Natural History), London. Holotype No. 101a; p.69.
- 1987 *Pithecia irrorata*. Hershkovitz, P. *Am. J. Primatol.* 12: 425–426, for further synonymy.
- 2013 *Pithecia hirsuta*. Van Roosmalen, M. G. M. and Van Roosmalen, T, 2013. *On the Origin of Allopatric Primate Species and the Principle of Metachromic Bleaching*. E-book, printed privately, p.63.

Holotype. Hershkovitz (1987) used Gray's (1843) description from vol. 1, color plate 3. No precise specimen was identified, but according to Napier (1976), the type is BMNH No. 101a: adult male, skin and skull.

Type locality. "Tropical America" also said to be "Brazil" (Gray, 1843, p.13), but based on evidence from the actual voyage accounts, it is most likely that the type was procured in Peru (see "Discussion" below).

Key specimens. FMNH No. 98040, adult male, skin and skull, collected by C. Kalinowski, 23 August 1961 and FMNH No. 93534 adult male, skin and skull, collected by C. Kalinowski, 20 October 1960; both from Peru, Madre de Dios, Río Manu, Altamira, 350–400 m. NNMN No. 409 mount, Catalog Nos. 2 & 6, without collector information and date (on specimen) from "Perou Septentr" (implying northern Peru, but without more details on the collector it is difficult to estimate location, even though truly north in Peru is unlikely). MZSP No. 19683 adult male skin collected by J. Hidasi, 24 May 1968, from Brazil, Rio Branco, Acre, the latter at "Fazenda Campo Lindo." MNRJ No. 3317, adult female, skin and skull, collected by C. Lako, June 1931 from Brazil, Lago do Mapiocu, west of the Rio Purus, assigned by gazetteer as Rio Mapixi (Paynter and Traylor 1991). NHRM No. 1153, large juvenile female, skin and skull, collected by A. Olalla, 20 October 1935 from Brazil, Rio Purus, Arumá.

Specimens examined. Forty-seven skins and skulls, and photographs of living animals in Peru by T. Gregory and tourist photos, and in Brazil by J.C. Bicca-Marques and F. Cardoso.



Description. Transitional juveniles are not as divergent as they are in some species.

Males. Overall, the pelage is black as in most sakis, with longer bands of white grizzling throughout ("irrorata" means "sprinkled") that vary in density with the age of the animal and location. For instance, the *P. irrorata* in Brazil, particularly older males in Acre, appear to be very grizzled with white. A distinct white crown "headband" or "bangs" is present—white tips of the nape whorl—but it is not dense as in *Pithecia rylandsi* sp. nov. In subadults, this line seems to trace down the sides toward the shoulders. The forearms can be brownish to white depending on the region they are from. *Pithecia irrorata* in Peru, particularly those distant from the Brazilian border, appear to be much browner on the forearms than those north of the Río Tahuamanu. The hands and feet are white. The faces are "pink" or unpigmented with a dark muzzle outlined by noticeable, but fine, short-haired, white malar stripes. Otherwise the hair on the face is lacking or sparse overall. In Peru, animals collected in the early 1960s near the Río Manu/Río Madre

de Dios confluence (at Altamira, which no longer exists as that name) were most similar to the type in their faces, even though they were more grizzled white than the type. The sakis further west as far as the Río Urubamba seem to have darker faces as adults, but resemble the juvenile form. *Pithecia irrorata* from Acre, near Xapuri and Rio Branco, are more similar to the type in that they have pink faces with black muzzles, but are more grizzled in their pelage. In general, males can have darker facial skin as they age, but it never approaches the blackness seen in *P. rylandsi* sp. nov., nor does their pelage become as white as in *P. rylandsi* sp. nov. All *P. irrorata* males have a pronounced ruff ranging from bright orange to dull orange/light tan. Juvenile males can be browner, with grizzling throughout the dorsal pelage. Their facial skin is “pink-black,” where they appear dark, but not black, with lighter pink highlighting around the eyes that is not nearly as contrasting as it is in *P. mittermeieri* sp. nov. or *P. rylandsi* sp. nov. juveniles (of either males or females). There is some light white hair on the face above the eyes, and a light “headband” or bang-line that is so distinct in adults is just forming in juveniles.

Females. Overall, the pelage is similar to that of males, where the forearms are very brownish, but not extensively buffy as in *P. vanzolinii*. They are browner across the front of the shoulders and chest, but do not have a defined light ruff. Young females have very black facial hair around the face with some white in the center of the forehead and a small amount above the eyes. In older adults in Peru, the faces can become grayer. Females in Acre can have an

overall body grizzling that is much whiter, approaching more of a *P. rylandsi* sp. nov. look, with faces retaining the very black facial hair (see “Discussion”). The skin of the face on young *P. irrorata* can be pinkish-black, but becomes blacker with age.

Measurements. See Table 22. Additional information: Adult male collected by R. Aquino, (AQ 21.4.88) on 21 April 1988 at San Lorenzo, Peru, weighed 2.5 kg and had an upper right canine tooth length of 10.1 mm.

Diagnosis. *Pithecia irrorata* differs significantly from the other bare-faced sakis in the region: *P. vanzolinii* and *P. rylandsi* sp. nov. *Pithecia irrorata* lacks the obvious buffy forearms and hindlimbs of *P. vanzolinii* and the very black faces, extreme extent of white pelage grizzling, and size of *P. rylandsi* sp. nov. *P. irrorata* have obvious orange ruffs, something *P. rylandsi* sp. nov. lacks, but *P. vanzolinii* loosely shares this feature in that it has a buffy-orange ruff to go with its buffy forearms. And while *P. irrorata* males in the wild may appear to have dark faces, they are mostly unpigmented except for their black muzzle. *Pithecia irrorata* females differ from either aforementioned species in that up through the subadult class they have black hair surrounding their faces similar to *P. vanzolinii* females, but as they age this ring can become grizzled with white, something that does not appear to happen in *vanzolinii* females. *Pithecia rylandsi* sp. nov. adult females have nearly naked, black faces with scant black hairs along the sides of the face, and can have white distinct eyebrows and pinkish to grey eyespots.

Table 22. Measurements for male *Pithecia irrorata* paratypes FMNH 98040, FMNH 93534 and female paratypes MNRJ No. 3317 and NHRM A62-1153.

Measurement	FMNH 98040 Male	FMNH 93534* Male	MNRJ 3317‡ Female	NHRM A62-1153 Female
Skull (mm)				
Length of brain case	85.14	79.99	83.3	77.1
Width of brain case	45.97	48.51	42.5	44.3
Zygomatic arch width	56.88	61.63	54.3	51.8
Orbits-outer	45.90	44.75	45.9	39.2 (est.)
Nose bridge	6.88	7.95	8.5 (est.)	0.78
L-orbit inner width	18.51	16.00	16.7	18.4
L-orbit inner height	18.71	17.84	17.0	18.2
Muzzle width	24.38	27.97	25.7	23.2
L-mandible length	59.80	63.19	45.8	48.8
L-mandible height	39.49	41.63	31.3	32.8
Canine length	11.44	13.87	–	–
Post-crania (mm)				
Head-body	419	440	490	440
Tail	496	455	480	407
Hind foot	131	127	130	101
Ear	32	37	18	–

*Top of braincase missing.

‡Occiput and bottom missing, nose broken on right side.

^ Right orbit broken.

Distribution. Map 12. In Brazil, *P. irrorata* follows the west side of the Rio Purus, south to Acre. Specifically there are specimens from Lago Mapiocu (likely Lago Mapixi) and Arumá in the northern reaches, and Rio Branco and Xapuri in the south. While it is tempting to say they are in the entire region between the rios Juruá and Purus, there are not enough specimens to support this, especially as the southern reaches of upper Juruá are where *P. vanzolinii* is found, and the north-west pocket between these rivers is where *P. albicans* can be found around Tefé and, as of 1935, at Jaburú on the Rio Purus. It is unknown where the boundaries lie with *P. vanzolinii* in the upper Rio Juruá watershed or *P. albicans* in the lower Rio Purus. It is also unknown if *P. irrorata* is found currently further east of the upper Rio Madeira in the southern-most reaches of Rondônia (see “Discussion”).

In Peru, they are primarily in the Manu region, west of the Río Manu and south of the upper Río Madre de Dios, west of the Manu confluence. They extend to the lower Río Urubamba and are likely to occur in all areas north-east of the ríos Urubamba/alto Madre de Dios/Manu to the Brazil border where, theoretically (as there are no specimens of either in the area) they would meet with *P. vanzolinii*. More data is needed on sakis in this region. Likewise, it is unclear how far east in Peru they extend, as *P. rylandsi* sp. nov. appears to be in the Los Amigos/Madre de Dios Conservation Concessions. Of note is an adult male *P. irrorata* collected by R. Aquino in San Lorenzo, Peru, near the Bolivian border that is very similar to the type. It is unclear where exactly it was collected and on which side of the Río Tahuamanu, but it is clear that somewhere near there is a population of *P. irrorata*, even though *P. rylandsi* sp. nov. is just over the border in the Pando (cf. *P. rylandsi* sp. nov.).

Their full distribution is unknown, but Cocha Cashu in their 2008 mammal census list *P. irrorata* (and I believe the sakis in this region are mostly likely *P. irrorata*) as “rare”: http://www.duke.edu/~manu/Home/list_of_species/mammals.htm.

Specific locations. Appendix I. PERU. *Ucayali*: Río Urubamba. *Madre de Dios* – Altamira; Río Tahuamanu – San Lorenzo. BRAZIL. *Amazonas*: Rio Purus – Lago do Arumá, Lago do Mapiocu/Mapixí. *Acre*: Xapuri; Rio Branco – Fazenda Campo Lindo.

Discussion. Hershkovitz (1987) describes the history of the type specimen thus:

“The formal description of *P. irrorata* appeared in Gray’s 1843 report on the mammals collected between 1836 and 1842 during the globe-encircling voyage of H.M.S. Sulphur. Precisely where, when, how or by whom the bare-faced saki was acquired is unknown. In any event, Gray’s 1842 reference to *P. irrorata* was evidently in anticipation of his 1843 report [Gray, 1843b].” (p.409). In the species account he reported that the holotype was “acquired,

probably in early 1836, on the voyage of H.M.S. Sulphur.” and restricted it “to west (left) bank Rio Tapajós, Parque Nacional da Amazônia, Pará, Brazil.” (p.426).

However, animals in this area do not resemble the type as closely as the sakis further south. Hershkovitz found no reference to the holotype during the accounts of the voyage of H.M.S. Sulphur, neither did C. P. Groves nor A.B. Rylands (pers. comm.). Hershkovitz reported that the Sulphur stopped in Rio de Janeiro, but I could not find any explorations by Belcher or the Sulphur into South America other than Colonial Peru where it is likely the saki specimen is from. However, I do agree with Hershkovitz that likely the holotype of *P. irrorata* was purchased live in a market by one of the crew and was brought on board as a pet, if it ever really was on board the ship at all. It is equally probable that “Brazils” was synonymous to “South America” at the time, and does not necessarily put the type in the actual country of Brazil (C.P. Groves, pers. comm.).

In Hershkovitz’s 1987 paper, *Pithecia irrorata* was not clearly defined (except by implication in his dichotomous key, p. 416), and he went straight to the level of subspecies denotation since he added *P. i. vanzolinii* to the species, as he did in cases where he recognized polytypic species. Much like *P. monachus*, any bald-faced saki was placed under *irrorata* in a “catch all” manner. It is interesting to speculate at this point on the features in the *irrorata* of Peru, particularly those that have browner forearms and darker faces in the males and the black hairs around the face of females, as these features are reminiscent of *P. vanzolinii*. It is possible that the animals in this region are color morphs, subspecies, or different species as they deviate from type.

There is much work to be done on *P. irrorata* throughout its range. The animals in the state of Acre appear to have more grizzling in their overall pelage than those in Peru, especially one female: MPEG No. 8926, skin only, collected by Flavio Pimenta, 29 January 1971. It is unknown if *P. irrorata* gets whiter with age as does *P. rylandsi* sp. nov., but it does seem clear it never approaches the extreme pelage change that is shown by *P. rylandsi* sp. nov.

Comissão Rondon sakis. Adding to the mystery of *irrorata* in Brazil, particularly in Rondônia and Mato Grosso, are collections from the Comissão Rondon (1909–1914), collected largely throughout the Rio Aripuanã/Rio Roosevelt–Rio Jamari region that are poorly preserved, but are worthy of further scrutiny. For now they are provisionally added into *P. irrorata* (for general appearance and skull features). It is entirely possible that these animals are a legacy population from 100 years ago that are no longer there—except perhaps as contributing to a new species in the UHE Samuel region as possible hybrids (cf. Rio Jamari sakis, Appendix II), or are poorly preserved *P. mittermeieri* sp. nov. as their location suggests (cf. *P. mittermeieri* sp. nov.).

Furthermore, it is interesting to note that there are some legacy specimens collected as part of the Comissão Rondon (in 1912) that are at present rolled into *P. irrorata*. These are a juvenile female, skin and skull (MNRJ 3322) and adult male, skin and skull (MNRJ 3339) both from São Manuel/Rio Teles Pires. Although not immediately easy to determine based on their skulls, as both are broken, by their skins they could easily be similar to the more recently collected animals along the Jacaréacanga highway. It is entirely possible that all of these specimens belong in *P. mittermeieri* sp. nov. based on location, and are artifacts of the preservation process. Certainly, more research needs to be done both on the legacy material and the present day populations in the region.

Sakis from Jacaréacanga. Sakis collected in the early 1970s immediately after the construction of the BR 230 Trans-Amazonica highway between Itaituba and Jacaréacanga on the Río Tapajós have some interesting variations—which could be due to them being a different species, color morphs, or subspecies, or they may be merely remnant populations of *P. irrorata*. Specimens at the Smithsonian collected by F.D. Pinheiro on 17 July 1972 at km 19 appear to be most similar to *P. mittermeieri* sp. nov. based on a hairy-faced female in the group (SMITH Nos. 461705, 461706), but animals collected on 19 July 1972 presumably from the same location or nearby (km 19), likely by Pinheiro as well, are quite different. MPEG No. 8150 is a large female with an incomplete skull, but it appears to be adult. She looks similar to *P. irrorata* females or subadult *P. mittermeieri* sp. nov. with very black fur around the face, white bangs, and not very much grizzling throughout the pelage. MPEG No.

21536 is an adult male, which in pelage looks intermediate between *P. mittermeieri* sp. nov. and *P. irrorata*, where there is a moderate amount of white grizzling, the forearms are slightly more densely covered, there is a prominent orange ruff—and it has a completely pink face! On km 212, collections on 29 November 1973, by an unknown collector are nearly identical to the km-19 animals—MPEG 8149 another adult male—this one showing some fine hairs on the face in a pattern somewhat similar to *P. mittermeieri* sp. nov. and another adult female, MPEG 21537 nearly identical to MPEG 8150. There are two small juvenile females also from km 212 in the Smithsonian Collection, likely collected by whomever collected the others in 1973 (or perhaps 1972)—SMITH Nos. 461918, 461919—both juvenile females, both appear to have furry faces, but could be either young of these “other” sakis or of *P. mittermeieri* sp. nov.

East of the Rio Tapajós. While it is entirely possible that sakis east of the Rio Tapajós are not related at all to *P. irrorata* or *P. mittermeieri* sp. nov., one of the two specimens is similar to the Tapajós females: MZSP No. 3632, subadult female, skin and skull, from Fazenda Marau, Santarém (according to E. Garbe in 1920 this was about four hours away from Santarém, in the foothills). And the other: MPEG No. 8152, a juvenile female, skin only, resembles a juvenile form of the pink-faced *irrorata*-like indeterminate sakis from the Jacaréacanga region.

A great deal more research is needed to determine not only where the legacy animals properly align, but if there are any remaining “true” *irrorata* left in the southern regions of Brazilian Amazon.



Figure 71. *Pithecia irrorata*. J. E. Gray's presumed type, from *The Zoology of the Voyage of the HMS Sulphur During the Years 1836–42, Mammalia*, Plate III, by R.B. Hinds (1843), and as referenced by Hershkovitz (1987) as the nominal holotype.



Map 12. Geographic distribution of *Pithecia irrorata*.

- | | | |
|---|---|---|
| Peru | 5. Altamira, Rlo Manu (location by gazetteer, Stevens & Traylor 1983) | Brazil |
| 1. Rio Urubamba | 6. Rio Manu | 8. Xapuri - Acre |
| 2. lower Rio Urubamba (T. Gregory Field Site) | 7. San Lorenzo | 9. Rio Branco - Acre |
| 3. Parque Nacional Manu | | 10. Rio Purus, Lago Mapixi |
| 4. Cocha Cashu | | 11. Reserva de Desenvolvimento Sustentável Piagaçu-Purus |
| | | 12. Rio Purus – Aruma (location by gazetteer, Paynter & Traylor 1991) |



Figure 72. *Pithecia irrorata*. BMNH London type No. 101a, skin.



Figure 73. *Pithecia irrorata*. BMNH London type No. 101a, skull.

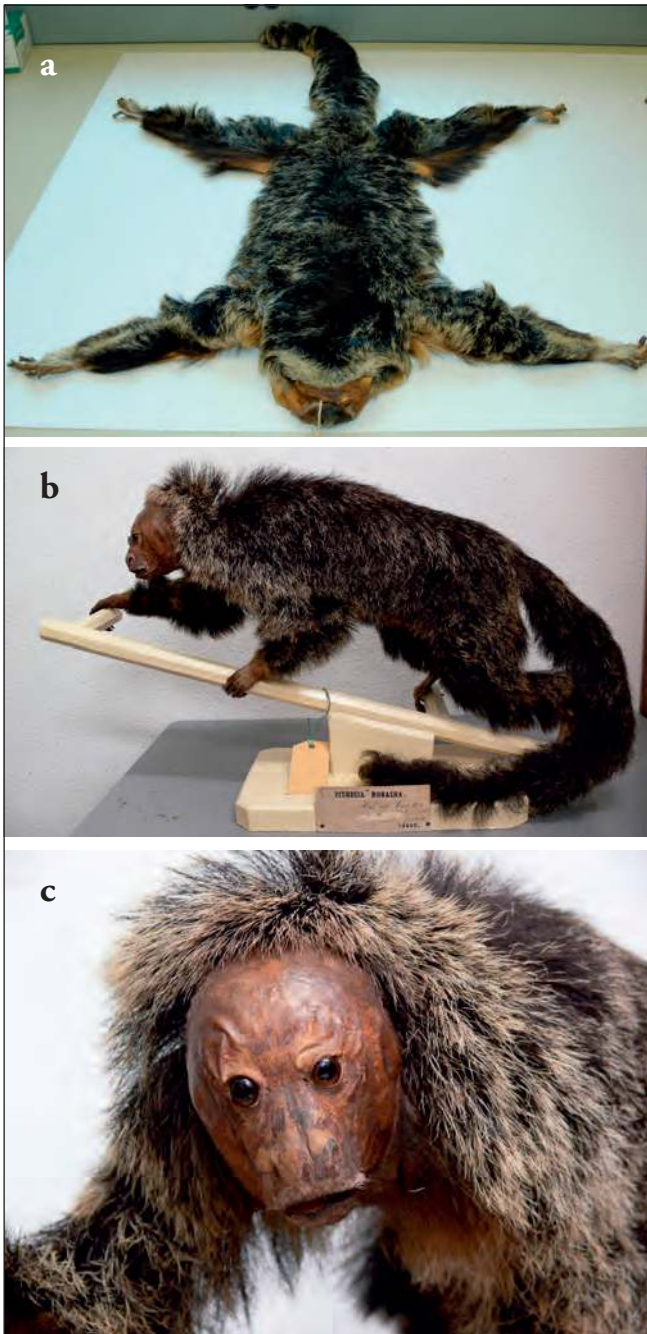


Figure 74. *Pithecia irrorata*. (a) Adult male, FMNH No. 98040, skin, Altamira, Rio Manu, Peru, and (b-c) subadult male/large juvenile, NNMN Leiden No. 409 mount and detail, Peru.

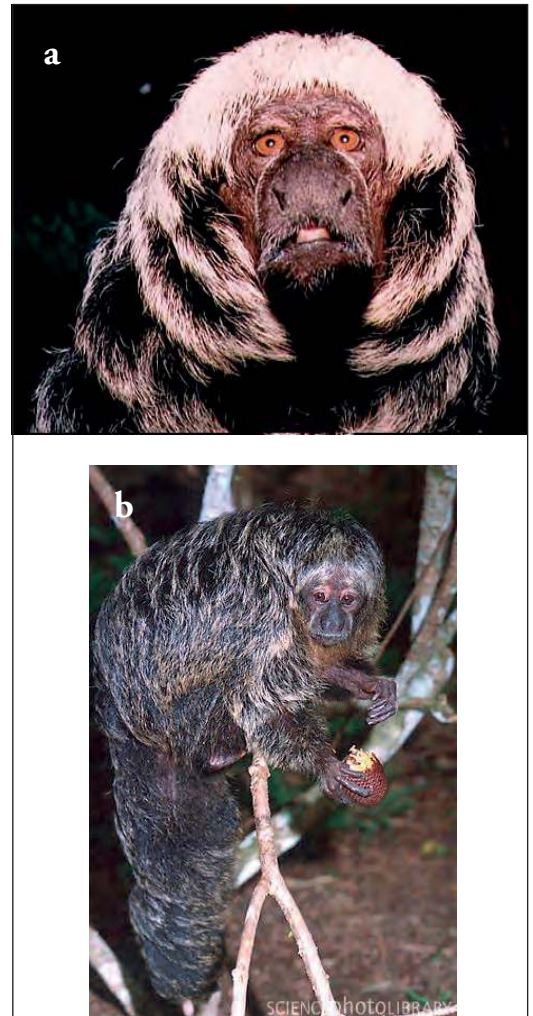


Figure 75. *Pithecia irrorata*. (a) Captive (pet) adult male, Rio Branco, Acre, Brazil, photo by J.C. Bicca-Marques, (b) Juvenile male *Pithecia irrorata* pet in Iquitos, photo by Science Photo Library (<http://www.sciencephoto.com/media/384772/view>).



Figure 76. *Pithecia irrorata*. Adult female MNRJ No. 3317, skin and skull.

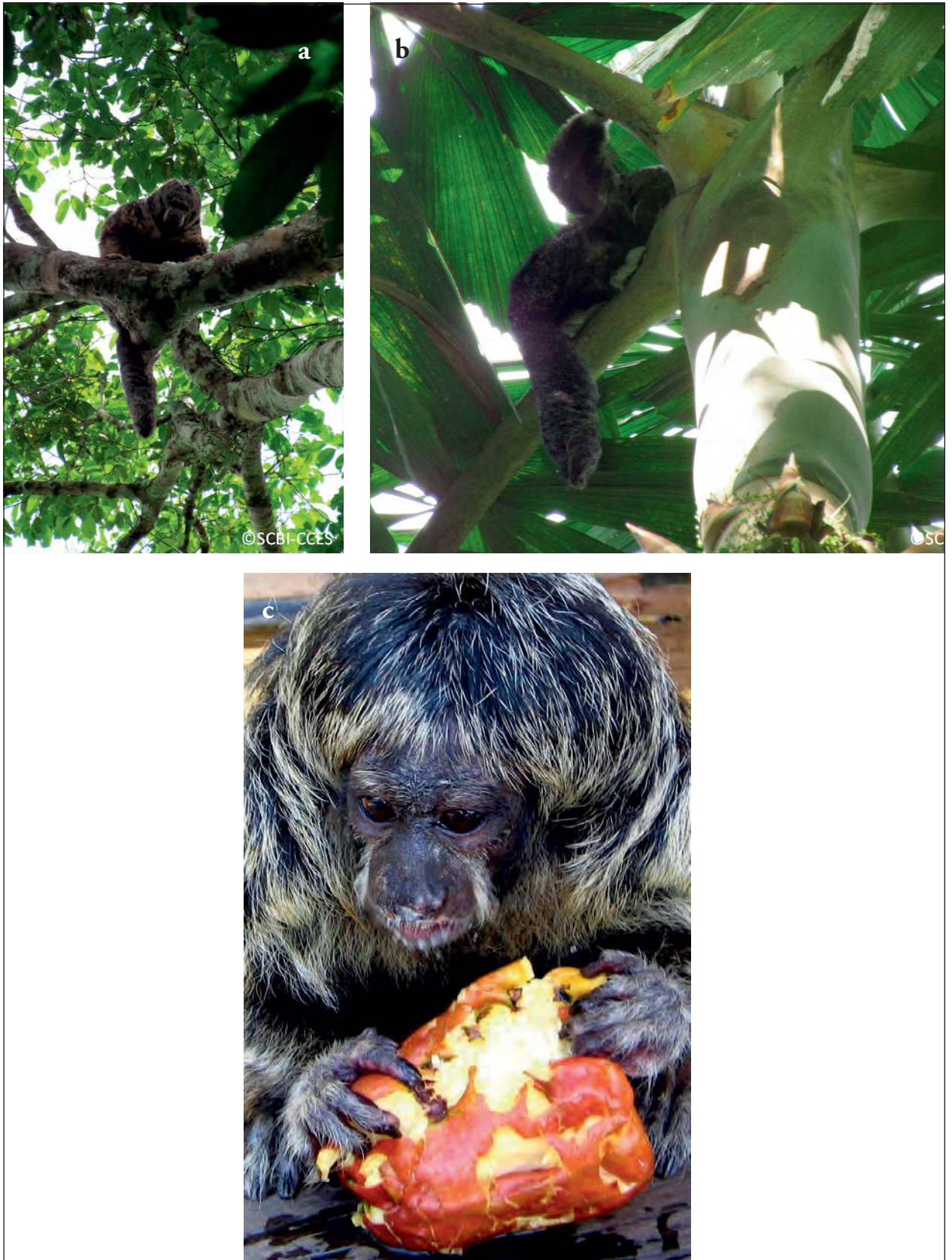


Figure 77. *Pithecia irrorata*. Females: (a) adult from Río Urubamba, Peru, photo by T. Gregory and SCBI-CCES, (b) large juvenile-subadult from Río Urubamba, Peru, photo by T. Gregory and SCBI-CCES, and (c) a small juvenile captive, eating a cashew fruit, in the Reserva de Desenvolvimento Sustentável Piagaçu-Purus, Rio Purus, Amazonas, Brazil, photo by Felipe Rossoni Cardoso.

VANZOLINI'S BALD-FACED SAKI

Pithecia vanzolinii (Hershkovitz, 1987)**Synonymy**

1987 *Pithecia irrorata vanzolinii* Hershkovitz, *P. Am. J. Primatol.* 12: 426–427; in part.

Holotype. Universidade de São Paulo, Museu de Zoologia (MZUSP), No. 5491, adult male, collected by A.M. Ollala, 29 October 1936, skin and skull.

Paratype. At MZUSP, there are 22 specimens designated by Hershkovitz as paratypes. I would recommend as an example an adult female No. 5495, skin and skull.

Type locality. Brazil, Santa Cruz, Rio Eirú, a southern tributary of the Rio Juruá, Amazonas, for both the holotype and all paratypes.

Description. Species determination is based on 36 specimens. Males and females are similar in pelage with black dorsal fur stippled in light white to cream grizzle, with contrasting pale yellowish-buffy arms and legs. A buffy ruff matches the limbs on both males and females, but the male's ruff is more distinct. A detailed description is given in Hershkovitz (1987). The descriptions by Hershkovitz and this paper are based solely on museum specimens.

Males. The face of the males is bare with black skin and they have white to cream malar stripes.

Females. Black skin on the face is fringed in soft black hair with a star or snip of white on the forehead generally present, and white to cream malar stripes that appear generally wider than in males. Juvenile females appear to have a much shaggier appearance in the face. Female body hair in general is not as thick or wavy as in males.

Diagnosis. Originally placed by Hershkovitz (1987) as a subspecies of *P. irrorata*, it is here elevated to species—there are no other sakis that closely resemble it.

Measurements. See Table 23.

Distribution. Map 13. Only in Brazil. Hershkovitz (1987) places them in south-western Brazil, between the south bank of the Rio Juruá and the south bank of the Rio Tarauacá in the south-west of the states of Amazonas and Acre. There are, however, very few documented locations for these animals, which are principally along the south-eastern side of the Rio Juruá, including: Amazonas – Rio Eiru, Santa Cruz, Santo Antônio, Lago Grande; Acre – Seringal Oriente “prox. Tassmatinga” (likely Taumaturgo), and Cruzeiro do Sul (which like Sarayacu in Peru or Manaus in Brazil is a site for multiple species collections).



Table 23. Measurements for *P. vanzolinii* holotype and a female paratype.

Measurement	Male MZUSP 5491	Female MZUSP 5495
Skull (mm)		
Length of brain case	84.6	83.9
Width of brain case	42.1	42.3
Zygomatic arch width	57.2	57.2
Orbits – outer	44.1	43.0
Nose bridge	6.8	6.3
L-orbit inner width	16.8	16.0
L-orbit inner height	17.1	16.8
Muzzle width	25.0	26.6
L-mandible length	54.3	58.8
L-mandible height	40.0	35.4
Post-crania (mm)		
Total length	935	740
Tail	420	465
Hind foot	120	120

Specific locations. Appendix I. BRAZIL. *Amazonas*: Rio Juruá - Lago Grande; Rio Eiru - Santa Antônia, Santa Cruz. *Acre*: Rio Juruá – Seringal Oriente, Tassmatinga, Cruzeiro do Sul

Discussion. As of this writing, I have not seen a living specimen of *P. vanzolinii* in captivity, in the wild, or as a photograph. It is possible this species is quite restricted in range or occurs in regions far from human populations or tourism. Every effort should be made to gather as much information as possible to determine its range and conservation status.



Map 13. Geographic distribution of *Pithecia vanzolinii*.

Brazil

1. Seringal Oriente

2. Cruzeiro do Sul

3. Rio Eirú, Santa Cruz (approx.)

4. Rio Eirú, Santo Antônio (approx.)

5. Rio Eirú, Lago Grande (approx.)

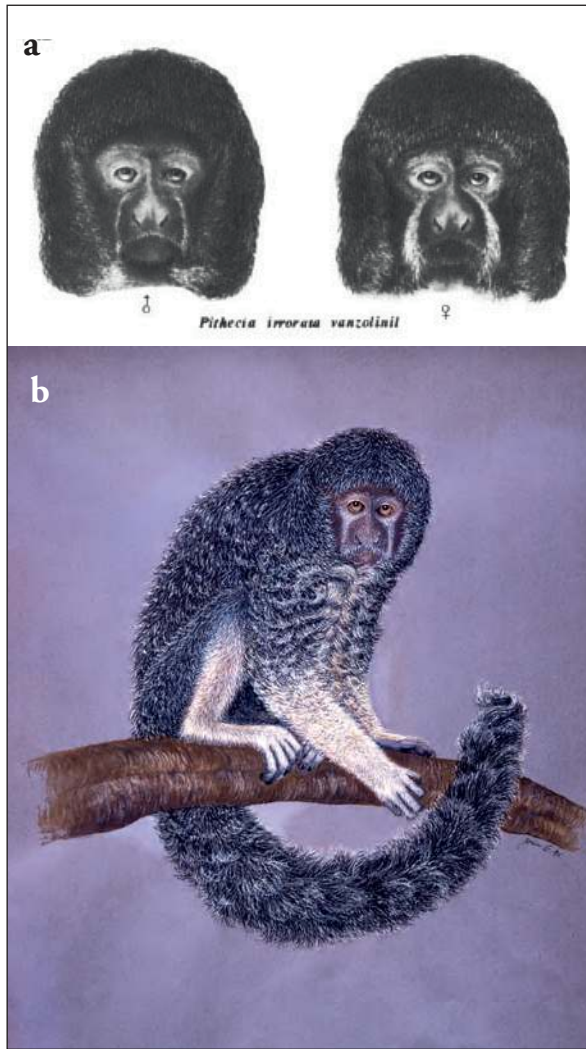


Figure 78. *Pithecia vanzolinii* from Hershkovitz (1987): (a) From Figure 19 male and female face, and (b) Figure 27, original color painting by Zorica Dabich and Philip Hershkovitz, through the courtesy of Field Museum of Natural History.



Figure 79. *Pithecia vanzolinii*. Holotype, adult male MZUSP 5491. Photos by L.K. Marsh.



Figure 80. *Pithecia vanzolinii*. Skull of holotype MZUSP 5491. Photos by L.K. Marsh.



Figure 81. *Pithecia vanzolinii*. Adult female paratype, MZUSP 5495.

MITTERMEIER'S TAPAJÓS SAKI

Pithecia mittermeieri sp. nov.**Synonymy**

1987 *P. i. irrorata*. Hershkovitz, P. *Am. J. Primatol.* 12: 425–426, in part.

2013 *P. irrorata*. Van Roosmalen, M. G. M. and Van Roosmalen, T., *On the Origin of Allopatric Primate Species and the Principle of Metachromic Bleaching*. E-book, printed privately, p.63.

Etymology. Named for Russell A. Mittermeier, President of Conservation International and long-time Chairman of the IUCN/SSC Primate Specialist Group. Dr. Mittermeier, who has been studying primates since 1970, has now seen more primate species in the wild than anyone, and is particularly fond of the Pitheciidae. His dissertation research was carried out in Suriname from 1975–1977 and included some of the first field work on sakis. He has been particularly influential in Brazil, where he has been working since 1971 and where his efforts on behalf of Brazil's amazing biodiversity have earned him the Order of the Southern Cross from the Brazilian government and the João Pedro Cardoso Award from the state of São Paulo. Given his long-term devotion to Brazil, it is especially appropriate that this Brazilian endemic be named after him. He has also been a long-time friend and supporter of my work, so I am also personally very pleased to name this new saki species in his honor.

Holotype. BMNH No. 27.8.5.9.1, adult male, skin and skull, collected by W. Hoffmanns, 14 September 1906.

Paratypes. MZSP No. 5549, adult male, skin and skull, collected by A.M. Olalla, 8 May 1936. BMNH No. 20.7.14.6, subadult male, skin and skull and MNRJ No. 3315, adult female, skin and skull, both collected by F. Lima, 22 July 1917. INPA No. 5707, subadult (lactating) female, skin and skull, collected by P.S. Pinheiro, 23 April 2005.

Type localities. All in Brazil: BMNH No. 28.8.5.9.1 from “Humaytha River,” Rio Madeira, by Gazetteer considered Humaitá (Paynter and Traylor, 1991). *Paratypes:* Brazil, Pará, Arua, Rio Arapiuns—south of the Rio Amazonas and just west of the Rio Tapajós. BMNH No. 20.7.14.6 and MNRJ No. 3315 Rio Tapajós, Vila Braga (south of Itaituba, left bank). INPA No. 5707 from the “Município de Novo Aripuanã, margem direita do Rio Aripuanã, Lago do Cipotuba.”

Specimens examined. Thirty skins and skulls, additional photographs from captive and living animals throughout the area.



Description. One of the most variable of all saki species, especially in the “transitional” juvenile males. Males and females both have tan to orange fur between the legs around their respective genitalia, similar to *P. pissinattii* sp. nov.

Males. Adult male dorsal pelage has long white bands of grizzling throughout the black, and the forearms are densely covered in shorter white hairs. Wrist cuffs are white underneath and grizzled white on top. The hind legs are black on the front half, similar to *P. pissinattii* sp. nov. males, but become very black and obvious as the males age. The hands and feet are white. The ruff is bright orange, but varies in density and extent among individuals. The hair extending toward the face is white and can become a wide white band in adult animals. And as in *P. rylandsi* sp. nov. the “bangs” are short over the front of the face, while the nape hairs—varying in intensity of whiteness depending on the age—form a “hole” over the ears making it appear as though there are black streaks coming from the sides of the head. It is more prominent in older individuals whose hair has become increasingly white. Adult males, depending on age, have varying degrees of scattered white hairs

along the sides of the face and the eyebrows, and as light malar lines and lips. The extent of the light white facial hair decreases as the animals get older. The skin of the face in older animals is black, in younger animals it is black, but the overall look of the face varies with age. Juvenile males of this species are some of the most striking and transitional of all sakis. Very young males have black face skin with prominent pink eyespots that can extend under the eyes as well. As they age, fine white hairs form over the eyes extending back to a horseshoe of fine white fringe around the face. In some photos of living *P. mittermeieri* subadult males appear “gray” faced, where the white can seem obvious and extensive (but short and light) and the eyespots not as intensely pink. Depending on the angle of the photo or the way the specimen was prepared and depending on the age, juveniles can appear greyish, coppery-brownish, very black with a white fringe, or colorful with both white hairs and very pink eyespots.

Females. Overall, the pelage is similar to that of males, but generally much less grizzled, especially when younger. As the females age, they become more grizzled overall, but never approach the whiteness seen in *P. rylandsi* sp. nov. females. Adult females have a darker ruff than males in general, but it sometimes can be a lighter tan tending toward orangish in some individuals. Very young females resemble young males with pink eyespots over the eyes and black faces, but they always have thick, shaggy malar lines, and a fringe of black hair around the back edge of the face, and hairs forming over the brow. As they age they have extensive facial hair that is white, similar to *P. pissinattii* sp. nov. females. Some subadult individuals have very black fur around the face, and very little pelage stippling. As they age, this hair can go from dark, to loosely white, to more

closely pressed to the face as blackish with white in it. The facial skin is black, with scattered hairs over the muzzle.

Diagnosis. Distinct from all other sakis in that the males are almost “clownish” with bright orange ruffs, grayish lightly haired faces as subadults, with traces of hair over the black faces in older adult males, and contrasting very white and black pelage with dense buffy to white forearms. Much older adults can be quite white in overall pelage, but unlike *P. rylandsi* sp. nov. males, retain their bright orange ruffs. Females in the upper sections of the range south of the Amazon and between the rios Madeira and Tapajós have very hairy faces as compared to the females of *P. rylandsi* sp. nov.

Measurements. See Table 24.

Distribution. Map 14. *Pithecia mittermeieri* is found only in Brazil, south of the Rio Amazonas between the rios Madeira and Tapajós, including the Rio Aripuaná drainage. Current populations appear to be concentrated primarily north of Aripuaná in Mato Grosso, although there is some evidence that historically they may have extended at least along the Madeira as far as the Mamoré and even Rio Guaporé (as per Natterer 1829 in Destacamento do Ribeirão and Rio Pacáas Novos, but cf. *P. rylandsi* sp. nov.). The collection of a male, juvenile male, and infant in “Nova Brasília, Polonoroeste,” presumed to be Ji-Paraná as per the gazetteers of Paynter and Traylor (1991), in 1985, demonstrates some populations north of the Rio Jamarí as well. Two photos of wild males taken in southern Rondônia suggest they are still in the region. One was a tourist photo in 2010 at Cacoal Selva Park, 470 km from Porto Velho, and the other in Chupinguaia in 2012 (Figure 85). Along

Table 24. *Pithecia mittermeieri* adult male holotype and male and female paratypes.

Measurement	BMNH 27.8.5.9.1 Male	MZSP 5549 Male	INPA 5707 Female	MNRJ 3315 [‡] Female
Skull (mm)				
Length of brain case	85.8	84.8	76.6	82.9
Width of brain case	43.4	44.9	42.1	47.0
Zygomatic arch width	58.4	55.7	50.0	–
Orbits – outer	46.7	43.6	41.0	43.3
Nose bridge	8.0	7.3	6.1	8.3
L-orbit inner width	17.5	15.6	15.5	14.6
L-orbit inner height	17.0	19.0	17.4	14.4
Muzzle width	27.0	26.1	20.2	24.5
L-mandible length	57.9	56.4	50.5	51.0
L-mandible height	27.0	37.3	34.1	–
Post-crania (mm)				
Head-body	460	450	370	350
Tail	450	450	410	490
Hind foot	85	135	105	115
Ear	35	–	30	30

[‡] Skull articulated and not fully cleaned.

the Tapajós, they extend possibly as far as Jacaréacanga and perhaps further south, depending on the presence of other species (see Discussion below).

Specific location. Appendix I. BRAZIL. *Para*: Rio Madeira - Borba, Humaitá; Parintins - Villa Bella Imperatriz, Lago Andina; Itaituba; Rio Arapiuns - Arua; Rio Humaitá; Rio Aripuanã; Rio Tapajós; Lago do Cipotuba; Villa Braga; Igarapé Auara; Igarapé Brabo; Igarapé Amorin; Limoal; Limontuba; Santarém - Fazenda Mararu. *Mato Grosso*: Aripuanã. *Rondônia*: Nova Brasília.

Discussion. The colloquial name for these sakis has generally been “the Tapajós saki,” and it will likely continue to be so even though the species name has been given as *P. mittermeieri*. The region between the rios Madeira and Tapajós has changed extensively over the last two hundred years. Railways and telegraph lines were introduced at the turn of the 19th century (instigated by Marechal Rondon). Because of highways such as the BR 364 in Rondônia completed in 1961, the Trans-Amazônica BR 230 inaugurated in 1972, and the devastating colonization and development program Polonoroeste (Northeastern Brazil Integration Development Program) in the 1980s, the forests have gone from complete coverage in Rondônia and Mato Grosso in the 1950s to approximately half or less today (per satellite images). Previous collection sites are now roads and towns leaving little doubt that the primate populations have been severely disrupted and have potentially led to hybrid zones (cf. Jamari sakis, Appendix II).

Likewise, as discussed for *P. irrorata*, it is not known if historic populations of *P. irrorata* were somewhere within the collecting routes of the Comissão Rondon, or how far north of the Rio Guaporé *P. rylandsi* sp. nov. extended originally, but today’s distribution is likely very different for all of these species. So while it is possible that *P. mittermeieri* extended throughout the region between the rios Madeira and Tapajós to the Guaporé, its exact distribution today is unknown.

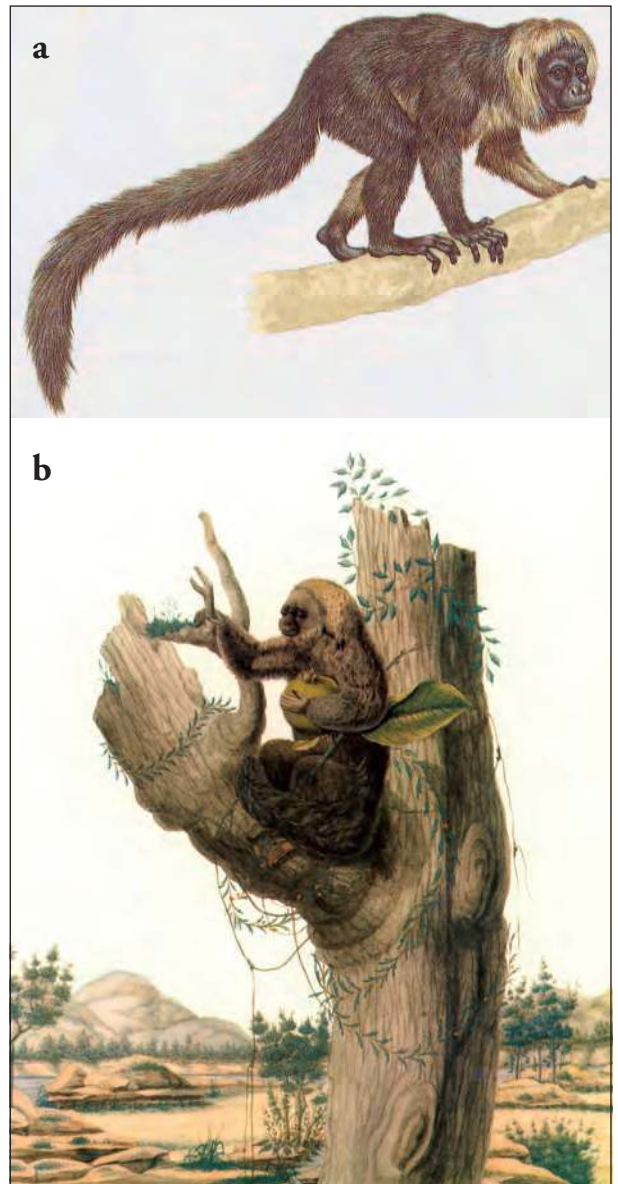


Figure 82. (a) Illustration of a juvenile male *Pithecia mittermeieri* by Graham Allen for P. Whitfield & R. Walker, and (b) Illustration of a subadult or adult male *P. mittermeieri* by Alexandre Rodrigues Ferreira (1783–1792).



Map 14. Geographic distribution of *Pithecia mittermeieri*.

Brazil

- | | | |
|---|--|--|
| 1. Amorin, Brabo, Limoatuba (Olalla collection, by gazetteer, Paynter Jr. & Traylor Jr. 1991) | 4. Parintins | 12. Humaitá |
| 2. Rio Arapiuns, Aruá (Olalla collection, by gazetteer, Paynter Jr. & Traylor Jr. 1991) | 5. Rio Andira | 13. Destacamento do Ribeirão (Natterer 1883) |
| 3. Limoal near Boim (Olalla collection, by gazetteer, Paynter Jr. & Traylor Jr. 1991) | 6. Lago Andira | 14. Rio Pacáas Novos (Natterer 1829) |
| | 7. Itaituba, Villa Braga | 15. Nova Brasília (Polonoreste 1985) |
| | 8. Igarapé Auara (Olalla collection, by gazetteer, Paynter Jr. & Traylor Jr. 1991) | 16. Cacoal State Park |
| | 9. Borba | 17. Chupinguala |
| | 10. Rio Aripuanã | 18. Retiro do Veado Branco, Serra do Norte (Comissão Rondon) |
| | 11. Lago do Cipotuba | 19. Km 16 on BR 230 (approx.) |



Figure 83. *Pithecia mittermeieri*. Holotype BMNH No. 27.8.5.9.1, adult male, skin.

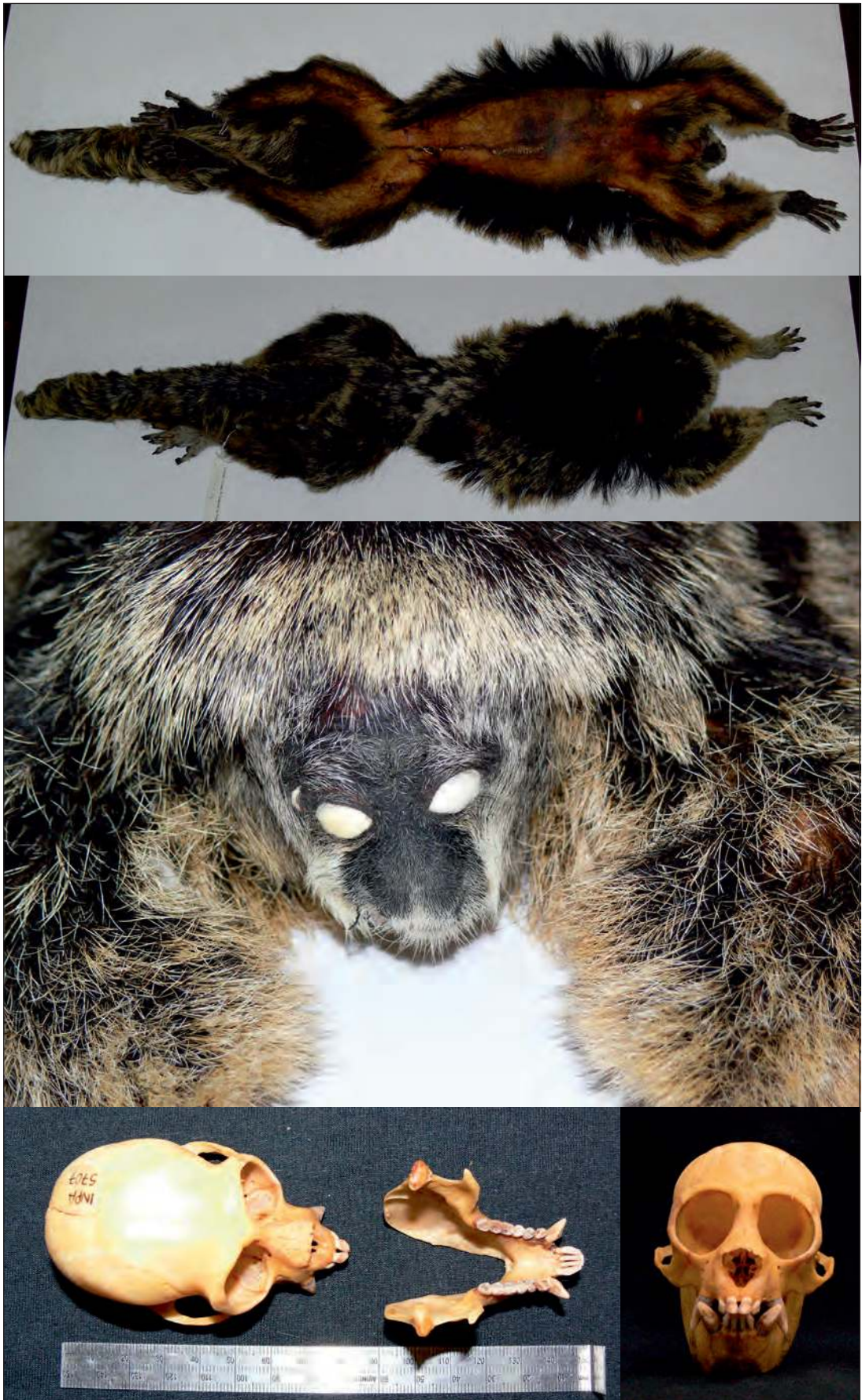


Figure 84. *Pithecia mittermeieri*. Paratype INPA No. 5707, lactating subadult female, skin and skull.



Figure 85. *Pithecia mittermeieri*. Males: (a) captive juvenile male, photo by L.C. Marigo, (b) captive juvenile male, photo L.C. Marigo, (c) captive sub-adult male, photo by N. Rowe, (d) captive adult male, photo by Matheus Fortunato, and captive adult male (older), photo by ZooChat.com, and (f) wild adult male in Chupinguaia, Rondônia, Brazil, by Kurazo Matheus Okada Aguilar.



Figure 86. *Pithecia mittermeieri*. Females: (a) adult captive female, photo by L.C. Marigo, and (b) subadult female with older adult male, photo by L.C. Marigo.

RYLANDS' BALD-FACED SAKI

Pithecia rylandsi sp. nov.**Synonymy**

- 1842 *Pithecia irrorata*. Gray, J. E. *Ann. Mag. Nat. Hist., 1st series* 10: 256. In part.
- 1976 *Pithecia monachus*. Heltne P., Freese, C. and Whitesides, G. *A Field Survey of Nonhuman Primates in Bolivia*, Report, PAHO, Washington, DC. 40pp.
- 1981 *Pithecia hirsuta*. Izawa, K. and Bejarano, G. *Kyoto Univ. Overseas Res. Rep. New World Monkeys* (2): 3, 5, 10.
- 1981 *Pithecia hirsuta*. Izawa, K. and Yoneda, M. *Kyoto University Overseas Res. Rep. New World Monkeys* (2): 16.
- 1987 *Pithecia irrorata*. Hershkovitz, P. *Am. J. Primatol.* 12: 425–426; in part.
- 2013 *Pithecia hirsuta*. Van Roosmalen, M. G. M. and Van Roosmalen, T. *On the Origin of Allopatric Primate Species and the Principle of Metachromic Bleaching*. E-book, printed privately, p.63.

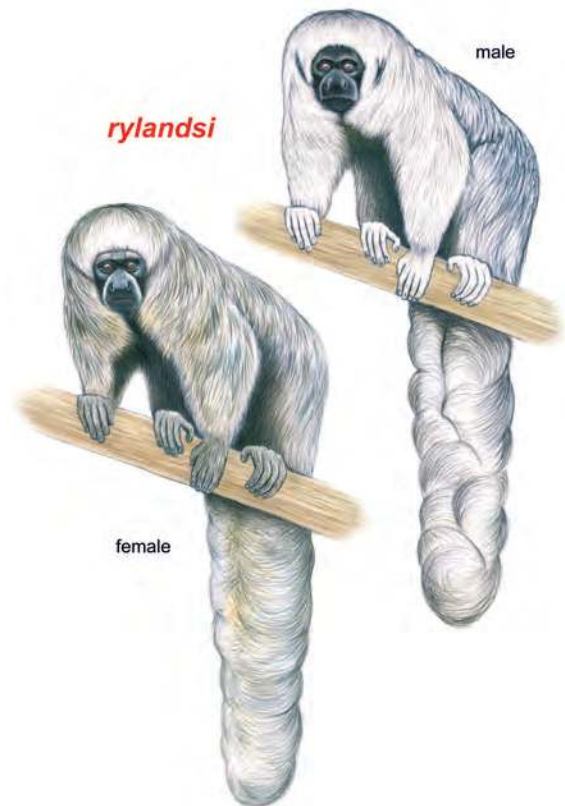
Etymology. Anthony Rylands is a Senior Research Scientist at Conservation International, Deputy Chair of the IUCN/SSC Primate Specialist Group, a member of the Brazilian Academy of Sciences, former professor of Vertebrate Zoology at the Federal University of Minas Gerais, and founding editor for the journal *Neotropical Primates*. He has mentored hundreds of young primatologists, and as coordinator for Conservation International's Primate Action Fund, has directly impacted primate research and conservation the world over. Dr. Rylands is a tireless academic and a dear friend. For all of these reasons and more, I name this species after him.

Holotype. AMNH No. 247669, subadult male, skin only, collected by K. Izawa, 5 December 1980 (listed as female on the label, but face appears male). As type skin does not have a corresponding skull, I include AMNH No. 248723, subadult male, skull only, collected by S. Anderson, 26 May 1982.

Paratypes. FMNH No. 123967, skin only, subadult female. As paratype skin does not have a corresponding skull, I submit KUPRI No. 5973, skull only, collected by M. Kimursa, 8 November 1978.

Key Specimens. KUPRI Nos. 5974 and 5975, both skulls only, collected by M. Kimursa in Bolivia with No. 5975 collected in Mucden, Bolivia on 5 August 1979.

Type localities. Bolivia, Pando Department: Holotype skin AMNH No. 247669 from the Río Tahuamanu, Mucden; holotype skull AMNH No. 248723 from the Río Nareuda.



Paratypes: FMNH No. 123967 from Bolivia, Pando Department, Porvenir, Río Nareuda. KUPRI No. 5973 from Bolivia.

Specimens examined. Eleven skins, 14 skulls, and 40 photos of living specimens (captive, rescued, wild) from numerous sources.

Information about this species comes in part from living photographs of wild and captive animals in Bolivia, Peru, and Brazil. No museum specimens are available from Peru. Specimens from Brazil are provisional pending further investigation. According to R. B. Wallace (pers. comm.), there are no *Pithecia* specimens in any of the Bolivian natural history museums.

Description. One of the largest of the sakis. Males and females have bare faces with black pigmentation.

Males. Overall pelage is transitional, as it is in most of the genus. When young, the males are black and moderately to heavily grizzled with white throughout. As they age, they become almost entirely white. Their dorsal coloration can be so intense with white that they take on a “skunky”

appearance. Males in Peru appear to have almost no black showing through the heavy white hair tips. The forelimbs can be buffy to white, and the hind limbs can have black on the inner leg, but it may not get as black as *P. mittermeieri* or the Jamari sakis (cf. Appendix II). The hands and feet are white to off-white. The crown bangs are also white in all ages, and can be quite thick compared to other species, and are shorter than the hair coming from the shoulders, making a “hole” where the ears are. This makes for the appearance of black stripes on the sides of the older males’ heads. This kind of pattern also appears in very old *P. mittermeieri* and sometimes in *P. irrorata*. Males tend to lack or have only very light malar lines, but do have white hair on the lips. They lack an obvious orange or bright ruff as in *P. irrorata*; instead they have a black or dark brownish ruff. Males retain light to pinkish eyespots over the eyes. Juvenile males are dark “pink-black,” where the facial skin is not as dark as adults and appears reddish-black, but tend toward black even from very young. Otherwise males have plain, extremely lightly furred or non-furred faces.

Females. Adult female pelage can be as intensely white as males and the hair on the forehead, creating “bangs,” can look like a white shield. Their forearms can be more buffy than those of the males, and this blonde-tan can extend across their chests. They do not have distinct ruff coloration, as it is sometimes a light buff or grayish. The black of their faces is deep with reddish undertones, and lacks hair. Younger females can have obvious white eyebrow hair. Very young females can look cartoonish with pink circles around the eyes, a very black face with some black hairs along the sides, and white forming as eyebrows. All ages of females have distinct, white, shaggy muzzle stripes. Young females have grayish faces, sometimes with a ring of light black hairs peripherally around the face with light grey eyebrow spots and light skin around eyes. Adult females retain the light colored eyebrow spots, and, depending on age, may retain some of the light black fringe, but in most cases, the faces are very bare save the bright muzzle lines.

Diagnosis. Easily distinguishable from all other bald-faced sakis by their large size, very black faces, and extreme white grizzling. *P. irrorata* males have far less white throughout, bright orange ruffs and light faces with dark muzzles. *P. irrorata* females have black-fringed faces as juveniles becoming greyer faced overall.

Measurements. See Table 25.

Distribution. Map 15. Found in north-western Bolivia, south-eastern Peru, and possibly in the south of the state of Rondônia and the west of the state of Mato Grosso in Brazil.

Bolivia. Found in the western Pando Department, but with some evidence that they may be in northeastern Beni and northern La Paz, particularly north/northwest of the Río Madre de Dios in those areas. Specific locations with

verification include: Mucden; north of the Río Tahuamanu, but east of the Peru border; and Municipio de Bolpebra, Provincia Nicolas Suarez. Additional locations reported for Bolivia by various authors without specimens or photos, summarized by R. B. Wallace (unpubl. data) by municipality include: Bolpebra – Buena Vista, Piaou, Rutina, Los Campos, El Refugio, Estación Tahuamanu, and San Sebastian (reported ‘not common’); Filadelfia – Pingo de Oro (‘rare’) and north of Río Tahuamanu, vicinity of Río Muyumanu; Bella Flor – Santa Rosa near Río Abunã, Bella Flor, Río Manuripi, and between the ríos Acre and Tahuamanu; Cobija – Cobija, Belo Horizonte, Tres Corazones, Puerto Rico, Tres Estrellas, Fortaleza; Porvenir – Porvenir along the Río Nareuda and Cocamita; Nuevo Esperanza – Federico Roman (Compartamentos Caiman, Manoa, and Río Negro); and Ingavi – Centro Dieciocho, north of Baraca San Juan de Nuevo Mundo.

Peru. Mainly north of the Río Madre de Dios, likely throughout the Reserva Territorial Madre de Dios, specifically in the Los Amigos Conservation Concession including Río Los Amigos, the Manu Wildlife Center, and Los Amigos Research Center. It is possible, as sakis are reported for Tambopata, that they are also south of the Río Madre de Dios, but this is unconfirmed. Their border with *P. irrorata* north of the Madre de Dios to the Brazilian border and further west toward the Parque Nacional Alto Purus is unknown.

Table 25. Skull measurements for *Pithecia rylandsi* holotype male AMNH 248723, and paratype female KUPRI 5973.

Measurements	AMNH 248723 Male	KUPRI 5973 Female
Skull (mm)		
Length of brain case	63.6	77.9
Width of brain case	42.6	n/a
Zygomatic arch width	54.8	51.4
Orbits-outer	42.6	40.4
Nose bridge	–	4.4
L-orbit inner width	–	15.5
L-orbit inner height	–	19.1
Muzzle width	–	21.8
L-mandible length	62.2	49.5
L-mandible height	47.9	36.4
Symphysis angle	37.0	–
M1-M1 mandible	21.3	–
M3-M3 maxillary	22.6	–
I-M3 maxillary	34.1	–
Nasal length	19.2	–
Nasal width	17.1	–
Condylobasal length	74.6	–
Postorbital constriction	34.1	–
Canine (L/R)	–	9.4/9.2

Brazil. While it is likely that these animals occur east and north of the Rio Guaporé into the states of Rondônia and Mato Grosso, and possibly as far north as the Rio Anari or west to the Rio Jamari (see Discussion, below), to be conservative in this account, their distribution will be restricted to the south (west) of the Rio Guaporé or just north (east) along its Brazilian shores where passable by arboreal primates.

Specific locations. Appendix I. **BOLIVIA.** *Pando:* Nicolas Suarez - Bolpebra; Tahuamanu; Mucden; Rio Nareuda. **BRAZIL.** *Rondônia:* Cacoal Selva Park; Rio Guaporé; Destacamento do Ribeiro; Rio Anari; Pedra Branca; Ritiro do Veado Branco - Serra do Norte; Guajará-Mirim. **PERU.** Madre de Dios: Río Madre de Dios - Manu Wildlife Center; Río Los Amigos Conservation Concession.

More data are needed to determine the borders and range of these monkeys in relation to those of *P. irrorata* in Peru and Acre, Brazil, and *P. mittermeieri* north of this area.

Discussion. These sakis are distinct and unmistakable. More data are needed to determine the boundaries with *P. irrorata* in Peru and *P. mittermeieri* in the southern

Brazilian Amazon. This is one of the few cases in this taxonomy where there is more information on living animals than reference material.

Material collected by J. Natterer in 1829 from Guajará-Mirim, Rio Pacaás Novos (old name, now very near Guajará-Mirim), and Rio Guaporé are juveniles and difficult to place firmly in *P. rylandsi*; therefore, as they are thought to have been collected on the north bank of the Rio Guaporé, they will be provisionally placed in *P. mittermeieri* (cf. *P. mittermeieri*). A female (MZSP No. 22895) collected in Rondônia, Rio Anari, Pedra Branca by D. F. Stotz that appears to be closer to *P. rylandsi* than to *P. mittermeieri*, extends the possibility that they were further north into Brazil at least in 1988. More study is needed for the *P. rylandsi* population in Brazil.

Except for south-eastern Peru and perhaps parts of Pando in Bolivia, it is likely the population is declining throughout the range. While I do not advocate more collections of these sakis, I do suggest we get as much detailed information from photos or from capture-release animals as possible to determine their relationship to *P. irrorata* and *P. mittermeieri*.



Map 15. Geographic distribution of *Pithecia rylandsi*.

Peru

1. Manu Wildlife Center
2. Concesión para Conservación, Los Amigos
3. Los Amigos Research Center

Bolivia

4. L. Porter Field Site
5. Mukden
6. Río Nareuda

Brazil

7. Rio Guaporé (approx. collection area both sides of river, Natterer 1829)
8. Mato Grosso do Sul (approx. collection area, Natterer 1826)



Figure 87. Illustration of what appears to be *Pithecia rylandi* drawn in 1790 by Alexandre Rodrigues Ferreira as part of his explorations into the southern Brazilian Amazon.



Figure 88. *Pithecia rylandi*. Holotype male, skin AMNH No. 247669 and skull AMNH No. 248723.

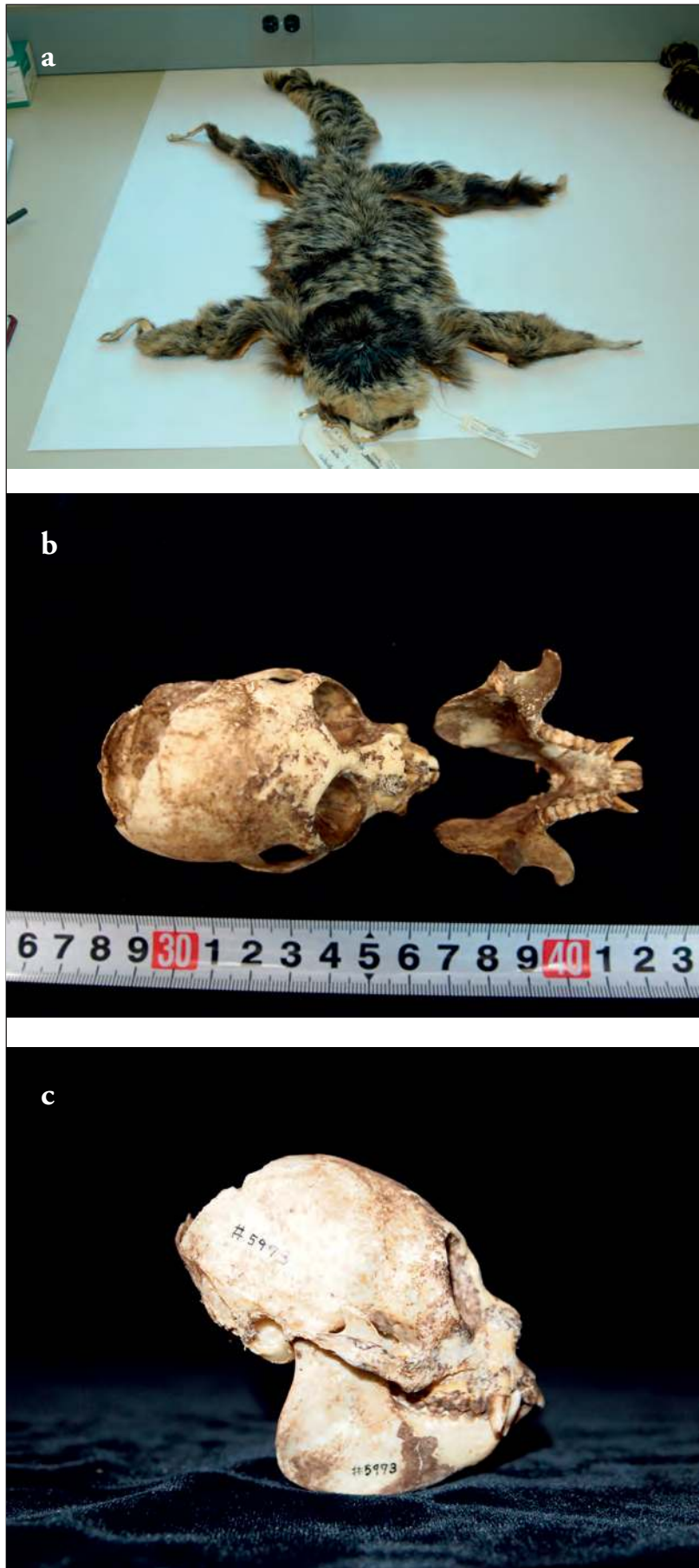


Figure 89. *Pithecia rylandi*. (a) Paratype subadult female FMNH No. 123967, skin, and (b-c) paratype skull KUPRI No. 5973.

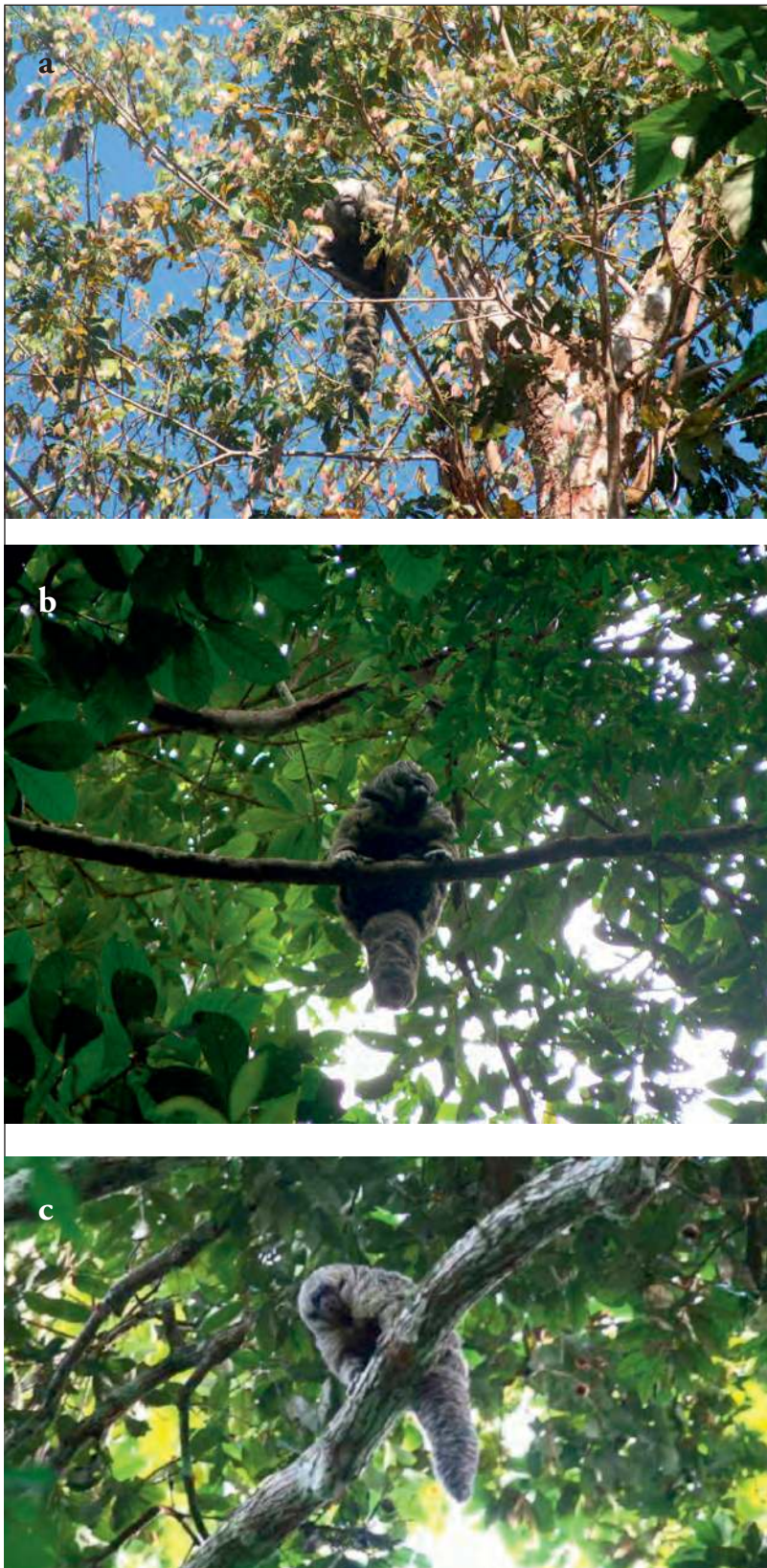


Figure 90. *Pithecia rylandsi*. Adult males (a) Pando, Bolivia, photo by Leila Porter; (b) Los Amigos, Peru, photo by Bretstickypartsblog, and (c) near Manu Wildlife Center, Peru, photo by Fred Yost.



Figure 91. *Pithecia rylandsi*. Adult females (a) wild, Pando, Bolivia. Photo by Leila Porter. (b–c) captive at CENP, Belém, Pará. Photos by Luiz Claudio Marigo.

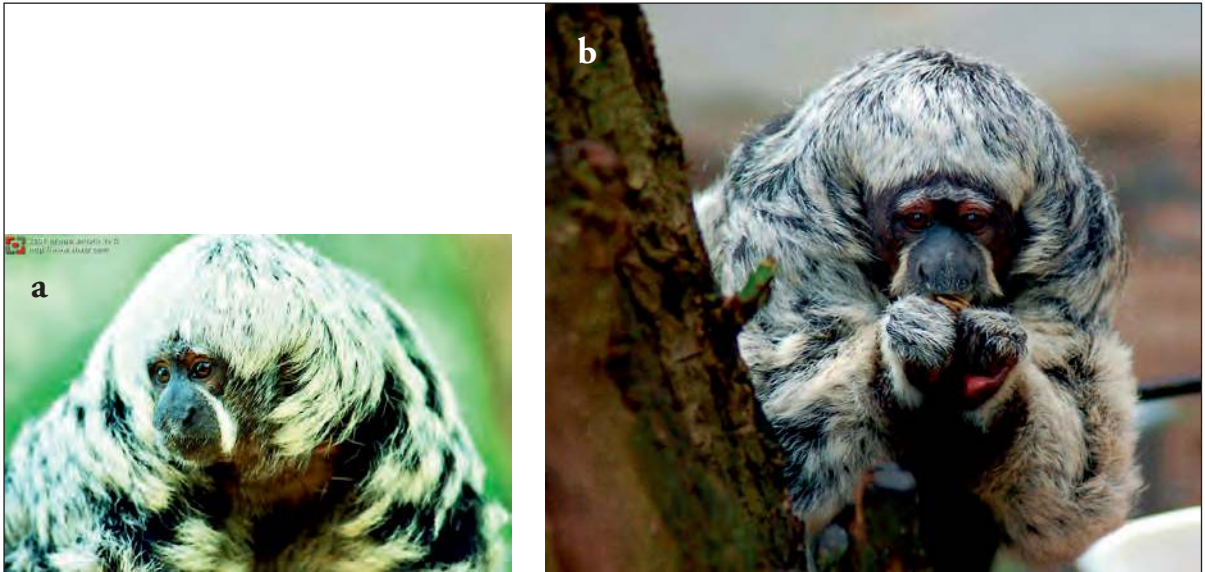


Figure 92. *Pithecia rylandsi*, subadult female (a) captive/rehabilitation at Inti Wara Yassi, Bolivia. Photo by www.trekker.com/ shatz.com; and (b) captive, Zoo Parque Itaituba, Arlete/flicker.

PISSINATTI'S BALD-FACED SAKI

Pithecia pissinattii sp. nov.

Synonymy

- 1987 *Pithecia irrorata irrorata*. Hershkovitz, P. *Am. J. Primatol.* 12: 425–426, in part.
 2013 *P. hirsuta*. Van Roosmalen, M. G. M. and Van Roosmalen, T, 2013. *On the Origin of Allopatric Primate Species and the Principle of Metachromic Bleaching*. E-book, printed privately, p.63.

Etymology. Named for Dr. Alcides Pissinatti, a Brazilian veterinarian, director and co-founder of the Centro de Primatologia do Rio de Janeiro (CPRJ/FEEMA), and Vice President of the Brazilian Academy of Veterinary Sciences. For nearly two decades Dr. Pissinatti has almost single-handedly pioneered captive breeding programs for endangered Brazilian primates, including the successful breeding and management of the muriqui (*Brachyteles*) in captivity. Because of his genuine kindness and intellect, and his devotion to the primates of Brazil including *Pithecia*, I dedicate this species to him.

Holotype. BMNH No. 26.5.5.7, adult male, skin and skull, collected by W. Ehrhardt, 14 November 1925.

Paratype. BMNH No. 25.12.11.2, adult male, skin and skull, and BMNH 27.8.11.13, adult female, skin and skull, collected from Canabouça by W. Ehrhardt, 14 November 1925. INPA No. 4060, juvenile female, skin and skull, from Autazes, collected by Marc G.M. van Roosmalen.

Type locality. BMNH holotype from “Middle Amazonas, Paraná do Jacaré, Canabouça.” Hershkovitz and others assign this location to Lago do Canabouça, just south of the Rio Solimões and between the rios Purus and Madeira.

Specimens examined. Thirty-five specimens, skins and skulls, and photos of living sakis by R.A. Mittermeier, R. Sampaio, and various tourists.

Description. Male and female faces are mostly pinkish to a darker red, tending toward black in older females. Both have distinct grizzling of white throughout the long black dorsal pelage that varies by age in its amount, but compared to other bald-faced sakis, it can be comparatively sparse in some individuals.

Males. Pelage varies, with younger males very grizzled in general, much more like females, and older males less so. The color bands of grizzling in the dorsal pelage vary as well from whitish to buffy-cream to tan, particularly on the forearms and shoulders, often with whiter cuffs at the wrist. The hind legs are often darker, brownish to blackish,



sometimes with dark bands lacking the white grizzling. The ventrum is lightly covered in black hairs with a distinct ruff ranging from bright orange to dull orange/light tan, generally with lighter roots. The hands and feet are white. Males have a white crown band of “bangs,” hair that is distinct, but not thick as in other species, that drapes over the forehead. Faces are mostly bare and are a deep reddish that seems almost a waxy reddish/black, even in well-preserved museum specimens. The hair on the face is lacking to sparse in adults, but with white malar lines that extend up under the eyes. Fine hairs above the eyes and around the back edges of the face sometimes remain even on older animals. Lips and muzzles can have sparse indistinct white hairs. In younger males, the faces can have more fine hair, but not nearly as much as the juvenile males east of the Rio Madeira (*P. mittermeieri*).

Females. Females often have more grizzling in the dorsal pelage than males—the back is tanner than in males, and especially on the arms and legs. Like males, their back legs can be half black along the front edge over the knee. The

ruff is present with dark brown base hairs ending in lighter tan to buffy bands. They often have darker wrist bands above the hands. The faces of adult females are covered in white soft hairs that cover the forehead, cheeks, and eyebrows. Females often have light white hairs especially on the forehead, and in older females, a loose white-grey band around the face, with a skin “diamond” in the center of the forehead just above the nose, between the eyes. The white malar lines are more obvious and often shaggier than in males. The skin above and below the eyes is light pinkish, especially in younger females, with the rest of the bare parts of the face black. In older individuals, the bare skin is blacker overall.

Diagnosis. Populations of *P. pissinattii* collected in 1935 in the region are very similar to those photographed by tourists on the Rio Juma (at Juma Jungle Lodge) as recently as 2009 (Figure 96, 98 a,b). *Pithecia pissinattii* are most similar to *P. mittermeieri* on the eastern side of the Rio Madeira, in that adult males with darker faces appearing black can in some photos seem similar to *P. mittermeieri*, especially when coupled with the brighter orange ruffs. However, juvenile and subadult male *P. mittermeieri* are very different from those of *P. pissinattii*. The young *P. mittermeieri* males have very bright pink eye spots that give way to white facial hair that in older subadults makes them have an overall “grey appearance,” and this does not seem to be the case for *P. pissinattii*. However, it is possible that *P. pissinattii* may

have legacy populations that were on both sides of the Rio Madeira, leading to features we now see in *P. mittermeieri*, particularly in females.

Measurements. See Table 26. Additional information: One skull measured, BMNH No. 25.12.11.1, subadult male (mm): braincase length 81.8, braincase width 42.1, zygomatic arch width 55.1, outer span of orbits 42.5, nasal constriction 0.74, orbit width – inner 15.2, outer 16.0, muzzle width 24.5, and mandible width 50.1.

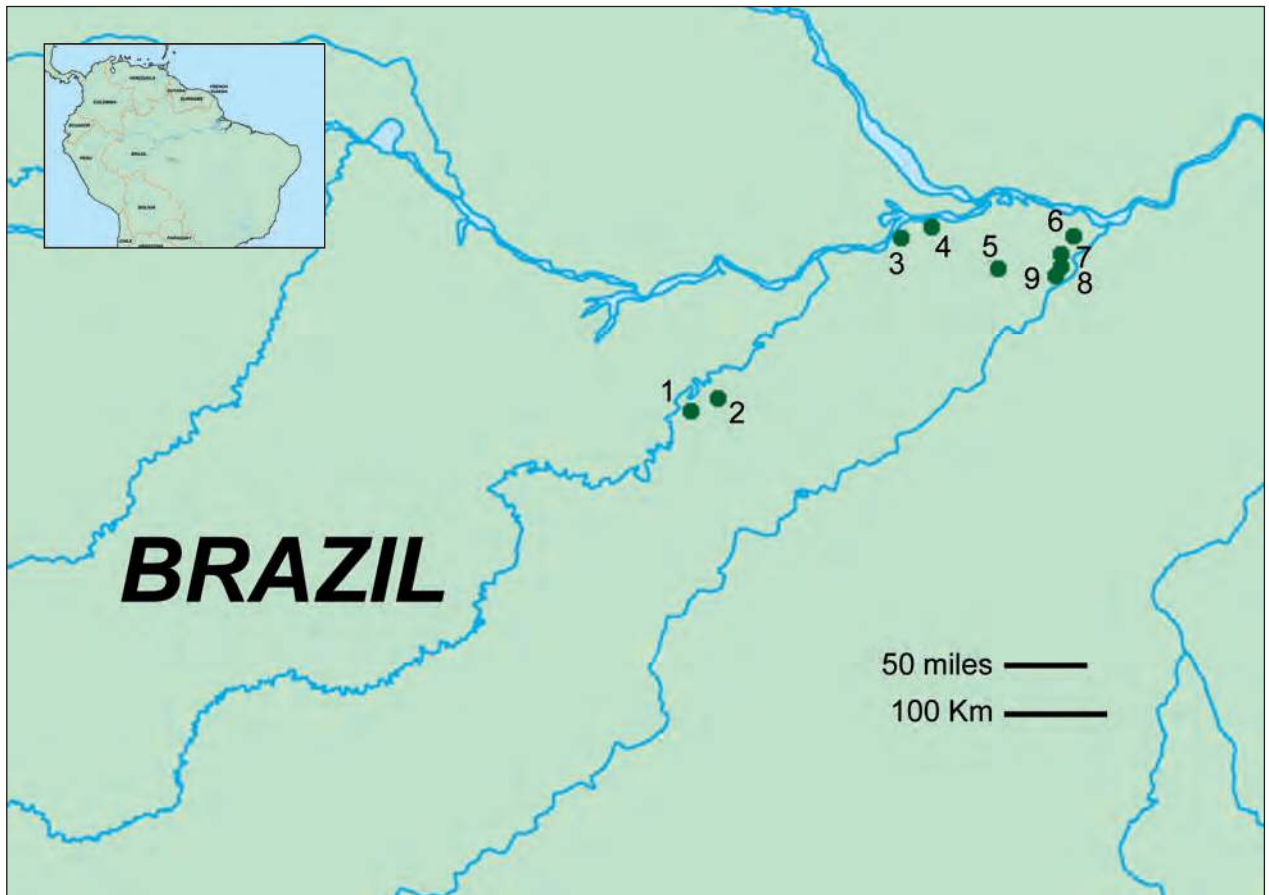
Distribution. Map 16. In Brazil only, they are found south of the Rio Solimões in the northern area between the rios Purus and Madeira, including Autazes, Lago do Canabouça, lago Sampaio and Miguel (including the area formerly called “Rosarinho”), Rio Juma, and one specimen reported from Itaboca, which appears to be a juvenile male *P. pissinattii* collected from the right bank (NHRM No. A62-1200). It is not known how far south between the Purus/Madeira these animals occur before they meet with *P. irrorata*, if they do at all.

Specific locations. Appendix I. BRAZIL. Amazonas: Solimões – Parana do Jacaré, Canabouça, Lago Canabouça; Rio Purus – Lago Jari, Itaboca; Autazes; Rio Juma - Juma Lodge; Rio Madeira - Rosarinho, Lago Miguel, Lago Sampaio; Manaquiri.

Discussion. *Pithecia pissinattii* sakis may occur east of the Rio Madeira, and gene flow with *P. mittermeieri* may be impacting the population west of the Rio Madeira. More research is needed, however. As with many saki populations in this monograph, the convention of large watersheds is used as a preliminary hypothesis for the separation of species, particularly in their lower, wider reaches.

Table 26. Reported measurements for *P. pissinattii* from Paraná do Jacaré, Canabouça, Brazil.

Post-crania (cm)	Head-body	Tail	Hind foot	Ear
Males				
BMNH 25.12.11.2	55	48	–	–
BMNH 26.5.5.7	54	48	–	–
BER 33937	51	52	–	–
BER 91314 (SAM)	50	47	–	–
BMNH 27.8.11.19 (Juv)	45	42	–	–
MNRJ 3313	45	48	11.5	2.4
MNRJ 3316	50	48	12.5	2.3
SEN 6917	47	47	–	–
NHRM A64-0097	49	48	–	–
Females				
NHRM 3314	50	45	11.8	2.4
BMNH 26.5.5.8	51	49	–	–
BMNH 27.8.11.14	50	49	–	–
BMNH 25.12.11.4	43	45	–	–
BMNH 27.8.11.13	53	47	–	–
BMNH 27.8.11.16	51	48	–	–
BMNH 25.12.11.3	52	48	–	–
BMNH 27.8.11.20	41	43	–	–



Map 16. Geographic distribution of *Pithecia pissenattii*.

Brazil

1. Itaboca
2. Rio Jari
3. Canabouça (by gazetteer Paynter Jr & Traylor Jr. 1991)

4. Manaquiri
5. Juma Lodge
6. Autazes

7. Rosarinho
8. Lago Sampaio
9. Lago Miguel



Figure 93. *Pithecia pissinattii*. Holotype BMNH No. 26.5.5.7, adult male, skin.



Figure 94. *Pithecia pissinattii*. Holotype BMNH No. 26.5.5.7, adult male, skull.



Figure 95. *Pithecia pissinattii*. Paratype BMNH No. 27.8.11.13, adult female skin and skull.



Figure 96. Adult male *Pithecia pissinattii* at Juma Jungle Lodge, Rio Juma, Brazil. Photo by Crijnfotin via Flickr.



Figure 97. *Pithecia pissinattii* subadult male from Manaquiri. Photo by Ricardo Sampaio.

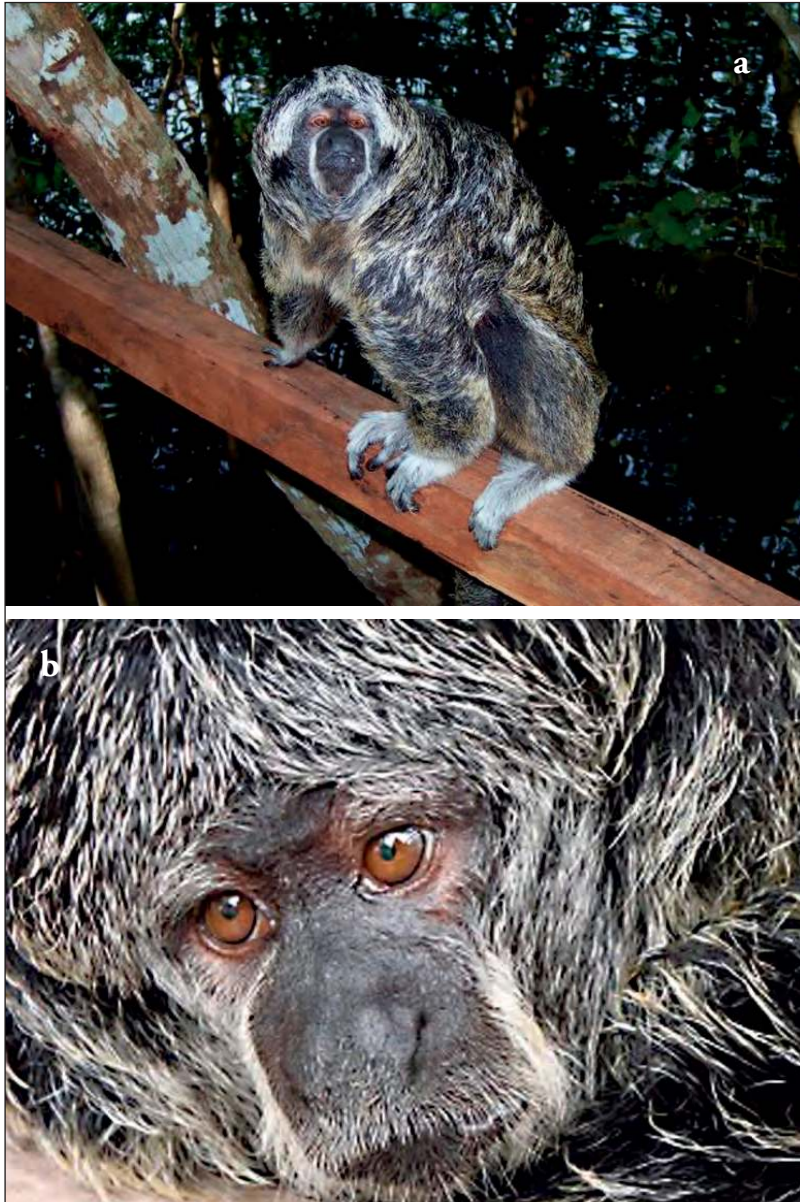


Figure 98. *Pithecia pissinattii*. (a) Adult female, photo by Trip Wow Website and (b) juvenile female, photo by Crijnfotin via Flickr, both at the Juma Jungle Lodge, Rio Juma, Brazil.

DISCUSSION

I think it is important to emphasize my goals with this monograph, as well as the goals of taxonomy in general. Groves (2001) said: “Taxonomy, like other fields of biology (ecology, ethology, physiology, genetics), is a dynamic science. Classifications are not engraved in stone, nor should they be; it is unfortunate that advances in the taxonomic field, unlike those in ecology and other disciplines, often require changing the names we give to species [...] but that is the way it must be, and the irritation felt [...] will pass quickly. Indeed, new predictions, to be tested in the field, may well emerge from the reclassification” (p.5). It is exactly my intent to create a hypothesis for the taxonomy of *Pithecia* so that we can continue to piece together the story, historic and present-day in the field, to give us greater detail for understanding this fascinating group of monkeys. Ultimately, the goal is to conserve as many saki species in the wild as possible, and that is only achievable with a working taxonomy. My rationale for this work was to “tame the madness” of *Pithecia* taxonomy, not to perfectly corroborate every specimen or living saki out there. I think this treatment comes close—even though in many cases I was a “lumping splitter,” I feel I gave as much rigor as possible to the determinations with the data at hand.

Taxonomic hygiene

I mentioned in the “Introduction” the trouble with comparative studies, especially in genetics, that are lax in assuming that *P. monachus*, *P. irrorata*, or other previous “catch-all” species are well-defined and valid taxonomic units. Even cladistic relationships between genera, such as those comparing *Pithecia* to other pitheciids, one would think to be “safe.” However, if samples, specimens or individuals are used from more than one geographic location, the lack of a rigorous taxonomy makes it entirely possible that more than one species is being lumped together to represent the “*Pithecia*” unit.

Researchers in cladistics, genetics, and morphology rarely report exactly what specimens were used, where they were collected, or on what grounds they are determining the species’ name. Those that do report detailed information on their test subjects, even if the taxonomy changes are at least able to clearly compare their work with others in the future.

Bortolus (2008) found that biology, ecology, biodiversity, genetics, and like disciplines, tend to disregard reporting the taxonomic pedigree. This occasions “a cascade of errors with negative consequences for the development of scientific knowledge, as well as for biodiversity and human welfare.” He concluded that, “a single incorrect taxonomic identification has a great potential to be assimilated into many different biological and ecological studies and then in several environmental management studies and programs, multiplying

its impact synergistically.” He maintained that these kinds of errors are likely to have a variety of negative consequences, such as identifying a population as homogeneous and monospecific when it should actually be recognized as a complex assemblage with distinct geographic distributions. At a minimum, cascading errors in taxonomy in our field are annoying and inaccurate, at worse they are affecting our ability to do good science, conserve species, or get funding.

Bortolus correctly argues that there is a real need for reliable taxonomic confirmation of the different taxa we work with through updated methods and perspectives. He maintains, “Ecologists usually have the feeling that taxonomic assistance may not be needed when working in areas that have been studied for decades (or centuries) by many other ecologists. However, it is clear that just because many other ecologists have been working in the exact same place we are now does not guarantee that the existing species assemblages are currently the same or prevent cryptic non-native species or genotypes from being introduced and unnoticed.” It is clear that we can easily substitute ‘primatologists’ for his ‘ecologists’ as we all suffer the same biases. And while we may not necessarily have cryptic species, we certainly might have more than one species within an historically named taxa, or, as is the case with *Pithecia*, species whose juvenile members have such vast color variations that in the past they were called out as new species.

It is clear in primatology, as it is in biology generally, that taxonomy is all too often seen as a dead science. I myself as a trained field ecologist could not think of anything worse than having to riffle through dead animals in the dusty stacks of a museum. But the lesson learned was a valuable one: we are making more of a mess by perpetuating mistakes than consulting our taxonomists when we do our research. Bortolus says this: “A main causal factor in the error cascade is that even though we recognize taxonomy as an important part of biology as a whole, during the last decades taxonomists have lost consideration from the rest of the scientists. If ecologists disregard or underestimate the work of taxonomists, then they must show reliability and excellence in their taxonomic identifications, and this is not what presently seems to be occurring.”

The path forward

So what can we do? I concur with Bortolus that in an ideal world we would be sure to consult with taxonomists directly and involve or consult them about the different taxa in our studies before we publish so we know exactly what species we are studying, comparing, or reporting on. However, in our field I can literally count on less than one hand the number of trained taxonomists at our disposal. Which means we all need to practice taxonomic hygiene when we publish our work, so that at a minimum we can accurately compare our findings.

To do this I suggest the following for all studies of primates.

1. Add a voucher photograph. This is especially important if you are studying *Pithecia*, but is needed for any species. If your document is published online, make sure it is in color. If your specimen is dead—either as a skin, skeletal material, fluid, tissue, DNA, mount, or other—add a photo of the living source, if possible. If it is not possible to obtain a photo, then a detailed description of the once-living animal could suffice.
2. Provide a specific location for where you are working or where your (living/dead) subject is from. Field primatologists tend to be good at this since they need to let us know where their field sites are. But an extra level of detail would be nice when speaking about study animals even *in situ*, such as sides of a river (left or right are old conventions, use ordinates), or how far from a river you traveled and in what direction you were when you (encountered, heard, studied, took samples from) the species.
3. Report as much information as you have on samples. If doing genetics, cladistics, or other experiments: specimen numbers, collection dates, locations, collectors, museums of origin, where you got the tissue sample—anything you can report is very important. If you receive samples from a catalog or bio supply house, it may take some doing, but track down the necessary source information.

If you believe you have a new species of primate, there are some immediate things to do before dashing off a publication about it.

1. Contact a taxonomist. There are many subject matter experts, but contacting one of our known primate taxonomists and have them direct you is so important. And if you do not know a taxonomist, look one up: every natural history museum has one.
2. Do not kill anything (not at first anyway). Get good photos, maybe dart it and take material for analysis, but do not take a voucher until it is clear you have a new species;
3. Do the work. If no one has done a paper (like this one) recently, you might need to track down all of the museum specimens, living photos, field sites, maybe do more field work—before you can rightfully declare a new species.

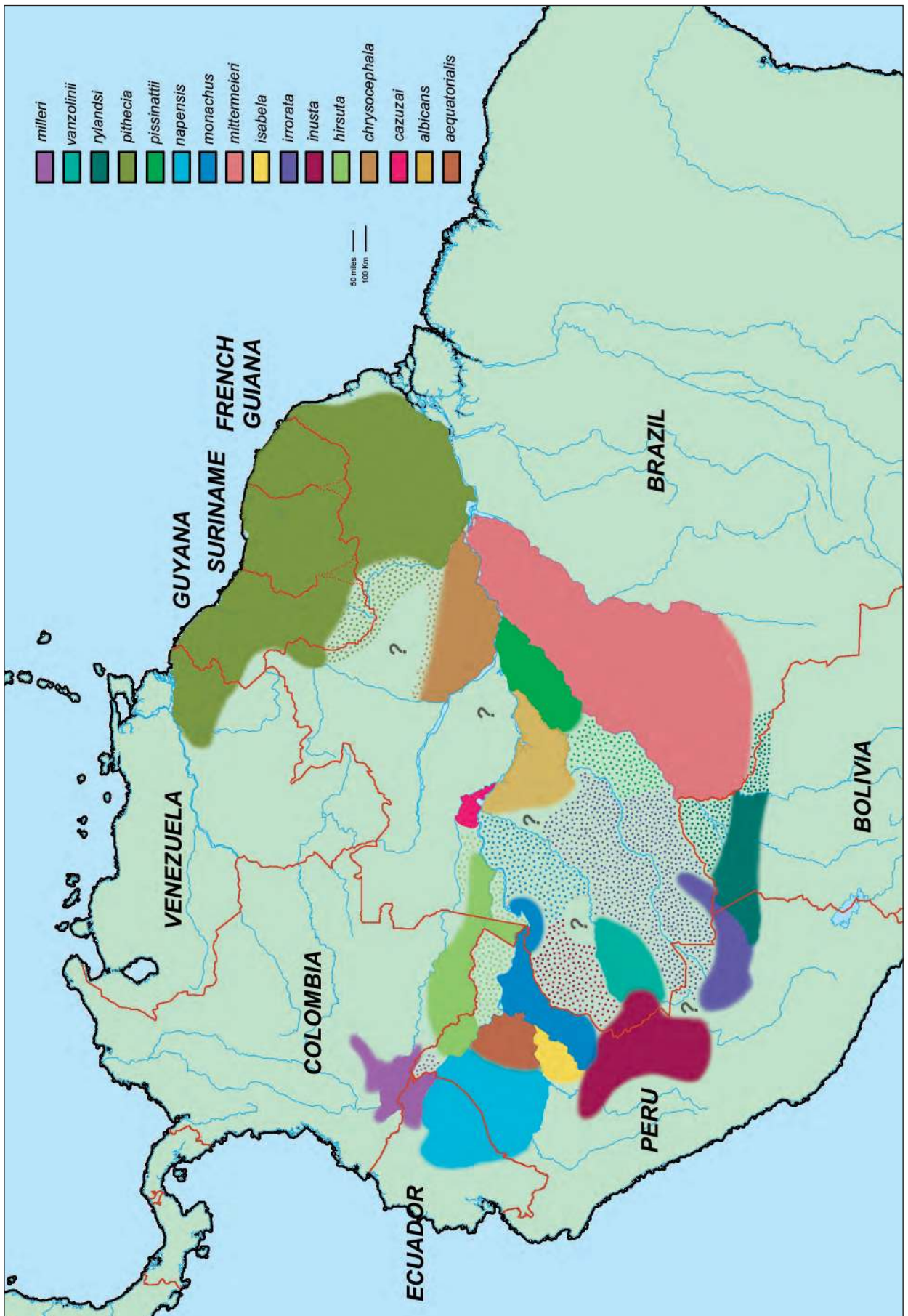
In conclusion, I implore all of us to do a better job in the nomenclature and taxonomy of Primates. Because it cannot be said enough, a reliable taxonomy is among the major factors guaranteeing the accurate identification of biodiversity hotspots, wilderness areas, endangered species, and areas of greatest concern that impact all of the animals

we care so much about...and besides, researchers 200 years from now will thank you.

Summary

In this revision, there are five original species, three species elevated from subspecific rank, three historic species reinstated, and five newly described species. The total number of *Pithecia* species is 16.

Map 17 illustrates the full range of *Pithecia* in the Amazon Basin and Shield countries. Figure 99 is a rough distributional schematic, and Figures 100 and 101 provide side-by-side representation of all species and schematics of all species described in this publication. Appendix III provides an interpretation based on this taxonomy of the Hershkovitz (1987) paintings by Zorica Dabich, which recently became available in color for our use through the courtesy of Field Museum of Natural History.



Map 17. The approximate distributions of the saki monkeys, *Pithecia*, following the classification proposed. Map by Stephen D. Nash.

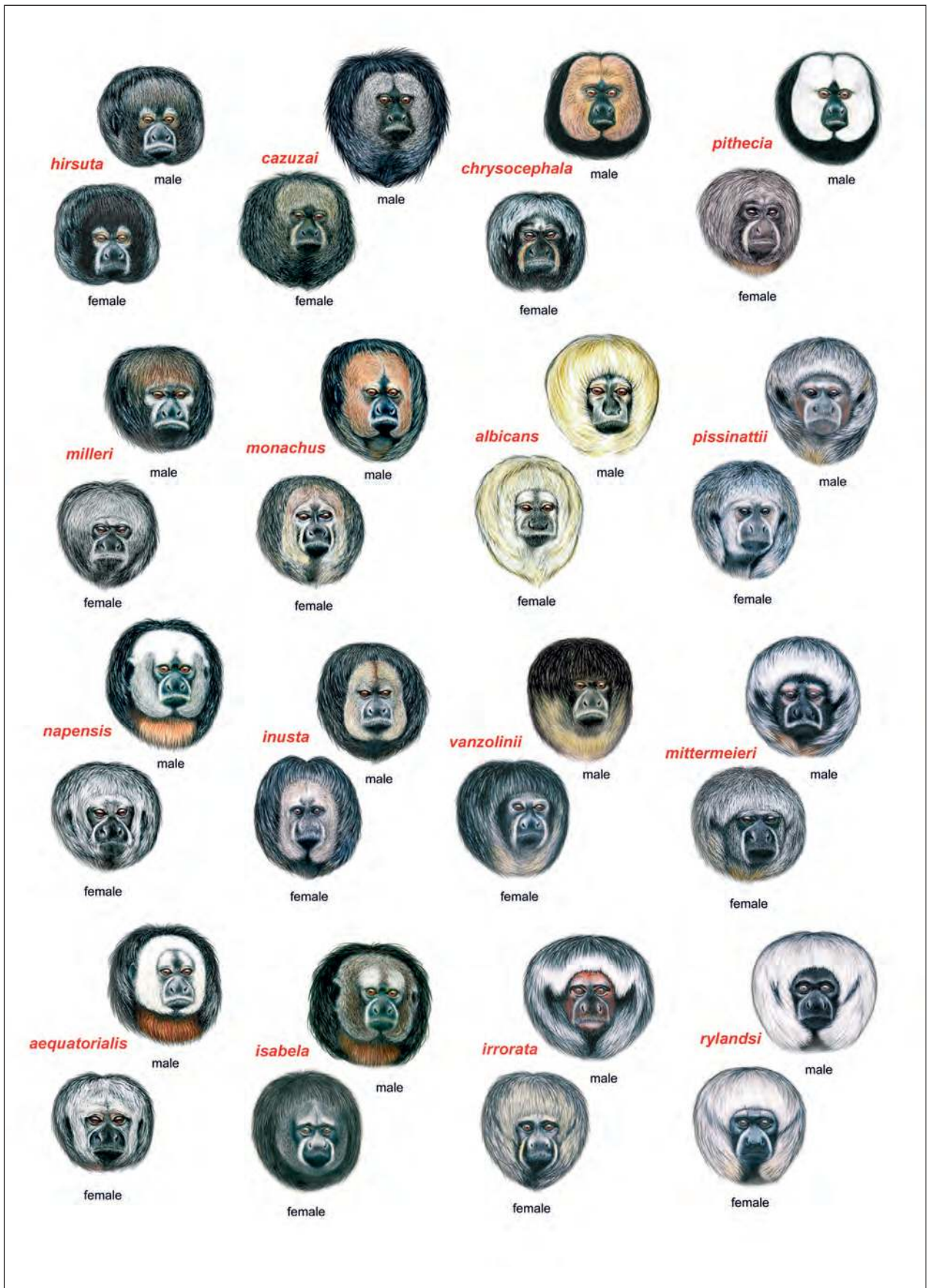


Figure 100. Male and female faces of all *Pithecia* species in a roughly geographic arrangement. Illustration by Stephen D. Nash.



Figure 101. The species of *Pithecia*, male and female, full bodies, in roughly geographic arrangement. Illustration by Stephen D. Nash.

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APPENDIX I: *PITHECIA* GAZETTEER AND COLLECTING LOCALITIES

- Acajutuba, Rio Negro, Amazonas, Brazil [03°02'S, 60°25'W; E. Sneath 1916].
- Acre, Estação Ecológica do Rio Acre, Brazil [PH].
- Aguarico (Río), Sucumbios, Ecuador [-0.27, -76.38].
- Altamira, Río Manu, Madre de Dios, Peru [-11.8, -70.8 // 12°12'S, 71°08'W; C. Kalinowski, 1960, 1961].
- Amacayacu National Park, Amazonas, Colombia [-3.29, -70.14].
- Amazonia, Parque Nacional da; near Itaituba, Pará, Brazil [-4.3, -56.7].
- Amorin (Igarapé), Pará, Brazil [-2.0, 54.9; Olalla Brothers 1931 in Paynter Jr. and Traylor Jr. 1991].
- Anavilhanas Archipelago, Estação Ecológica, [02°45'S, 60°45'W; PH].
- Andira (Lago), Amazonas, Brazil [-2.3, -56.9].
- Andira (Rio), mouth; Amazonas, Brazil [-2.4, -56.8].
- Aniba (Igarapé); Amazonas, Brazil [02°55'S, 58°33'W; A.M. Olalla 1936].
- Apuau (Rio), Amazonas, Brazil ["02°32'S, 60°48'W"; M.C. Mello 1959].
- Aripuaná (old), Mato Grosso, Brazil [09°10'S, 60°38'W; F. Stolle 1914].
- Aripuaná (Rio) [-4.2, -60.4; F. Röhe].
- Arrawarra Creek, Nickerie, Suriname [5.46, -55.71].
- Arouani River, French Guiana [4.74, -53.78].
- Arua, Rio Arapiuns, Pará, Brazil [02°39'S, 55°38'W; A.M. Olalla 1936].
- Arumá, Rio Purus, Amazonas, Brazil [04°44' S, 62°08'W; A.M. Olalla 1935].
- Atabani (Rio) (= Itabani, Rio), Amazonas, Brazil [02°47'S, 58°14'W; A.M. Olalla 1937].
- Atalaya do Norte, Rio Javari, Amazonas, Brazil [-4.24, -70.19].
- Auara (Igarapé), Rio Madeira, Amazonas, Brazil [4°24' S, 59°35'W; Olalla brothers. 1930].
- Autazes, Rio Madeira, Amazonas, Brazil [-3.58, -59.13].
- Ayapua (Lago), Amazonas, Brazil [-4.35, -62.14].
- "Bacabal Cuieira Apuau", Rio Negro, Amazonas, Brazil [M.C. Mello. April 1959; PH].
- Baeza, Napo, Ecuador [-0.2, -77.9; W.M. Richardson, January 1913].
- Balbina (Balbina Dam, Represa de Balbina, south end), Rio Uatumã, Amazonas [-1.7, -59.4].
- Balta, Rio Curanja, Rio Purus, Ucayali, Peru [10°08'S, 71°13'W; J.P. O'Neill 1963 and A.L. Gardner 1966, 1968, 1971 (PH)].
- Barra do Rio Negro (= Manaus), Amazonas, Brazil [-3.06, -59.97].
- Bartica, Demerara-Essequibo, Guyana [6.41, -58.62].
- Base Atun, Río Samiria, Reserva Nacional Pacaya-Samiria, Loreto, Peru [-5.17, -74.67].
- Belen, Río Cunucunuma, Amazonas, Venezuela [03°39'N, 65°46'W; M. Tuttle 1967].
- Benjamin Constant, Rio Javari, Amazonas, Brazil [-4.25, -70.03].
- Berbice; Guyana [05°27'N, 57°57'W; PH].
- Bigi Poika, Para SR, Suriname [5.64, -55.49].
- Blanco (Quebrada), Loreto, Peru [4°19'S, 73°14'W].
- Bobonaza (Río), Morona-Santiago, Ecuador [01°44'S, 77°29'W // mouth: -2.57, -76.63].
- Boia (Lago), Rio Tefé, Amazonas, Brazil [approx. 04°10'S, 65°7'W; Paynter Jr. and Traylor Jr. 1991].
- Boiuçu, Buiussu (Igarapé) (= Boiussu, Igarapé), Pará, Brazil [01°53'S, 54°53'W].
- Bolivia (Igarapé); Amazonas, Brazil [03°08'S, 60°01'W; E. Sneath 1916].
- Bolivar Botanical Garden, Orinoco, Venezuela [7.8, -63.3].
- Bomba, Río Bomba at mouth, Loreto, Peru [07°19'S, 73°55'W; Stevens and Traylor Jr. 1983].
- Bonasia (= Bonasika); Essequibo, Guyana [06°45'N, 58°30'W].
- Bonnesique Creek (Bonasika River), Essequibo, Guyana [06°45'N, 58°30'W].
- Borba, Rio Madeira, Amazonas, Brazil [-4.34, -59.59].
- Botonamo (Rio), near Río Cuyuni, Bolivar, Venezuela [06°59'N, 61°11'W; PH].
- Branco (Rio), Acre, Brazil [-9.8, -67.8].
- Branco (Rio), alto, at Rio Maracá, Amapá, Brazil [00°32'N, 52°13'W; PH].
- Brabo, (Bravo), Pará, Brazil [-2.0, 54.9; Olalla brothers 1931 in Paynter Jr. and Traylor Jr. 1991].
- Bratica, Guyana [6.44, -58.61].
- Bravo, Edo. do Eira (= Lara), Pará, Brazil [-1.89, -55.18].
- Bravo (Igarapé), Rio Tapajós Pará, Brazil [02°26'S, 55°00'W; PH].
- Bravo Ravine, Río Cotuhe, Amazonas, Colombia [3.03, -70.16].

- Brownsberg Nature Preserve, Brokopondo, Suriname [5.00, -54.87; R. A. Mittermeier].
- Brownsberg Nature Preserve, Sipaliwini, Suriname [05°1'N, 55°34'W; M. Norconk].
- Caciporé do Amapá (Rio), Amapá, Brazil [3.8, -51.2].
- Cacoal Selva Park, Rondônia, Brazil [-10.9, -61.5].
- Cachoeira do Tronco, Rio Erepecuru (= Rio Parú do Oeste), Pará, Brazil [01°04'S, 56°02'W; M. Lasso 1937].
- Cahuinari (Río), Amazonas, Colombia [-1.38, -71.65].
- Caititu (Igarapé), Rio Uatumá, Amazonas, Brazil [-1.75, -59.75].
- Canabouça, Paraná do Jacaré; Amazonas, Brazil [03°30'S, 60°41'W; K. Lako 1932, W. Ehrhardt 1925-26 (PH)].
- Canabouça (Lago); Amazonas, Brazil [cf., Canabuoca].
- Canacari (Lago) or Canacary, Amazonas, Brazil [02°57'S, 58°15'W; A.M. Olalla 1935].
- Caño Agua Blanca, Curare-Los Ingleses Indigenous Reserve, Colombia [01°19'36"S, 69°46'02"W; E. Palacios]
- Caño Arapa, Puré National Park, Colombia [02°19'S, 69°44'W; E. Palacios]
- Caño Curare, Curare-Los Ingleses Indigenous Reserve, Colombia [01°20'5"S, 69°49'22"W; E. Palacios]
- Caño El Boliviano, Camaritagua Indigenous Reserve / Vereda Madroño, Colombia [01°24'42"S, 69°34'58"W; E. Palacios]
- Caño Esperanza, Puré National Park, Colombia [01°50'23"S, 69°43'39"W; E. Palacios]
- Caño Mateo, Puré National Park, Colombia [02°08'S, 69°48'W; E. Palacios]
- Caño Zumaeta, Curare-Los Ingleses Indigenous Reserve, Colombia [01°22'19"S, 69°58'04"W; E. Palacios]
- Caruaro (Lago), Rio Iça at Solimões, Amazonas, Brazil [03°29'S, 68°02'W; K. Lako and Salatke (PH)].
- Carvara, (Lago do), Brazil [03°07'S, 68°02'W; PH].
- Cassipore (Rio) (= Rio Caceporé do Amapá); Amapá, Brazil [PH].
- Caterpiza (Río), Río Santiago, Amazonas, Peru [-3.6, -77.7].
- Caucaya Airport, Puerto Leguizamo, Putamayo, Colombia [-0.12, -74.76].
- Caucaya (Quebrada), Limoncocha, Miguel Velasquez Farm, Putamayo, Colombia [-0.07, -74.83].
- Cayenne, French Guiana [5.03, -52.33].
- Cerro Azul, Río Ucayali, Ucayali, Peru [07°14'S, 74°34'W; J.M. Schunke 1947].
- Chamicuros, Río Samiria, Loreto, Peru [05°30'S, 75°15'W; H. Bassler Collection 1927 (PH)].
- Chicosa, Río Ucayali, Ucayali, Peru [10°21'S, 74°00'W; R.W. Hendee 1927].
- Cipotuba (Lago do), Rio Aripuaná, Rondônia, Brazil [-4.8, -60.2].
- Chupinguaia, near RO-391, Rondônia, Brazil [-12.0, -61.0].
- Cobija, Río Acre Pando, Bolivia [11°01'S, 68°44'W; C. Freese, P. Heltne, N. Castro, and G. Whiteside 1975 (PH)].
- Cocha Cashu, Río Madre de Dios, Madre de Dios, Peru [-11.88, -71.39].
- Colina do Veado, Óbidos; Pará, Brazil [01°54'S, 55°31'W; E. Snethlage 1912 (PH)].
- Cononaco (Río), Ecuador [-1.2, -75.9].
- Contamana, Loreto, Peru [-7.34, -75.01].
- Copataza (Río), Pastaza, Ecuador [02°07'S, 77°27'W; C. Buckley 1877, 1878].
- Coppename River, Lolopasi west bank, across from Foengoe Island, Sipaliwini, Suriname [4.86, -55.96].
- Côrrego do Campo, Pimento Bueno, Rondônia, Brazil [q.v.; Comissão Rondon, 1914 (PH)].
- Cotuhe (Río), Tarapaca, Amazonas, Colombia [-2.77, -69.72].
- Cravari, Mato Grosso, Brazil [PH].
- Cruzeiro do Sul, Amazonas, Brazil [-7.63, -72.68].
- Cuieiras (Rio), mouth of, Rio Negro, Amazonas, Brazil [-2.83, -60.50].
- Cuipeua (Lago), near Boiussu, Pará, Brazil [PH].
- Cuiteua (Lago) (= Lago Cuipeua), Pará, Brazil [-1.84, -55.5].
- Cumeria (= Cumaria), Río Ucayali, Ucayali, Peru [09°52'S, 74°01'W; R.W. Hendee, August 1927].
- Curaca (Quebrada), Loreto, Peru [04°60'S, 73°43'W; F. Cornejo].
- Curaray (Río), mouth; Loreto, Peru [-2.0, -74.1].
- Curaray and Nahiño (between ríos), Peru [-1.3, -75.5; R. Aquino].
- Curaray (Río), mouth, at Río Napo, Ecuador [02°22'S, 74°05'W; Olalla brothers, October, November, December 1925].
- Curumo (Río), Bolivar, Venezuela [07°15'N, 61°20'W; PH].
- Cuyabeno National Park (incl. Laguna Garza Cocha) [-0.10, -75.86].
- Dadanawa, Rupununi, Guyana [02°50'N, 59°30'W; PH].
- Demerara Coast Region, Guyana [7.5, -58.6].
- Demerara River, Guyana [5.88, -58.4].

- Destacamento, Río Marañón, Loreto, Peru [03°21'S, 72°45' W; M. Ximenez de la Espada, 1865].
- Destacamento do Ribeiro, Rondônia, Brazil [-9.6, -65.3; Natterer 1883]
- Ega (= Tefé), Amazonas, Brazil [cf. Tefé]
- Eiru (Río), mouth at Río Juruá, Amazonas, Brazil [06°26'S, 69°52'W].
- Eirunepé (= João Pessoa); Amazonas, Brazil [06°0'S, 69°52'W].
- El Dorado, Bolívar, Venezuela [06° 44'N, 61° 38'W; PH].
- El Hacha (Quebrada) Caquetá River Expedition 1960 [-0.15, -74.57].
- El Infierno Farm, Puerto Santander, Río Caquetá, Caquetá, Colombia [0.70, -75.20].
- El Manaco, 59 Km SE of El Dorado at Km 74, Bolívar, Venezuela [7.2, -61.6].
- Erepecurú (Río) (now upper Río Parú do Oeste) [01°30'N, 56°00'W].
- Espelho (Serra), Pará, Brazil [cf. Faro, PH].
- Esperanza, Quebrada, Río Yavari-Mirim, Loreto, Peru [04°21'S, 71°58'W; C. Kalinowski, 1957].
- Essequibo (River), West Demerara, Guyana [6.70, -58.58].
- Estación Biológica Pithecia Loreto, Río Samiria, Peru [05°10'S, 74°40'W; PH].
- Estación Biológica Panguana, Río Lullapichis, Huanaco, Peru [09°36'S, 74°56'W].
- Estribaciones, Ecuador [00°32'S, 77°34'W; L. Albuja].
- Estirão do Equador, Ro Javari, Amazonas, Brazil [-4.38, -71.55].
- Faro, Río Nhamunda, Pará, Brazil [02°11'S, 56°44'W].
- Flexal (Lago) (also see Bravo), Pará, Brazil [-1.89, -55.18].
- Fonte Boa, Río Solimões, Amazonas, Brazil [-2.44, -66.07].
- Fordlândia, Río Tapajós, Pará, Brazil [03°40'S, 55°30'W; PH].
- Forte do Río Branco, Roraima, Brazil [03°01'N, 60°28'W].
- Galvez (Río), Loreto, Peru [05°15' S, 73°10'W].
- Gi-Paraná (Río), (= likely Río Ji-Paraná), Rondônia, Brazil [08°03'S, 62°52'W; PH].
- Gordão (Igarapé), Río Juruá, Amazonas, Brazil [06°35'S, 69°52'W; A.M. Olalla, 1936].
- Grande (Igarapé), left bank Río Juruá, Amazonas, Brazil [06°37'S, 69°52'W; A.M. Olalla, 1937].
- Grande (Lago), Río Juruá, Amazonas, Brazil [06°41'S, 69°53'W; A.M. Olalla 1936].
- Grande (Río), Bolívar, Venezuela [08°16'N, 61°17'W; PH].
- Guajará-Mirim, Rondônia, Brazil [-10.80, -65.34].
- Guaporé (Río); Rondônia, Brazil (= Río Mamoré, Beni, Bolivia) [11°55'S, 65°10'W].
- Guri, Operación Rescate, Río Caroni, Bolívar, Venezuela [07°40'N, 63°00'W; PH].
- Guri (Lago), Bolívar, Venezuela [8.2, -62.9].
- Gurisoco, El Palmar; Bolívar, Venezuela [08°01'N, 61°56'W; PH].
- Hanover, Weg (nearby), Para SR, Suriname [5.57, -55.13].
- Humaitá, Río Madeira, Amazonas, Brazil [-6.9, -63.0].
- Humboldt, Von (= Von Humboldt), Huanuco, Peru [08°45'S, 75°05'W; PH].
- Iaunari (= Yavanari or Javanari), Amazonas, Brazil [-0.3, -64.8].
- Itaboca, Río Purus, Amazonas, Brazil [04°53'S, 62°41'W; A.M. Olalla 1935].
- Inuya (Río), mouth at Río Urubamba, Ucayali, Peru [-10.68, -73.46].
- Ipousin (= Ipoucin Crique), French Guiana [04°09'N, 52°24'W].
- Iqué-Aripuaná, Estação Ecológica, Mato Grosso, Brazil [PH].
- Iqué, Estação Ecológica, Mato Grosso, Brazil [PH].
- Iqué-Juruena, Estação Ecológica, 11°30'–12°21'S, 58°42'–59°53' W; E.Z.F. Setz and K. Milton 1983 (PH).
- Iquitos, Río Amazonas, Loreto, Peru (03°46'S, 73°12'W).
- Irاندuba, Río Amazonas, Amazonas, Brazil [-3.0, -60.2].
- Itabani (Río), or Atabani, Amazonas, Brazil [02°47'S, 58°14'W; A.M. Olalla 1937].
- Itaboca, Río Purus, Amazonas, Brazil [-4.83, -62.76].
- Itacoatiara, Río Amazonas, Amazonas, Brazil [-3.04, -58.44].
- Itaituba; Pará, Brazil [04°17'S, 55°59'W; PH].
- Jaburu, Río Purus, Amazonas, Brazil [05°36'S, 64°03'W; PH].
- Jacarécanga; Pará, Brazil [-6.23, -57.77].
- Jamundá (cf. Nhamundá), Pará, Brazil.
- Jari (Río) at Lago Jari, Pará, Brazil [-4.93, -62.37].
- Jaru, Reserva Biológica Federal; Rondônia, Brazil [10°00' S, 62°00'W; PH].
- Javanari, (cf. Yavanari), Amazonas, Brazil.
- João Pessoa (= Eirunepé), Amazonas, Brazil [06°40'S, 69°52'W; A.M. Olalla, 1936].
- Juma Lodge, Lago Juma/Río Juma, Amazonas, Brazil [03°48'S, 59°49'W].
- Juruá (Río); mouth, at Río Amazonas, Amazonas, Brazil [-2.64, -65.75].
- Kabalebo River, Sipaliwini, Suriname [4.40, -56.98].

- Kaieteur Falls, Essequibo, Guyana [5.27, -59.49].
- Kaiserberg Airstrip; Nickerie, Suriname [03°10'N, 56°15'W; PH].
- Kapoeri Creek, Nickerie, Suriname [5.41, -57.13].
- Kayser Gebergte, current airstrip nearby, Sipaliwini, Suriname [3.3, -56.4].
- Kayser Mountains, Sipaliwini, Suriname [3.3, -56.7; M. van Roosmalen study].
- Kalacoon, Mazaruni-Potaro, Guyana [06°24'N, 58°39'W; Stephens and Traylor Jr. 1985].
- Kartabo, Mazaruni-Potaro, Guyana [06°23'N, 58°41'W; Stephens and Traylor Jr. 1985].
- Km 16, BR 230, Rondônia, Brazil [-7.2, -62.6].
- Km 19, Itaituba-Jacarácanga, Pará, Brazil [06°13'S, 57°44'W; PH].
- Km 21, BR 174 Tarumã, Manaus, Amazonas, Brazil [-2.97, -60.0].
- Km 104-200, Manaus-Itacoatiara; Amazonas, Brazil [02°58'S, 58°59'W; M. Mello 1967].
- Km 105, BR 174 N, Manaus, Amazonas, Brazil [-1.94, -60.08].
- Km 212, Itaituba-Jacarácanga, Para, Brazil [04° 53' S, 56° 47' W; PH].
- Km 165, Manaus-Itacoatiara; Amazonas, Brazil [03°01'S, 59°00'W; M. Mello 1965, A. Faustino 1965].
- Km 170, Manaus-Itacoatiara; Amazonas, Brazil [03°01'S, 58°58'W; M. Mello 1967].
- Km 190, Manaus-Itacoatiara; Amazonas, Brazil [02°58'S, 58°52'W; M. Moreira 1966, M. Mello 1967].
- Kourou Road, Saut Laurent, French Guiana [5.38, -53.07].
- La Coca, Río Napo, Napo, Ecuador [00°28'S, 76°58'W; M. Jiménez de la Espada, 1865].
- Lagarto, Río Ucayali, approx. Olalla camp, Ucayali, Peru [-10.64, -73.81].
- Lagarto Cocha (mouth), border Ecuador/Peru [00°39'S, 75°16'W; Olalla brothers 1926 - 1928].
- Lago Piratuba, (Reserva Ecológica), Amapá, Brazil [01°37'N, 50°10'W; A. B. Rylands and R. A. Mittermeier 1982 (PH)].
- La Chorrera, Igara-Paraná (Río), 20 km downstream of La Raicilla Ravine, Amazonas, Colombia [-1.47, -72.62].
- La Macarena, Meta, Colombia [2.21, -73.94].
- La Muralla (= Morelia), Caquetá, Colombia [1.50, -75.73].
- La Poule, Saramacca, Suriname [05°47'N, 55° 25'W; PH].
- Las Patas, Bolivar, Venezuela [07°11'N, 62°22'W; PH].
- La Solita Creek, Solita, Colombia [00°54'N, 75°39'W].
- La Trinidad, El Palmar, Bolivar, Venezuela [07°25'N, 61°49'W; PH].
- Lely Gebergte, Sipaliwini, Suriname [4.47, -54.65].
- Limoal, near Boim, Pará, Brazil [-2.82, -55.17; Paynter Jr. and Traylor Jr. 1991].
- Limoatuba, Pará, Brazil [-2.0, 54.9; Olalla brothers 1931 in Paynter Jr. and Traylor Jr. 1991].
- Limontuba (= Limoatuba), Pará, Brazil [PH].
- Llullapichis (= Yuyapichis) (Río) mouth, Huanuco, Peru [-9.62, -74.96].
- Loksie Hattie, Suramaca River, Brokopondo, Suriname [5.33, -55.35].
- Los Amigos Concesión para Conservación, Río Los Amigos, Madre de Dios, Peru [12°34'S, 70°6'W].
- Macapá, Amapá, Brazil [0.03, -51.07].
- Macas, Morona-Santiago, Ecuador [-2.1, -78.1].
- Maisisa, Ucayali, Peru [08°36'S, 74°19'W; Stevens and Traylor Jr. 1983].
- Mamirauá Reserve, Amazonas, Brazil [-2.40, -65.36].
- Mamore (Río), mouth, Beni, Bolivia, also Rio Guaporé, Rondônia, Brazil [-10.43, -65.39].
- Manacapurú, Rio Solimões, Amazonas, Brazil [-3.1, -60.6].
- Manaquiri, south of Rio Amazonas, Amazonas, Brazil [-3.37, -60.42].
- Manarica Creek, Essequibo River, Guyana [PH].
- Manaus, Amazonas, Brazil [-3.06, -59.97].
- Manu, Parque Nacional, Madre de Dios, Peru [-11.8, -70.8].
- Mapixi (Lago), (= Lago Mapiocu), Rio Purus, Amazonas, Brazil [05°43'S, 63°54'W; K. Lako 1931].
- Maracá (Rio), Roraima, Brazil [-0.1, -51.6].
- Mararu, Pará, Brazil [-10.43, -65.39].
- Marua (= cf. Mararu); Pará, Brazil.
- Matapi Creek and Kabalebo River near Corantijn River, Suriname [5.08, -57.60].
- Matapi, Suriname [5.11, -57.30].
- Mato Grosso, Mato Grosso do Sul (Natterer 1826), Brazil [-14.3, -59.9].
- Mazaruni River, Essequibo, Guyana [06°24'N, 58°39'W; PH].
- Mazan, Río Amazonas, Loreto, Peru [-3.47, -73.06].
- Mecaya (Río), below mouth, right bank, Río Caquetá, Putumayo, Colombia [00°29'N, 75°11'W; P. Hershkovitz, March 1952].
- Miguel (Lago), (approx. now Lago Bonfim), Rio Madeira, Amazonas, Brazil [-3.79, -59.11].
- Mocoa, Putamayo, Colombia [1.26, -76.65].
- Moengo, SW, Suriname [5.66, -54.44].

- Moengotapoe, Marowijne, Suriname [5.65, -54.29].
- Montalvo, Río Bobonaza, Pastaza, Ecuador [02°14'S, 76°58'W].
- Montanita, Florencia, Caquetá, Colombia [01°30'N, 75°28'W].
- Montealegre (= Monte Alegre), Huanuco, Peru [09°30'S, 74°57'W; Tessman, November 1922].
- Morelia, Río Fragua, Caquetá, Colombia [01°31'N, 75°41'W; L.E. Miller, July 1912].
- Moroni River, Suriname [5.52, -54.05].
- Mucden (= Mukden), Pando, Bolivia [-11.0, -69.1].
- Mukden, Pando Bolivia [11°25'S, 69°01'W; L. Porter, field site]
- Napo Wildlife Center, Río Napo, Ecuador [-0.2, -76.8].
- Napo (Río) at Coca, Orellana, Ecuador [-0.46, -76.98].
- Napo (Río) north near mouth of Río Curaray, Loreto, Peru [-22.0, -74.0; Olalla brothers collection 1925].
- Napo (Río), north of Iquitos, Loreto, Peru [-1.57, -74.21; Olalla brothers collection 1925].
- Nareuda (Río), Mukden, Bolivia [11°18'S, 6°46'W].
- Nashiño (Río), Peru [near -98, -75.31; R. Aquino].
- Nassau Gebergte, near Marowijne River, Sipaliwini, Suriname [4.85, -54.60].
- Nauta, Loreto, Peru [-4.58, -73.77].
- Navio, Serra do (=Vila do Serra), Amapá, Brazil [1.1, -52.0].
- Negro (Río) mouth at Rio Amazonas, Amazonas, Brazil [-3.13, -59.90].
- Nevati (Mission, right bank), Río Pichis, Oxapampa, Pasco, Peru [10°21'S, 74°51'W; D.R. Seidel 1964, M.D. Tuttle 1963].
- Nhamundá (Río), Pará, Brazil [02°14'S, 56°43'W].
- Nova Brasília, Rondônia, Brazil [-10.4, -61.9].
- Nuevo San Juan, Río Galvez, Loreto, Peru [05°15'S, 73°10'W].
- Nuria (Altiplanicia); Bolivar, Venezuela [07°50'N, 61°40'W; PH].
- Óbidos, Pará, Brazil [-1.84, -55.51].
- Oiapoque, French Guiana [3.97, -51.83].
- Oko Mountains, Cuyuni-Mazaruni, Guyana [06°25'N, 58°57'W; E.R. Blake 1937 (PH)].
- Oriximiná; Pará, Brazil [-1.4, -55.9].
- Orosa, Río Amazonas, Loreto, Peru [03°23'S, 72°07'W; Olalla brothers 1926].
- Orosa (Río), Loreto, Peru [-3.69, -72.44; R. Aquino].
- Pacáas Novos (Rio), Rondônia, Brazil [-10.85, -65.00; Natterer 1829].
- Pacáas Novos, Parque Nacional, Rondônia, Brazil [10°30'S, 63°35'W; PH].
- Pacaya-Samiria, Reserva Nacional, Loreto, Peru [-5.20, -74.59].
- Pachitea (Río) mouth, Huanuco, Peru [-8.74, -74.50].
- Palmares, Amazonas, Brazil [PH].
- Palomeu River Camp, Tapanahoni River, Marowijne, Suriname [3.3, -55.4].
- Papel Azul (Igarapé); Amazonas, Brazil [02°45'S, 60°40'W; PH].
- Paramaribo, Suriname [5.87, -55.16].
- Pastaza (Río) mouth at Rio Maraño, Pastaza, Peru [04°54'S, 76°24'W].
- Paranova (Lagoinho), Rio Guaporé, Rondônia, Brazil [11°55'S, 65°10' W; J. Natterer, 1829].
- Paratuco (Rio) (= Piratucu), Amazonas, Brazil [01°59'S, 56°58' W; Olalla brothers 1930].
- Perica River, Moengo, Suriname [5.91, -54.69].
- Parinari (= Parinari Caño?), Loreto, Peru [-4.1, -74.5; Bluntsali-Peyer Expedition 1913].
- Parintins, Amazonas, Brazil [-2.2, -56.7].
- Parque Nacional da Amazônia, Rio Tapajós, Pará, Brazil [03°42'S, 57°21'W; PH].
- Parú do Oeste (Rio), Pará, Brazil [-1.1, -56.0].
- Passarinho (Igarapé), Amazonas, Brazil [PH].
- Patana (Cachoeira), Pará, Brazil [3.13, -62.35].
- Pebas, Río Amazonas, Loreto, Peru [03°20'S, 71°49'W; R.W. Hendee 1928].
- Penal Settlement, Burntbush, Mazaruni-Potaro, Guyana [06°24'N, 58°39'W; PH].
- Piratuba, Lago; Amapá, Brazil [01°37'N, 50°10'W; A. B. Rylands and R. Mittermeier 1982 (PH)].
- Pisqui (Río), Ucayali, Peru [07°45'S, 75°01'W; H. Bassler Collection, 1923].23
- Ponta da Castanha, SW bank Rio Tefé, Amazonas, Brazil [-3.81, -64.97 approx; A. Johns 1985].
- Porongaba, Rio Juruá, Acre, Brazil [-8.66, -72.82].
- Porteira, Pará, Brazil [-0.8, -57.0].
- Porto Mauá, Manaus, Amazonas, Brazil [03°08'S, 60°01'W; M. Oreira 1967, F. Almeida 1965].
- Porto Saids, Rio Juruá, Acre, Brazil [-8.17, -72.76].
- Porto Tírios, Parú do Oeste, Pará, Brazil [02°18'N, 55°16'W; PH].
- Potaro Landing, Essequibo, Guyana [05°22'N, 59°08'W, PH].
- Pucallpa, Ucayali, Peru [-8.35, -74.55].

- Puerto Indiana, Río Amazonas, Loreto, Peru [-3.4, -73.04 //03°28'S, 73°03'W; H. Bluntschli, 1912; Olalla brothers, 1926].
- Puerto Japón, Río Peneya, Caquetá, Colombia [00°07'N, 74°24'W].
- Puerto Leguizamo and La Tagua [between rivers: -0.05, -74.73; K. Watanabe Expedition 1973–1974].
- Puerto Melendez, N bank Rio Marañon, Loreto, Peru [04°27'S, 77°31'W; H. Bassler Collection, February 1929].
- Puerto Pachitea, Río Pachitea, Huanaco, Peru [-9.93, -75.03].
- Puerto Pungo, Río Punga, Loreto, Peru [-5.7, -74.1].
- Puerto Pungo, Río Tapiche, Loreto, Peru [06°14'S, 74°02'W; PH].
- Puerto Tokio, Río Peneya, Caquetá, Colombia [00°12'N, 74°23'W].
- Puerto Victoria, Río Pachitea, Huanaco, Peru [-9.88, -74.94].
- Quebradón El Ayo, Puré National Park, Colombia [01°35'S, 69°30'W; E. Palacios]
- Quixito (Río), Loreto, Peru [04°25'S, 70°15'W].
- Reserva de Desenvolvimento Sustentavel Piagaçu-Purus, Rio Purus, Amazonas, Brazil [-4.5, -62.3].
- Reserva Nacional Allpahuayo-Mishana, Loreto, Peru [-3.91, -73.12].
- Reserva Nacional Pacaya-Samiri, Loreto, Peru [05°15'S, 74°40'W]
- Retiro do Veado Branco, Serra do Norte, Rondônia, Brazil [11°20'S, 59°00'W; Comissão Rondon].
- Rio Acre, Estação Ecológica, Acre, Brazil [10°45'S, 70°00'W; PH].
- Rockstone, Essequibo River, Guyana [5.98, -58.53].
- Rosarinho, Amazonas, Brazil [03°42'S, 59°08'W; Olalla brothers 1930].
- Rupununi River, mouth, Rupununi, Guyana [4.0, -59.0].
- Samiria (Río), mouth; Loreto, Peru [04°42'S, 74°12'W].
- Sampaio (Lago), Rio Madeira, Amazonas, Brazil [-3.84, -59.17].
- San Fernando, Río Yavari-Mirim, Loreto, Peru [04°11'S, 70°52'W; C. Kalinowski, 1957].
- San Francisco, left bank Río Napo, Napo, Ecuador [00°30'S, 76°22'W; P. Hershkovitz, March 1936].
- San Jose del Encanto, Río Caraparana, Putumayo, Colombia [01°50'S, 73°28'W; H. Hill, 1975, 1976].
- San Martín de Turumbari, Río Cuyuni, Bolivar, Venezuela [06°42'N, 61°02'W; PH].
- San Lorenzo, near border with Bolivia, Madre de Dios, Peru [-11.3, -69.3; R. Aquino Collection].
- San Salvador, Río Tapiche, Amazonas, Peru [-5.0, -73.9].
- Santa Cecilia, Río Maniti, Loreto, Peru [03°26'S, 72°46'W; C. Kalinowski, June 1957].
- Santa Cruz, Rio Eiru, Amazonas, Brazil [07°23'S, 70°47'W; PH].
- Santa Elena, Río Samiria, Loreto, Peru (05°11'S, 74°45'W; PH).
- Santa Lucia (not Santa Luisa), Río Nanay, Loreto, Peru [03°35'S, 74°30'W; C. Kalinowski 1956 (PH)].
- Santa Luisa (likely location), Río Nanay (lower near Rio Marañon), Loreto, Peru [-4.35, -74.12; Stephens and Traylor Jr. 1983].
- Santarém, Rio Tapajós, Pará, Brazil [-2.55, -54.72].
- Santa Rita do Weil (= Santa Rita), Rio Solimões, Amazonas, Brazil [-3.48, -69.31; W. Ehrhardt, 1926].
- Santiago (Río) mouth, Esmeraldas, Ecuador [-4.30, -77.63].
- Santo Antônio, Rio Eiru, Amazonas, Brazil [06°42'S, 69°52'W; PH].
- Sapote (Quebrada), Río Ucayali, Loreto, Peru [-5.18, -74.15; R. Snyder].
- Sarayacu, Río Ucayali, Loreto, Peru [-6.72, -75.10].
- Sarayaku, Morona-Santiago, Ecuador [-1.6, -77.5].
- Saut Laurent du Maroni, French Guiana [5.60, -53.99].
- Saut Sabbat, French Guiana [5.50, -53.66].
- Saut Tigre, French Guiana [5.38, -52.93].
- São Felipe at or below, Rio Juruá, Amazonas, Brazil [unknown location, ca. 07°S (PH); E. Garbe, 1901-1902].
- São Joaquim, Rio Branco, Roraima, Brazil [03°01'N, 60°29'W; PH].
- São Manoel (= São Manuel), Rio Teles Pires, Pará, Brazil [07°21'S, 58°03'W; F. Hoehne 1912, 1914].
- São Paulo (Fazenda), Amazonas, Brazil [q.v.].
- São Sebastião do Uatumã, Rio Uatumã, Amazonas, Brazil [-2.56, -58.15].
- Saramacca, Suriname [6.5, -55.5].
- Sarayacu, Pastaza, Ecuador [-1.5, -77.5].
- Sarayacu, Río Bobonaza, Pastaza, Ecuador [01°44'S, 77°29'W; PH].
- Sarayacu, Ucayali, Peru [-6.4, -75.0].
- Sarayacu, Olalla Camp (March-May 1927), Ucayali, Peru [-6.63, -75.04; Stevens and Traylor Jr. 1983].
- Sarayacu, Olalla Camp (May-June 1927), Ucayali, Peru [-6.59, -75.14; Stevens and Traylor Jr. 1983].
- Sarayacu, Olalla Camp (August 1927), Ucayali, Peru [-6.89, -75.10; Stevens and Traylor Jr. 1983].
- Seringal Oriente, Rio Juruá, Acre, Brazil [08°48'S, 72°46'W; PH].

- Serpa (Lago), Itacoatiera, Amazonas, Brazil [03°05'S, 58°30'W; A. M. Olalla 1936-1937].
- Serra de Espelho, Faro, Pará, Brazil [02°11'S, 56°44'W; A. M. Olalla 1930, 1937].
- Shiripuno Research Lodge, Río Shiripuno, Ecuador [01°06'S, 76°43'W; L. K. Marsh].
- Sushufindi, Succumbios, Ecuador [-0.04, -76.64].
- Siguin (or Sihuín), Río Pastaza, Loreto, Peru [03°07'S, 76°26'W; C. Olalla, Mission Flornoy, 1936].
- Silves, Amazonas, Brazil [02°50'S, 58°13'W; A. M. Olalla 1937].
- Sipaliwini Airstrip (1970s), Sipaliwini, Suriname [3.9, -56.2].
- Supamo (Río), Bolívar, Venezuela [07°00'N, 62°15'W; PH].
- Supinaam River, Demerara, Guyana [06°23'N, 58°41'W; Stephens and Traylor Jr. 1985].
- Tabatinga, Amazonas, Brazil [-3.7, -69.6].
- Tabalosos, Huanuco, Peru [-6.36, -76.63].
- Tabocal (Tabucal), Amazonas, Brazil [-3.03, -58.18 // Tabucal: 00° 47' S, 67° 15' W; A. M. Olalla 1929].
- Tacshacurary (Río) at Río Machete (mouth) [-2.66, -73.62].
- Tahuamanu (Río), Pando, Bolivia [11°06'S, 68°36'W; K. Izawa 1978].
- Tahuayo Lodge, Río Tahuayo, Loreto, Peru [-4.22, -73.22].
- Tamashiyacu, Río Amazonas, Amazonas, Peru [-4.01, -73.15].
- Tamboryacu (Río), Loreto, Peru [-1.5, -74.2; R. Aquino].
- Tapanahoni River (cf., Paloemeu River) [3.3, -55.4].
- Tapiche (Río), Amazonas, Peru [-5.0, -73.9].
- Tapirapoan (= Tapirapua); Mato Grosso, Brazil [PH].
- Tapirapua, Rio Cipotuba, Mato Grosso, Brazil [14°51'S, 57°45'W; F. Hoehne 1914].
- Taumaturgo (Vila), Acre, Brazil [PH].
- Tefé (Lago), Amazonas, Brazil [03°22'S, 64°42'W; H. Bates 1850-54 (PH)].
- Tefé (Río); Amazonas, Brazil [-3.81, -64.97].
- Teresinha, Rio Amaparí, Amapá, Brazil [00°58'N, 52°02'W; PH].
- Terra Santa, Lago do Algodal, Pará, Brazil [02°06'S, 56°29'W; PH].
- Tigrillo (Río), Río Tigré, Peru [04°20'S, 74°16'W; PH].
- Tiputini Biodiversity Station, Río Tiputini, Yasuní National Park, Ecuador [-0.5, -76.3].
- Tírios, Rio Parú do Oeste, Pará, Brazil [02°18'N, 55°16'W; PH].
- Tonantins (Río), Amazonas, Brazil [-2.79, -67.87; J. B. von Spix 1820].
- Tracajatuba (Rio), Amapá, Brazil [1.1, -51.1].
- Tres Troncos, La Tagua, Río Caquetá, Colombia [00°08'N, 74°41'W].
- Trombetas, Rio, Reserva Biológica, Pará, Brazil [01°05'S, 57°02'W; A. B. Rylands and R. A. Mittermeier 1982].
- Tumatumari, Potaro River, Essequibo, Guyana [05°22'N, 59°00'W; PH].
- Tushemo (= Tushma or Tusma), Ucayali, Peru [08°38' S, 74°22'W; L. Rutter, 1926].
- Tutapisco (Río), Peru [-3.02, -73.26].
- Uariní, Pará, Brazil [-2.91, -65.10].
- Uatumá (Río), Amazonas, Brazil [-2.56, -58.15].
- Uauaçú (Lago), (Coarí), Amazonas, Brazil [-4.19, -62.37].
- Urubamba (Río), mouth at Río Ucayali, Ucayali, Peru [10°44'S, 73°45'W; Olalla brothers, 1927].
- Urubamba (Río) lower, T. Gregory Field Site, Ucayali, Peru [-11.74, -72.91].
- Urubú (Río), mouth, Amazonas, Brazil [02°55'S, 58°25'W; PH].
- Urucú (Río), Amazonas, Brazil [-4.46, -64.35].
- Utoquina; Ucayali, Peru [-9.67, -74.08 // 08°16'S, 74°32'W; H. Bassler collection 1923].
- Vereda La Leona, Valparaiso, Colombia [01°08'N, 75°35'W].
- Vila Bella Imperatriz, Lago Andira, Amazonas, Brazil [02°50'S, 56°55'W; Olalla brothers 1930].
- Villa Garzón, Puerto Limón, El Picudo Indigenous Reservation, Putumayo, Colombia [1.13, -76.60].
- Vila Braga, Pará, Brazil [04°25'S, 56°17'W. [F. Lima, 1917].
- Vila Nova (Río), Amapá, Brazil [00°30'N, 51°50'W; PH].
- Voltzberg, east bank, Coppename River, Sipaliwini, Suriname [4.81, -56.04].
- West River, Wilhelmina Mountains, Nickerie, Suriname [03°45'N, 56°30'W; PH].
- Wia-Wia Nature Preserve, Moengo, Suriname [5.94, -54.44].
- Wilhelmina Mountains, approx. West River, Sipaliwini, Suriname [4.0, -56.6].
- Xapurí, Acre, Brazil [-10.4, -68.5].
- Yanayacu, Río Marañón, Loreto, Peru [-4.79, -74.95].
- Yarina Eco Lodge, Río Napo, Napo, Ecuador [-0.3, -76.8].
- Yavanari (= Iaunari); Amazonas, Brazil [-0.3, -64.8].
- Yavari (Río), near mouth, Loreto, Peru [04°21'S, 70°02'W; PH].
- Yavari Mirim (Río), Loreto, Peru [-4.51, -72.70].
- Yavari Mirim (Río) mouth, Loreto, Peru [04°29'S, 71°47'W].

Yotacuay; Delta Amacuro, Venezuela [08°30'N, 61°00'W;
PH].

Yuturi Eco Lodge, Río Napo, Ecuador [-0.5, -76.0].

Zanderij, Para SR, Suriname [5.60, -55.21].

Zinho (Igarapé) near Igarapé Aniba, Amazonas, Brazil
[-2.91, -58.55].

Zuid River, Sipaliwini, Suriname [3.4, -56.4].

* Unspecified coordinates per Gmap.

^ PH indicates locations reported by P. Hershkovitz (1987).

APPENDIX II. THE JAMARI SAKI

Introduction

The specimens presented in this appendix were mostly collected by H. Schneider in the inundation area of the Samuel hydroelectric dam (Jirau dam) of the Rio Jamari, Rondônia, Brazil. These animals appear distinct, particularly the females which do not resemble any other females in the genus, at least by the specimens available. While it was tempting to declare them as a distinct species, more data needs to be collected on living sakis in that region.

The information below follows a taxonomic format, but is without types or names.

Synonymy

1987 *P. irrorata* Hershkovitz, P. (1987). *Am. J. Primatol.* 12: 425–426, in part.

Key Specimen I. MPEG No. 21961, adult male, skin and skull, collected by H. Schneider and E. Martins, 29 April 1988.

Key Specimen II. MPEG No. 21785, adult male, skin and skull, collected by H. Schneider, 2 February 1988.

Additional Important Specimens. *Males:* MPEG Nos. 21775 subadult, skin (H. Schneider, 7 December 1987); 21791 subadult, skin (H. Schneider, 25 March 1988); 21792 subadult, skin and skull (H. Schneider, 3 March 1988); 21937 subadult, skin and skull (H. Schneider, 29 August 1987); and 21959 adult skin (H. Schneider and E. Martins, 1987). *Females:* MPEG collection Nos.: 21787 adult, skin and skull (H. Schneider, 18 January 1988); 21784 adult, skin and skull (H. Schneider, 2 February 1988); 21778 adult, lactating, skin and skull (A.P. de Souza Júnior and F. Braga, 19 November 1987); 21782 adult, skin and skull (A.P. de Souza Júnior and F. Braga, 23 November 1987); 21934 adult, skin and skull (A.P. de Souza Júnior and F. Braga, 27 November 1987); 21960 adult, skin and skull (H. Schneider and E. Martins, 1987). MNRJ Nos.: 28479 adult, skin with 28480 infant male, skin and skull (A.P. de Souza Júnior and E. Dente, 24 January 1988).

Key Specimens Locality. All key specimens from Samuel hydroelectric dam, both sides of Rio Jamari, upper Rio Madeira right side, Rondônia, Brazil.

Total Specimens Examined. 32 skins and skulls. I have not seen any confirmed living photos.

Description. *Males.* All males, young and old, have the front half of their back legs black (to varying degrees in young animals), and very black wrist cuffs on the forearms

in all ages. Based on the type series, adult males can be “*irrorata*-like” or “*rylandsi*-like.” The “*rylandsi*-like” male colorations (MPEG No. 21961) are very grizzled white with very black back legs, but with orange ruffs more similar to either *P. irrorata* or *P. mittermeieri*. Hands and feet are off-white. Faces are primarily black, but can be dark red throughout with little facial hair. There maybe a few stray white hairs between the eyes, but any facial hair is concentrated to the very white stiff lip and lower nose hairs, without discernable muzzle lines—similar to *P. rylandsi*. Older males may be like either *rylandsi* or *mittermeieri* in that they can get very white. A very white male with an orange ruff MPEG No. 21959, skin only, is an example, but the face is not preserved well. The “*irrorata*-like” adult males are less grizzled, have ruffs with dark roots and light tips, have distinct white brow bands, and have black muzzles with unpigmented or reddish facial skin. They have light, but distinct muzzle lines in addition to the stiff white lip hair. In MPEG No. 21785, there are some light white hairs above the eyes as well. Subadult and juvenile males are less and more uniformly grizzled throughout their dorsal pelage. Their ruffs are varied depending on age from very light buffy to darker with light tan roots to more orange. Young faces are mottled pink and black, but do not have distinct eyespots as in *P. rylandsi*, the pattern is much more diffuse. It is possible that as they age they become more “*irrorata*-like” but it is unclear for how long as older skulls belonging to both the black faces and the “*irrorata* faces” are among the collection.

Females. Adult females can look similar to the “*irrorata*-like” males in that they have black muzzles and unpigmented or reddish facial skin with white brow bangs. They have lighter eyespots of similar color to most of the face, save where there are patchy black pigments or the blackish muzzle. Even in young animals they have shaggy white malar lines and white lips that are not as distinct as the males. They have some light black facial hair surrounding the face in subadult females, similar to *P. irrorata* females. They also have white eyebrows similar to *P. rylandsi* subadult females, but in most cases it appears as more of a star in the forehead between the eyes. In older females, this brow can be more concentrated to between the eyes with light white and black hair dispersed over the rest of the face or a light trace of white that covers the centerline of the forehead from the hairline to the eyes. The rest of the pelage is uniformly moderately grizzled with forearms densely covered in white to buffy hairs. Ruffs are less defined than males, are dark brown, and are finely haired. Faces are variable in that when young they are very pink and unpigmented, but might have stiff white hairs forming as the eyebrows. Subadult to adult females have an enlarged vulva and obvious clitoris, and can easily be mistaken for

males especially in dried specimens. Infant females look just like males in preserved specimens.

Measurements: Tables 27 and 28.

Distribution. Map 18. Mostly collected in the region of the Samuel hydroelectric dam on the Rio Jamari, both sides of the river. It is possible that these sakis occur in the entire region of the Mamoré-Madeira-Jamari.

Discussion. Specimens from MPEG and MNRJ were collected by H. Schneider, and A.P. de Souza Júnior and F. Braga between 1987 and 1989. A juvenile male collected by S.F. Ferrari on 5 September 1990 along the BR 230 (Humaitá-Itaituba) at km 16 appears to belong to this group. If they do prove to be distinct, it would extend their distribution much further north. However, it is entirely possible that this (and possibly all) Jamari sakis belong to *P. mittermeieri* which dominates the region.

The Jamari sakis are an interesting group primarily because adult males can resemble both a variation of *P. irrorata* and *P. mittermeieri* males (although the Jamari animals in the “black phase” seem like a cross between *P. mittermeieri* and *P. rylandsi*). It is unclear if these animals are hybrids, if they are polymorphic, or if they are a described species that is very long-lived and continue to transition colors, such as *P. mittermeieri* or *P. rylandsi*. Likewise, it will be important to study in detail *P. irrorata* populations, particularly in the state of Acre to determine boundaries with this Jamari group, and with *P. mittermeieri* and *P. rylandsi* populations

north of Rio Guaporé. Looking at females alone as compared to the species potentially in the area—*irrorata*, *mittermeieri*, *rylandsi*—the Jamari sakis females are distinct as adults. And in general, it appears Jamari sakis are unique when the skulls are compared, but more study is needed.

There are specimens in the Comissão Rondon collection at MNRJ that are similar to some of the sakis in the Jamari collection (for example, MNRJ No. 3335 and MPEG No. 21937). Comparing both collections, however, does not yield enough similarities, although the possibility is not ruled out that they are the same as those collected in the upper Aripuanã region during the Comissão Rondon expeditions; however, it is equally likely that the Comissão Rondon animals are legacy *P. irrorata* (cf. *P. irrorata*) from a long ago larger distribution of these animals. It is also entirely possible that these animals are *P. mittermeieri*, but with a pelage change over the decades since the Comissão Rondon.

Because of the extreme variation in these specimens, it is difficult to say if they have ever been photographed living. It is possible that if females had darker faces and white eyebrows only, they might look similar to *P. rylandsi* subadult females, and likewise that subadult males may be mistaken for either *P. irrorata*, *P. rylandsi* or *P. mittermeieri* especially in captivity. It is critical to get some photos or to observe living sakis in the Rio Jamari watershed, particularly around Samuel hydroelectric dam, as they are likely in highly fragmented habitat, and are threatened no matter the ultimate species determination.

Table 27. Post-cranial measurements (mm) and weights (g) of specimens.

Specimen	Total Length	Tail	Hind Foot	Ear	Weight
MNRJ					
28479 - AF	860	460	110	32	1550
28480 - INF	460	260	75	–	335
MPEG					
21776 - SAF	750	450	112	17	1100
21777 - SAF	760	450	119	26	1100
21783 - JM	660	360	107	34	930
21784 - AF	833	435	116	35	1780
21785 - AM	860	440	116	36	2750
21786 - AF	785	450	115	30	1700
21787 - AF	800	410	115	31	1800
21788 - SAF	760	385	110	29	2010*
21789 - INF	550	310	93	13	560
21790 - JF	730	380	105	28	1280
21934 - AF	840	440	116	30	2000
21935 - JM	665	380	95	31	800
21936 - INF	450	230	74	25	300
22001 - JM	734	402	114	33	1580

AM = adult male, SAM = subadult male, JM = Juvenile male, AF = adult female, SAF = subadult female, JF = juvenile female, INF = infant. *Pregnant?

Table 28. Skull measurements (mm) from the Hocrácio Schneider and Arlindo Pinto de Souza Júnior and Fernando Braga collections at MPEG.

Specimen MPEG Nos.	Length of brain case	Width of brain case	Zygomatic arch width	Orbits-outer	Nose bridge	L- orbit inner width	L- orbit inner height	Muzzle width	L- mandible length	L- mandible height
Males										
21785	87.0	44.1	59.6	47.2	8.7	17.1	18.4	25.9	59.7	40.5
21783	72.9	44.1	43.0	36.7	5.6	13.3	16.	18.8	38.8	25.5
21792	86.4	44.6	58.7	43.2	6.7	16.7	17.7	26.3	55.6	40.5
21794	82.2	41.3	53.1	44.1	8.2	16.3	16.8	23.6	53.0	36.1
21935	69.5	44.0	41.1	36.0	5.5	13.9	15.5	19.4	39.3	25.7
21937*	93.0	53.5	62.0	48.0	4.3	19.6	20.8	27.5	–	–
21961	82.4	40.0	56.5	46.5	7.4	17.1	19.2	24.5	53.2	40.1
22001‡	78.1	40.1	49.5	40.3	5.6	15.0	18.0	22.0	49.1	33.3
Females										
21786	81.4	42.9	52.3	42.7	7.9	16.0	18.0	23.4	50.5	36.2
21776	75.2	43.2	45.7	37.5	5.93	13.8	16.8	21.5	46.1	29.2
21777	76.2	42.9	46.1	37.4	5.4	15.0	16.7	20.1	45.6	30.3
21780	85.1	41.9	53.1	44.3	7.1	16.6	18.7	22.6	53.7	38.3
21778	78.8	40.9	49.6	41.3	7.1	16.3	18.0	21.2	49.5	39.6
21789	79.2	41.8	48.9	41.2	6.4	13.9	17.0	21.9	50.4	33.4
21782	82.5	43.2	54.3	45.3	7.7	17.2	18.1	23.9	52.2	38.4
21788	80.7	41.3	51.1	43.4	6.9	16.9	18.4	23.3	53.7	36.0
21790	76.2	43.0	47.3	39.3	6.9	14.6	16.2	21.2	46.1	30.2
21787	82.1	43.1	51.8	44.5	7.6	17.2	17.8	23.6	51.4	34.7
21793	69.5	42.3	35.1	35.1	5.4	13.8	15.8	18.1	34.4	23.0
21934	79.4	41.1	52.4	41.0	6.1	16.0	18.1	23.1	49.2	27.5
21938	71.5	39.8	49.7	38.3	4.5	15.8	18.0	20.5	44.4	34.2
21960	80.8	42.3	50.5	40.1	6.25	15.5	17.5	21.6	50.2	35.8
23039	68.3	40.1	38.8	33.0	4.2	14.1	15.8	16.7	35.4	19.5

* Correct skull for specimen?

‡ Collected by S.F. Ferrari.



Map 18. Location map for Jamari sakis.

Brazil

1. UHE Samuel, Schneider collection site

2. Rio Jamari, Usina Hidroelétrica Samuel

3. Schneider and Junior collection sites (approx.)

4. Braga and Souza Júnior collection sites (approx.)



Figure 102. Key specimen MPEG No. 21961, adult male, skin.



Figure 103. Key specimen MPEG No. 21961, adult male, skull



Figure 104. Key specimen MPEG No. 21785, adult male, skin.



Figure 105. Key specimen MPEG No. 21785, adult male, skull.



Figure 106. Key specimen adult female MPEG No. 21934, skin.



Figure 107. Key specimen adult female MPEG No. 21787, skin.

APPENDIX III. UNDERSTANDING FIGURE 17 FROM P. HERSHKOVITZ 1987: THE TAXONOMY OF SOUTH AMERICAN SAKIS, GENUS *PITHECIA* (CEBIDAE, PLATYRRHINI): A PRELIMINARY REPORT AND CRITICAL REVIEW WITH THE DESCRIPTION OF A NEW SPECIES AND A NEW SUBSPECIES, *AM. J. PRIMATOL* 12:387–468

Introduction

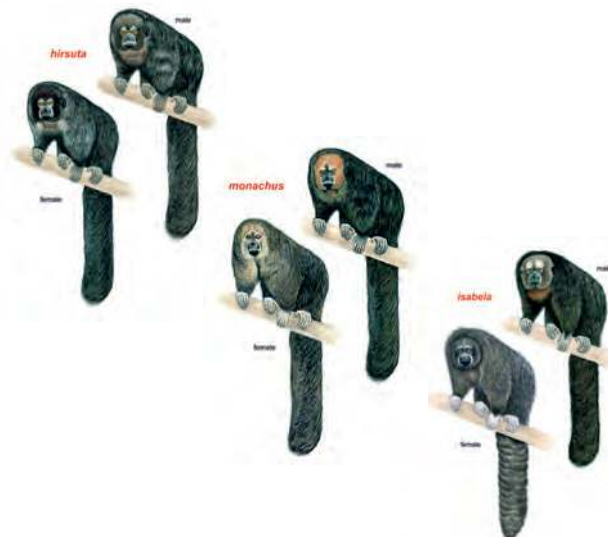
The following is a reinterpretation of the paintings commissioned by Philip Hershkovitz with artist Zorica Dabich for his unfinished volume *Living New World Monkeys, Volume 2* (Hershkovitz died before it was completed). All images used are by Zorica Dabich and Philip Hershkovitz, through the courtesy of Field Museum of Natural History.

These images were published in Hershkovitz (1987) as Figure 17. The caption for that image read:

“Fig. 17. *Pithecia*: Males of all species (and subspecies of *P. irrorata*) and female of *P. pithecia pithecia*, all to same scale; an arrangement of photographs of individual paintings in color by Zorica Dabich (from Hershkovitz, *Living New World Monkeys, Volume 2* [in preparation]). Differences between subspecies of *P. monachus* and *P. pithecia* are not apparent in the black and white figures.”

The figure shows the paintings in order of: “*P. monachus*, *P. i. irrorata*, *P. i. vanzolinii*, *P. albicans*, *P. aequatorialis*, *P. pithecia* (female), and *P. pithecia* (male).”

All of the corresponding art for comparison in this appendix is by Stephen Nash.



Painting A: *P. monachus*



This image depicts an amalgam of saki traits that lead to some of the confusion that was *P. monachus* throughout the Amazon (cf. “The Monachus Mess” in *P. monachus* Discussion). The species this painting most closely resembles is the newly described *Pithecia isabela* as some members of the species can have a faded “white wash” forehead instead of the more distinct white eye spots and have a minimal amount of white stippling throughout the body pelage (cf. *P. isabela*).

Alternatively, this image is a catchall of generic female characteristics, but it is unclear for which species. It was this painting, that turned *P. monachus* into a clumping of everything, male and female, that might fit this ambiguous image, especially since it was published in black and white.

What Hershkovitz did not realize is that the type for *monachus*, a juvenile of indeterminate sex with a white band around its face, would not grow up and retain that color pattern, but would transition, like many of the species do, into a form that looks completely different as an adult.

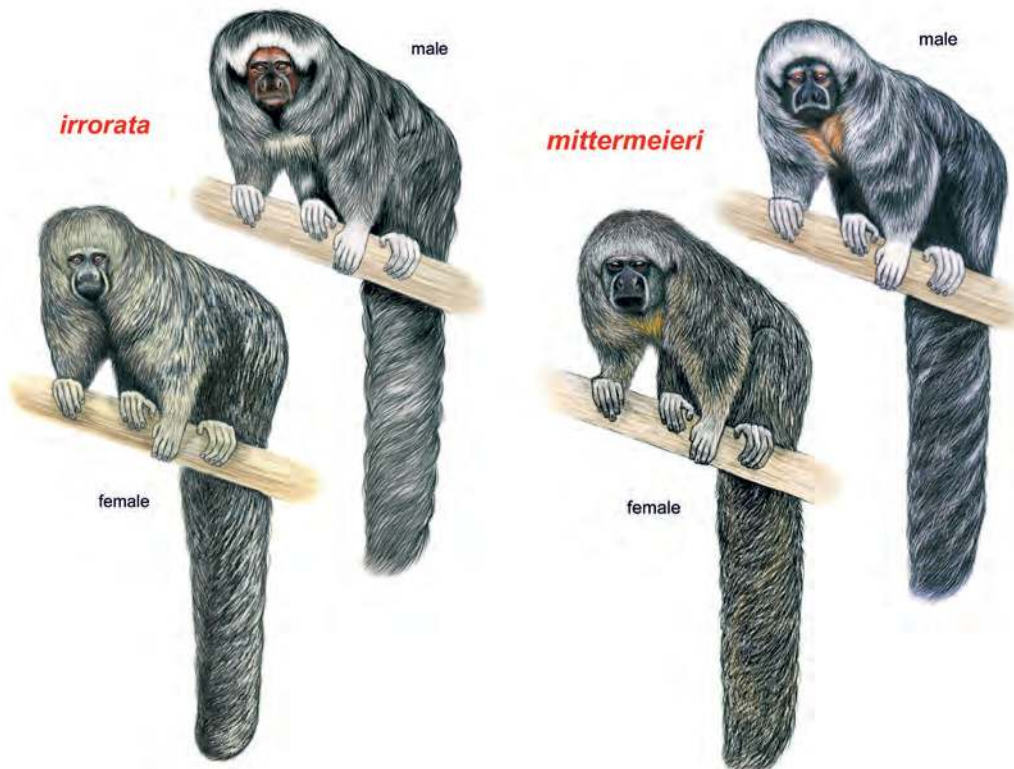
As a comparison, at left are *P. hirsuta*, *P. monachus*, and *P. isabela*, the likely candidates that contributed to this “blended” image.

Painting B: *P. irrorata*

This juvenile male *P. mittermeieri* appears to be the most similar to the painting from Hershkovitz (1987). Photo by L.C. Marigo (Figure 85a, *P. mittermeieri*).

This image of "*P. irrorata*" is another amalgam because Hershkovitz did not know there was more than one bald-faced saki species when he published in 1987. This image by itself looks most similar to a subadult *P. mittermeieri*, as does the photo in Hershkovitz 1987 in Figure 25 (cf. Table 2, "Introduction").

As a comparison, below are illustrations of *P. irrorata* and *P. mittermeieri*.

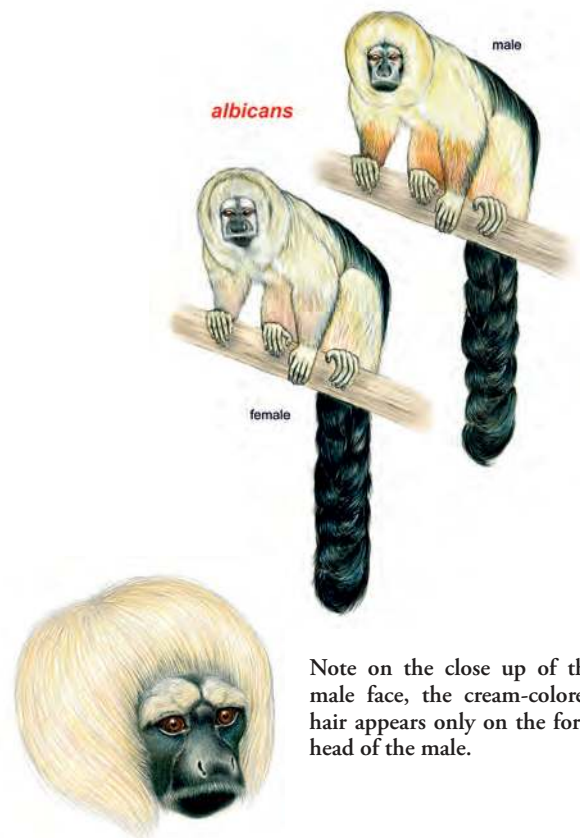


Painting C: *P. vanzolinii*

This painting of a *P. vanzolinii* male was based on museum material and fairly well represents the species. It is unlikely that Hershkovitz ever saw any of these animals alive, which is the same challenge for this taxonomy. The Nash version of male and female is pictured at the right.

Painting D: *P. albicans*

This is an interesting depiction of *P. albicans* in that the males and females are very similar in pelage, but it is the females that have the white facial hair. Thus, this painting is actually of a female *P. albicans*. Male *P. albicans* have a mostly plain face with cream-colored eyebrows, as the illustrations at right demonstrate.

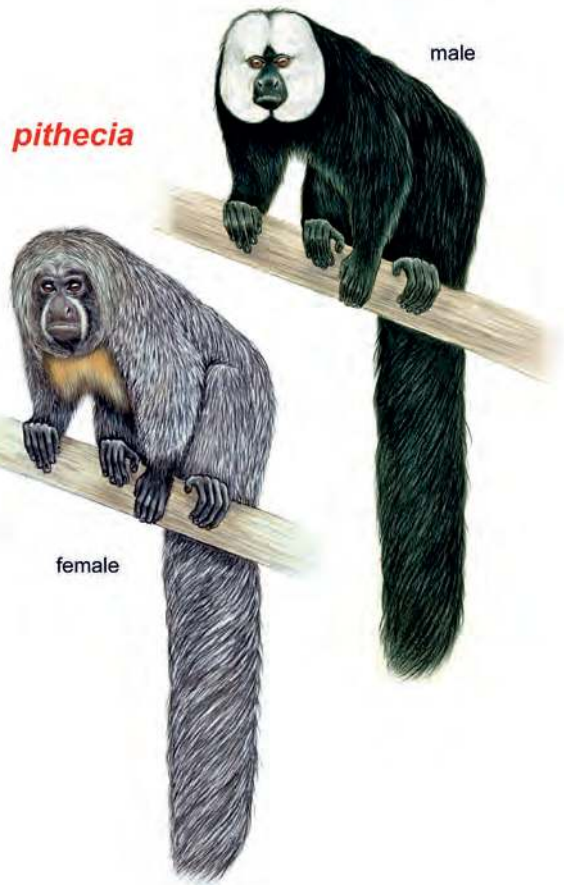


Note on the close up of the male face, the cream-colored hair appears only on the forehead of the male.

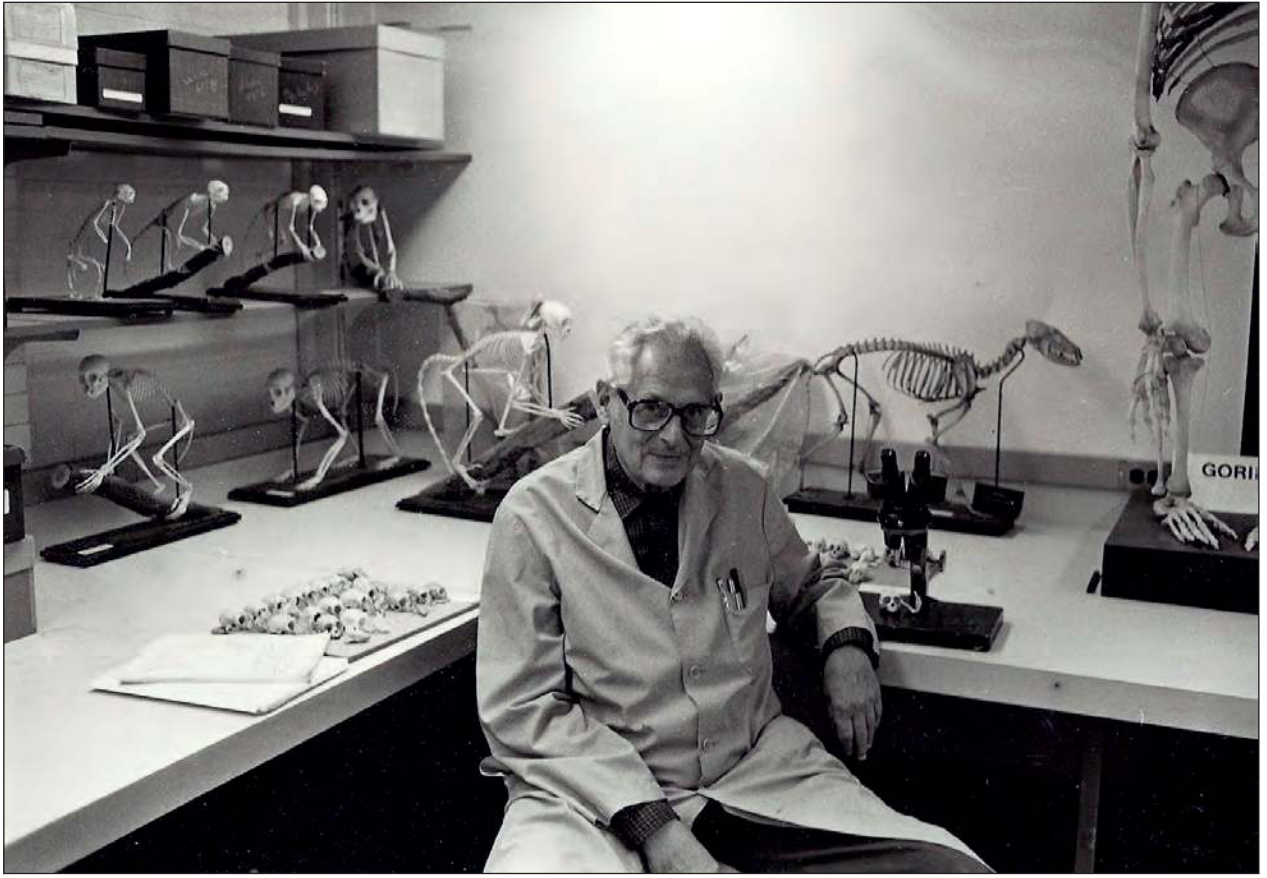
Painting E: *P. aequatorialis*

This lovely painting, the original of which hangs in the basement hallways of The Field Museum, is a nearly accurate depiction of Hershkovitz's *P. aequatorialis*. The only thing missing is the distinct orange ruff on the male. At the right for comparison, is Nash's version of the male and female.



Painting F: *P. pithecia* male.Painting G: *P. pithecia* female

The most recognizable and most collected of all of the *Pithecia* species, *P. pithecia* is perfectly well represented in these two accurate paintings. The nearly identical Nash version is at right.



Philip Hershkovitz, Emeritus Curator of Mammals in his laboratory at the Department of Mammalogy in the Field Museum of Natural History in Chicago (1.987). Photo by Stephen Nash.

Notes to Contributors

Scope

The journal/newsletter aims to provide a basis for conservation information relating to the primates of the Neotropics. We welcome texts on any aspect of primate conservation, including articles, thesis abstracts, news items, recent events, recent publications, primatological society information and suchlike.

Submissions

Please send all English and Spanish contributions to: Erwin Palacios, Conservación Internacional – Colombia, Carrera 13 # 71-41 Bogotá D.C., Colombia, Tel: (571) 345-2852/54, Fax: (571) 345-2852/54, e-mail: <epalacios@conservation.org>, and all Portuguese contributions to: Júlio César Bicca-Marques, Departamento de Biodiversidade e Ecologia, Pontifícia Universidade Católica do Rio Grande do Sul, Av. Ipiranga, 6681 Prédio 12A, Porto Alegre, RS 90619-900, Brasil, Tel: (55) (51) 3320-3545 ext. 4742, Fax: (55) (51) 3320-3612, e-mail: <jcbicca@pucrs.br>.

Contributions

Manuscripts may be in English, Spanish or Portuguese, and should be double-spaced and accompanied by the text on CD for PC compatible text-editors (MS-Word, WordPerfect, Excel, and Access), and/or e-mailed to <epalacios@conservation.org> (English, Spanish) or <jcbicca@pucrs.br> (Portuguese). Hard copies should be supplied for all figures (illustrations and maps) and tables. The full name and address for each author should be included. Please avoid abbreviations and acronyms without the name in full. Authors whose first language is not English should please have their English manuscripts carefully reviewed by a native English speaker.

Articles. Each issue of *Neotropical Primates* will include up to three full articles, limited to the following topics: Taxonomy, Systematics, Genetics (when relevant for systematics and conservation), Biogeography, Ecology and Conservation. Text for full articles should be typewritten, double-spaced with no less than 12 cpi font (preferably Times New Roman) and 3-cm margins throughout, and should not exceed 25 pages in length (including references). Please include an abstract in the same language as the rest of the text (English, Spanish or Portuguese) and (optional) one in Portuguese or Spanish (if the text is written in English) or English (if the text is written in Spanish or Portuguese). Tables and illustrations should be limited to six, except in cases where they are fundamental for the text (as in species descriptions, for example). Full articles will be sent out for peer-review. For articles that include protein or nucleic acid sequences, authors must deposit data in a publicly available database such as GenBank/EMBL/DNA Data Bank of Japan, Brookhaven, or Swiss-Prot, and provide an accession number for inclusion in the published paper.

Short articles. These manuscripts are usually reviewed only by the editors. A broader range of topics is encouraged, including such as behavioral research, in the interests of informing on general research activities that contribute to our understanding of platyrrhines. We encourage reports on projects and conservation and research programs (who, what, where, when, why, etc.) and most particularly information on geographical distributions, locality records, and protected areas and the primates that occur in them. Text should be typewritten, double-spaced with no less than 12 cpi (preferably Times New Roman) font and 3-cm margins throughout, and should not exceed 12 pages in length (including references).

Figures and maps. Articles may include small black-and-white photographs, high-quality figures, and high-quality maps. (Resolution: 300 dpi. Column widths: one-column = 8-cm wide;

two-columns = 17-cm wide). Please keep these to a minimum. We stress the importance of providing maps that are publishable.

Tables. Tables should be double-spaced, using font size 10, and prepared with MS Word. Each table should have a brief title.

News items. Please send us information on projects, field sites, courses, Thesis or Dissertations recently defended, recent publications, awards, events, activities of Primate Societies, etc.

References. Examples of house style may be found throughout this journal. In-text citations should be first ordered chronologically and then in alphabetical order. For example, "... (Fritz, 1970; Albert, 1980, 2004; Oates, 1981; Roberts, 2000; Smith, 2000; Albert *et al.*, 2001)..."

In the list of references, the title of the article, name of the journal, and editorial should be written in the same language as they were published. All conjunctions and prepositions (i.e., "and", "in") should be written in the same language as rest of the manuscript (i.e., "y" or "e", "En" or "Em"). This also applies for other text in references (such as "PhD thesis", "accessed" – see below). Please refer to these examples when listing references:

Journal article

Stallings, J. D. and Mittermeier, R. A. 1983. The black-tailed marmoset (*Callithrix argentata melanura*) recorded from Paraguay. *Am. J. Primatol.* 4: 159–163.

Chapter in book

Brockelman, W. Y. and Ali, R. 1987. Methods of surveying and sampling forest primate populations. In: *Primate Conservation in the Tropical Rain Forest*, C. W. Marsh and R. A. Mittermeier (eds.), pp.23–62. Alan R. Liss, New York.

Book

Napier, P. H. 1976. *Catalogue of Primates in the British Museum (Natural History). Part 1: Families Callitrichidae and Cebidae*. British Museum (Natural History), London.

Thesis/Dissertation

Wallace, R. B. 1998. The behavioural ecology of black spider monkeys in north-eastern Bolivia. Doctoral thesis, University of Liverpool, Liverpool, UK.

Report

Muckenhirn, N. A., Mortensen, B. K., Vessey, S., Fraser, C. E. O. and Singh, B. 1975. Report on a primate survey in Guyana. Unpublished report, Pan American Health Organization, Washington, DC.

Website

UNESCO. 2005. UNESCO Man and the Biosphere Programme. United Nations Educational, Scientific, and Cultural Organisation (UNESCO), Paris. Website: <http://www.unesco.org/mab/index.htm>. Accessed 25 April 2005. ("Accessada em 25 de abril de 2005" and "Consultado el 25 de abril de 2005" for articles in Portuguese and Spanish respectively).

For references in Portuguese and Spanish:

"and" changes to "e" and "y" for articles in Portuguese and Spanish respectively.

"In" changes to "Em" and "En" for articles in Portuguese and Spanish respectively.

"Doctoral thesis" changes to "Tese de Doutorado" and "Tesis de Doctorado" for articles in Portuguese and Spanish respectively.

"MSc Thesis" changes to "Dissertação de Mestrado" and "Tesis de Maestría" for articles in Portuguese and Spanish respectively.

"Unpublished report" changes to "Relatório Técnico" and "Reporte no publicado" for articles in Portuguese and Spanish respectively.