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IUCN/SSC Primate Specialist Group logo courtesy of Stephen D. Nash, 2002.

Front cover: A male white-collared lemur, *Eulemur albocollaris*. This lemur has the smallest range of any *Eulemur* species, being restricted to a thin strip of lowland forest in southeastern Madagascar, from just above the Manampatrana River south to the Mananara River. One of the species listed among the world's 25 most endangered primates 2004–2006. Photograph by Russell A. Mittermeier.

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Primates in Peril:
The World's 25 Most Endangered Primates, 2004–2006

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Introduction

To promote the public awareness of the critical situation of numerous primate species around the world, in 2000 the IUCN/SSC Primate Specialist Group, together with Conservation International, drew up a list of the 25 primates they considered were most endangered and most in need of attention for conservation and research. The year 2000 marked the end of a century that had witnessed no primate extinctions — and yet had ushered in the wholesale destruction of enormous numbers of primate populations around the world.

The 2000 list received exceptional coverage in a media environment already saturated with millennial news, and in some cases a primate's listing on the Top 25 led to real improvements in its conservation status. In view of this, an updated Top 25 list was released in 2002, following a special open discussion-meeting at the 19th Congress of the International Primatological Society (IPS) in Beijing, China, in which primatologists contributed information fresh from the field. Their revisions culminated in the official endorsement by the IPS of the Top 25, which is now a joint endeavor of the Primate Specialist Group, the IPS, and Conservation International. In August 2004, at the 20th Congress of the IPS in Torino, Italy, nearly 200 primatologists attended a second open session, which developed this most recent list of the Top 25 most endangered primates (Table 1). So, from its origins as a stand-alone warning, the list of the Top 25 has evolved into a periodic survey of those primates that researchers and conservationists feel would most benefit from — and most desperately need — the widest possible awareness of their rarity and peril. The species and subspecies that appear in the 2004–2006 list have been chosen not only for the degree of threat to their populations, but also as representatives of a region, ecosystem, or taxonomic group (Fig. 1). In each review of the list, primates may be added or removed to allow for exposure of new species, but their departure does not necessarily mean that they are no longer exrtremely threatened. Protecting these primates requires prolonged research and lasting conservation measures.

Of the 25 primates in the 2004–2006 most-endangered list, four are from Madagascar, seven from Africa, 10 from Asia, and four from the neotropics (Table 1). They are distributed through 17 countries: four are endemic to Madagascar and four occur in Vietnam, without doubt the two countries most in need of major efforts for the protection of their forests and wildlife (Table 2).

Seven of the 25 primates are listed for the first time: the white-collared lemur (*Eulemur albocollaris*), the Mt. Rungwe galago (as yet undescribed), the Bioko red colobus (*Procolobus pennantii pennantii*), the Horton Plains slender loris (*Loris tardigradus nycticeboides*), Miller's grizzled surili (*Presbytis hosei canicrus*), the western purple-faced langur (*Semnopithecus vetulus nestor*), and the Colombian brown spider monkey

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With contributions from: Alexandre T. Amaral, Simon K. Bearder, Jean Philippe Boubli, Douglas Brandon-Jones, Gustavo Canale, Camila Cassano, Tim R. B. Davenport, Thomas R. Defler, Jinie Dela, Luiz Gustavo Dias, Carolyn L. Ehardt, Susie Ellis, Agustin Fuentes, Carlos Eduardo Guidorizzi, Frank Hawkins, Steig Johnson, Maria Cecília M. Kierulff, William R. Konstant, Annette Lanjouw, Mark Leighton, Jean-Marc Lernould, Lindsay Magnuson, W. Scott McGraw, Sérgio Lucena Mendes, David Meyers, Alan R. Mootnick, Alba Lucia Morales-Jiménez, Tilo Nadler, K. Anna I. Nekaris, John F. Oates, Lisa Paciulli, Andrew Perkin, Fabiana Prado, Martina Raffel, José Vicente Rodríguez-Mahecha, Noel Rowe, Gabriel Rodrigues dos Santos, Ian Singleton, Roswitha Stenke, Jacqui L. Sunderland-Groves, Karen B. Strier, Thomas T. Struhsaker, Roland Wirth and Zhaoyuan Li.

Table 1. The world's 25 most endangered primates, 2004–2006.

	Madagascar		
1.	*Prolemur simus* (Gray, 1871)	Greater bamboo lemur	Madagascar
2.	*Eulemur albocollaris* (Rumpler, 1975)	White-collared lemur	Madagascar
3.	*Propithecus candidus* Grandidier, 1871	Silky sifaka	Madagascar
4.	*Propithecus perrieri* Lavauden, 1931	Perrier's sifaka	Madagascar
	Africa		
5.	*Galagoides* sp. (undescribed)	Mt. Rungwe galago	SW Tanzania
6.	*Procolobus pennantii pennantii* (Waterhouse, 1838)	Pennant's red colobus	Bioko Is., Equatorial Guinea
7.	*Procolobus rufomitratus* (Peters, 1879)	Tana River red colobus	Kenya
8.	*Cercocebus atys lunulatus* (Temminck, 1853)	White-naped mangabey	Côte d'Ivoire, Ghana
9.	*Cercocebus sanjei* Mittermeier, 1986	Sanje River mangabey	Tanzania
10.	*Gorilla beringei* Matschie, 1903	Eastern gorillas	Rwanda, Uganda, DRC
11.	*Gorilla gorilla diehli* Matschie, 1904	Cross River gorilla	Cameroon, Nigeria
	Asia		
12.	*Loris tardigradus nycticeboides* Hill, 1942 *	Horton Plains slender loris, Ceylon Mountain slender loris	Sri Lanka
13.	*Simias concolor* Miller, 1903	Pagai pig-tailed snub-nosed monkey, Simakobu	Mentawai Is., Indonesia
14.	*Presbytis hosei canicrus* Miller, 1934	Miller's grizzled surili	Indonesia (E. Central Kalimantan)
15.	*Trachypithecus delacouri* (Osgood, 1932)	Delacour's langur, white-rumped black leaf monkey	Vietnam
16.	*Trachypithecus poliocephalus poliocephalus* (Trouessart, 1911)	Golden-headed langur, Cat Ba langur	Vietnam (Cat Ba Island)
17.	*Semnopithecus vetulus nestor* Bennett, 1833	Western purple-faced langur	W. Sri Lanka
18.	*Pygathrix cinerea* Nadler, 1997	Grey-shanked douc	Vietnam
19.	*Rhinopithecus avunculus* Dollman, 1912	Tonkin snub-nosed monkey	Vietnam
20.	*Nomascus nasutus hainanus* (Thomas, 1892)	Hainan black-crested gibbon	China (Hainan Is.)
21.	*Pongo abelii* Lesson, 1827	Sumatran orangutan	N. Sumatra, Indonesia
	Neotropics		
22.	*Leontopithecus caissara* Lorini & Persson, 1990	Black-faced lion tamarin	Brazil
23.	*Cebus xanthosternos* Wied-Neuwied, 1826	Buff-headed tufted capuchin	Brazil
24.	*Ateles hybridus brunneus* Gray, 1872	Brown spider monkey	Colombia
25.	*Brachyteles hypoxanthus* (Kuhl, 1820)	Northern muriqui	Brazil

* *Loris tardigradus nycticeboides* in Nekaris, K. A. I. 2003. Rediscovery of the Ceylon mountain slender loris in the Horton Plains National Park, Sri Lanka, *Asian Primates* 8(3/4): 1–7, and Nekaris, K. A. I. and Jayewardene, J. 2003. Pilot study and conservation status of the slender loris (*Loris tardigradus* and *L. lydekkerianus*). *Primate Conserv.* (19): 83–90.

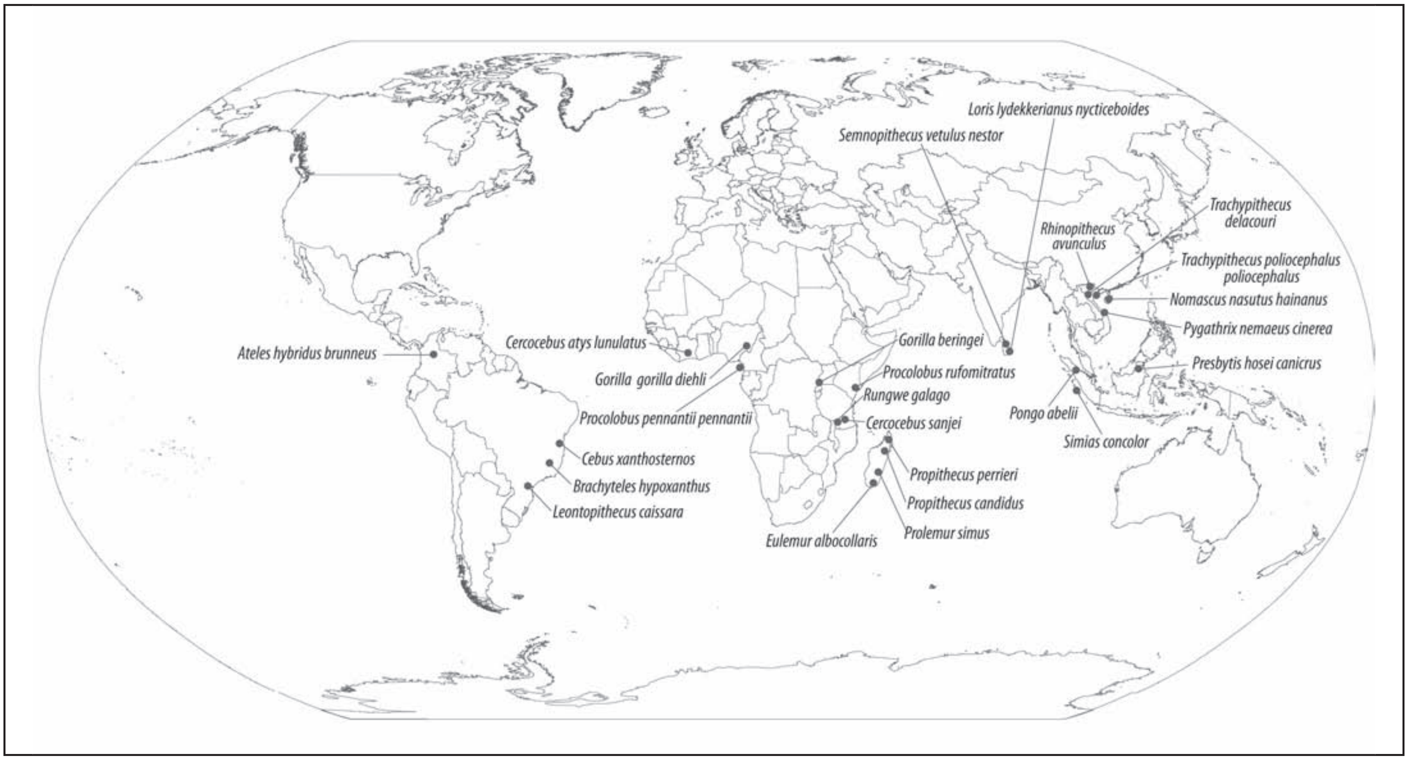

Figure 1. The world's 25 most endangered primates, 2004–2006.

Table 2. Distribution of the world's 25 most endangered primates – countries.

Madagascar	*Prolemur simus, Eulemur albocollaris, Propithecus candidus, Propithecus perrieri*	4
Vietnam	*Trachypithecus delacouri, Trachypithecus p. poliocephalus, Pygathrix cinerea, Rhinopithecus avunculus*	4
Brazil	*Leontopithecus caissara, Cebus xanthosternos, Brachyteles hypoxanthus*	3
Indonesia	*Simias concolor, Presbytis hosei canicrus, Pongo abelii*	3
Sri Lanka	*Loris tardigradus nycticeboides, Semnopithecus vetulus nestor*	2
Tanzania	Mt. Rungwe galago, *Cercocebus sanjei*	2
Colombia	*Ateles hybridus brunneus*	1
Cameroon	*Gorilla gorilla diehli*	1
China	*Nomascus nasutus hainanus*	1
Côte d'Ivoire	*Cercocebus atys lunulatus*	1
DRC	*Gorilla beringei*	1
Equatorial Guinea	*Procolobus pennantii pennantii*	1
Ghana	*Cercocebus atys lunulatus*	1
Kenya	*Procolobus rufomitratus*	1
Nigeria	*Gorilla gorilla diehli*	1
Rwanda	*Gorilla beringei*	1
Uganda	*Gorilla beringei*	1

(*Ateles hybridus brunneus*). Fifteen of the primates have been members of this list since the first edition in 2000 (Table 3).

Madagascar

Greater Bamboo Lemur

Prolemur simus (Gray, 1871)
Madagascar
(2002, 2004)

Formerly in the genus *Hapalemur*, the greater bamboo lemur was placed in the genus *Prolemur* by Groves (2001), based on a suite of distinctive dental and chromosomal characteristics (Vuillaume-Randriamanantena *et al*. 1985; Macedonia and Stanger 1994; Stanger-Hall 1997). As its common name implies, the greater bamboo lemur is the largest of Madagascar's bamboo-eating lemurs (Albrecht *et al*. 1990). Genetic studies further support its separation from the other bamboo lemurs and suggest that *Hapalemur* may, in fact, be more closely related to the genus *Lemur* (Rumpler *et al*. 1989; Macedonia and Stanger 1994; Stanger-Hall 1997). Historical records (Schwarz 1931) and sub-fossil remains confirm that it was once widespread throughout the island (Godfrey and Vuillaume-Randriamanantena 1986; Wilson *et al*. 1988; Godfrey *et al*. 1999). Documented populations are very patchily distributed and restricted to the south-central portion of the country's eastern rain forests, including those of Kianjavato, Ranomafana, and Andringitra national parks (and the corridor between them), Evendra (near Ivato, southeast of Andringitra), Karianga (near Vondrozo), and possibly the forest fragments south of Ifanadiana (Meier and Rumpler 1987; Wright *et al*. 1987; Sterling and Ramaroson 1996; Goodman *et al*. 2001; Irwin *et al*. 2005). Recent unpublished reports also indicate its presence in the forests of Karianga, northwest of Manombo (E. E. Louis Jr. pers. comm.) and north up to the region of Moramanga (Dolch *et al*. 2004; Rakotosamimanana *et al*. 2004). Shoots, young and mature leaves, and pith of the bamboo *Cathariostachys madagascariensis* can account for as much as 95% of the diet (Tan 1999, 2000). Other food items include flowers of the traveler's palm (*Ravenala madagascariensis*), and fruits of *Artocarpus integrifolia*, *Ficus* spp. and *Dypsis* spp., and leaves of *Pennisetum clandestinum* (Meier and Rumpler 1987). Observations of animals in the wild and captivity suggest that *P. simus* is cathemeral (Santini-Palka 1994; Tan 1999, 2000). They live in polygynous groups of seven to 11 animals occupying home ranges of 60 ha or more (Sterling and Ramaroson 1996; Tan 1999, 2000). The greater bamboo lemur is threatened by slash-and-burn agriculture, illegal logging, the cutting of bamboo and hunting with slingshots (Meier 1987; Meier and Rumpler 1987). It has vanished from most of its former range and only a few relatively small populations have been documented thus far in the southeast. Hunting and habitat destruction are the presumed causes. It occurs in the national parks of Ranomafana and Andringitra (although limited by suitable microhabitat within these protected areas), and perhaps a thousand or more individuals inhabit the Ranomafana region, but not all within the national park. Opportunities exist to extend protection to lemur populations in neighboring forests, as well as to develop a fairly long corridor of protected forests between Ranomafana and Andringitra, within which it is presumed other greater bamboo lemur populations will be found.

William R. Konstant, Jörg U. Ganzhorn & Steig Johnson

White-collared Lemur

Eulemur albocollaris (Rumpler, 1975)
Madagascar
(2004)

Genetic analyses support full species status for *Eulemur albocollaris*, as do field studies in apparent hybrid zones with *Eulemur fulvus rufus* (Sterling and Ramarason 1996; Johnson and Wyner 2000; Wyner *et al*. 2002), even though it is very similar in appearance to *E. collaris* (Djletati *et al*. 1997; Wyner *et al*. 1999). The white-collared lemur has the most restricted range of any species of the genus, occuring only in southeastern Madagascar in a thin strip of forest that runs from just north of the Manampatrana River south to the Mananara River (Petter and Petter-Rousseaux 1979; Tattersall 1982; Irwin *et al*. 2005). A hybrid zone with *E. fulvus rufus* appears to lie within the headwaters region of the Manampatrana River in Andringitra National Park. An isolated population occurs in the Manombo Special Reserve near Farafangana. Recent analyses combining ground surveys and Landsat imagery indicate that the total habitat remaining within this species' range is approximately 700 km², with an estimated remaining population of 7,265 ± 2,268 individuals (Irwin *et al*. 2005). Information regarding the natural history of this lemur comes largely from recent studies conducted in the forests of Vevembe. According to Johnson (2002), it is largely frugivorous, its diet supplemented with flowers, leaves, and fungi. Flowers are an

Table 3. The world's 25 most endangered primates: 2000, 2002, and 2004.

2000	2002	2004
Madagascar		
Hapalemur aureus		
Hapalemur griseus alaotrensis		
	Hapalemur simus	*Prolemur simus*
		Eulemur albocollaris
Propithecus perrieri	*Propithecus perrieri*	*Propithecus perrieri*
Propithecus candidus	*Propithecus candidus*	*Propithecus candidus*
Propithecus tattersalli		
Africa		
		Mt. Rungwe galago (undescribed)
	Cercopithecus diana roloway	
Cercopithecus sclateri		
Mandrillus leucophaeus		
	Cercocebus galeritus galeritus	
Cercocebus galeritus sanjei	*Cercocebus galeritus sanjei*	*Cercocebus sanjei*
Cercocebus atys lunulatus	*Cercocebus atys lunulatus*	*Cercocebus atys lunulatus*
Procolobus badius waldroni	*Procolobus badius waldronae*	
		Procolobus pennantii pennantii
	Procolobus rufomitratus	*Procolobus rufomitratus*
Gorilla gorilla beringei	*Gorilla beringei beringei*	*Gorilla beringei*
Gorilla gorilla diehli	*Gorilla gorilla diehli*	*Gorilla gorilla diehli*
Asia		
		Loris tardigradus nycticeboides
	Simias concolor	*Simias concolor*
	Presbytis natunae	
Trachypithecus delacouri	*Trachypithecus delacouri*	*Trachypithecus delacouri*
Trachypithecus poliocephalus	*Trachypithecus poliocephalus*	*Trachypithecus poliocephalus poliocephalus*
	Trachypithecus leucocephalus	
		Presbytis hosei canicrus
Pygathrix nemaeus cinerea	*Pygathrix nemaeus cinerea*	*Pygathrix cinerea*
Rhinopithecus avunculus	*Rhinopithecus avunculus*	*Rhinopithecus avunculus*
	Rhinopithecus bieti	
	Rhinopithecus brelichi	
		Semnopithecus vetulus nestor
Hylobates moloch		
Hylobates concolor hainanus	*Nomascus nasutus*	*Nomascus* sp. cf. *nasutus hainanus*
Pongo abelii	*Pongo abelii*	*Pongo abelii*
Neotropical region		
Leontopithecus rosalia		
Leontopithecus chrysopygus		
Leontopithecus caissara	*Leontopithecus caissara*	*Leontopithecus caissara*
Cebus xanthosternos	*Cebus xanthosternos*	*Cebus xanthosternos*
		Ateles hybridus brunneus
Brachyteles hypoxanthus	*Brachyteles hypoxanthus*	*Brachyteles hypoxanthus*
Lagothrix flavicauda		

especially important food late in the dry season. The species is cathemeral (active both day and night throughout the year). Social groups tend to be multi-male/multi-female, relatively large, and regularly exhibit fission-fusion. Selective logging, hunting, and the continued conversion of its rain forest habitat to agricultural land are the greatest threats to the survival of the white-collared lemur. It is found in only two protected areas, the Andringitra National Park and Manombo Special Reserve, but the Andringitra population hybridizes with *E. fulvus rufus* (CBSG 2002). Recent surveys have identified populations in unprotected forests (Vevembe, for example) that could be added to existing parks and reserves (Johnson and Overdorff 1999).

William R. Konstant & Steig Johnson

Silky Sifaka

Propithecus candidus Grandidier, 1871
Madagascar
(2000, 2002, 2004)

Propithecus candidus is a large white sifaka from north-eastern Madagascar. Its extremely restricted range includes the humid forest belt extending from Maroantsetra to the Andapa Basin and the Marojejy Massif, although the precise limits are unknown (Tattersall 1982). It is believed to have occurred as far north as Sambava, but its range appears never to have included the Masoala Peninsula. What we know about the ecology and behavior of the silky sifaka has come from short-term research conducted in the montane forests of Marojejy National Park (Duckworth *et al*. 1995; Kelley and Mayor

2002; Patel 2002; Patel *et al*. 2003). Population surveys have been carried out in Marojejy National Park by Sterling and McFadden (2000), and in Anjanaharibe-Sud Special Reserve by Schmid and Smolker (1998). The species has a patchy distribution and is absent from large parts of both reserves as well as areas to the south. Groups are most commonly encountered at altitudes above 1,000 m. Group sizes range from three to seven animals. The diet is highly folivorous, including mature and young leaves, but they also eat fruit, seeds, bark, soil, and roots. Marojejy and the Anjanaharibe-Sud Special Reserve are the only officially protected areas where the silky sifaka occurs, and their forests are not immune from disturbance and the hunting that accompanies encroaching human settlements (Garbutt 1999). The remaining population could be as low as several hundred, and is unlikely to be more than 5,000. A small number of unexplored forest reserves and classified forests in northeastern Madagascar are within the presumed range of this species and should be surveyed (Mittermeier *et al*. 1994). The silky sifaka has been spotted in the proposed Makira conservation site but population density appears extremely low and distribution very patchy.

William R. Konstant, Frank Hawkins & David Meyers

Perrier's Sifaka

Propithecus perrieri Lavauden, 1931
Madagascar
(2000, 2002, 2004)

The striking black Perrier's sifaka inhabits a small area of dry forests in extreme northern Madagascar, including the Analamera Special Reserve and Andrafiamena hills, and the northeastern limits of the Ankarana Special Reserve (Petter *et al*. 1977; Tattersall 1982; Hawkins *et al*. 1990). Very little is known of its habits in the wild. It occurs in small groups of two to six individuals that range over an area of up to 30 ha, and it eats a variety of leaves, unripe fruit, stems, and flowers (Meyers and Ratsirarson 1988, 1989; Mayor and Lehman 1999). Like much of Madagascar's wildlife, Perrier's sifaka is threatened by hunting, clearing land for agriculture, timber-cutting for charcoal and construction, fire to clear pasture for livestock and, most recently, small-scale mining for gemstones. It is the rarest, least-studied, and most endangered of all Madagascar's sifakas. The only two protected areas in which Perrier's sifaka is found are the Analamera and Ankarana special reserves, the former apparently harboring the largest remaining populations (Ganzhorn *et al*. 1996/97). It has recently been seen in the area between Analamera and Ankarana special reserves, and these forests should be annexed to the existing protected areas to increase the chances of this species' survival (D. Meyers pers. obs.). The only other site where the species occurs (in small numbers) is in Andavakoera Classified Forest (ZICOMA 1999), and conservation efforts are urgently required there. Total numbers are unknown, but could be as low as a thousand or as high as 8,000. Comprehensive density estimates are urgently needed.

William R. Konstant, Frank Hawkins & David Meyers

Africa

Mt. Rungwe Galago

Galagoides sp. nov.
Tanzania
(2004)

Recent surveys for galagos on Mt. Rungwe in the southwest highlands of Tanzania confirm the presence of an as-yet-unnamed galago species. This may be the same form that Groves (2001) referred to as the Ukinga galago from the Ukinga Mountains, part of the Livingstone Mountains, off the northeast shore of Lake Malawi, and adjacent to and east of Mt. Rungwe. The Livingstone Forest Reserve, now included within the proposed Kitulo National Park, is linked with Mt. Rungwe by a 2-km-long corridor of degraded montane forest near Bujingijila. Judging by its size and vocal repertoire, the Rungwe galago belongs to the genus *Galagoides*. Tape recordings of vocalizations, photographs, and preliminary comparisons with museum specimens reveal characters that distinguish the Mt. Rungwe galago from other known dwarf galagos (*Galagoides*). To date we have recorded it on Mt. Rungwe and in low densities in Mporoto Ridge Forest Reserve and Livingstone Forest Reserve. The species-specific advertisement call of the Mt. Rungwe galago, which is of the "incremental" type, and at least two alarm calls are distinct from those of other galagos that have an incremental advertisement call. These include *Galagoides orinus,* a highland forest galago from the nearby Eastern Arc Mountains. Other distinguishing features are the dark brownish-green pelage, very bushy tail, and face markings.

Preliminary ecological evidence indicates that the Mt. Rungwe galago prefers areas of forest with large numbers of wild bananas, although it is also found in the *Hagenia*-dominant montane forest in the north of Mt. Rungwe where there is little, if any, wild banana. Animals have been seen entering the large, cone-shaped banana flowers and eating the nectar. Large amounts of pollen stick to the fur of the feeding animals. This might indicate a significant role as a pollinator.

The forests of Mt. Rungwe and the surrounding highlands are affected by widespread logging, charcoal manufacture, and hunting as a result of a long-term lack of effective management. Pressure on the Rungwe area forests is high due to agricultural expansion because the high rainfall, and the fertile volcanic soils make this one of the most productive areas in Tanzania. The Mt. Rungwe galago is known to only a few local hunters and is rarely hunted. Systematic surveys to estimate population densities have yet to be carried out. The conservation status of this species no doubt depends on the conservation of remaining habitat. The total area of the remaining forest patches on Mt. Rungwe, the Mporoto Ridge Forest Reserve, and the Livingstone Mountains is believed to be less than 300 km². Further surveys are underway in the region to gather more data.

Andrew Perkin, Simon Bearder,
Tim R. B. Davenport & Thomas M. Butynski

Pennant's Red Colobus

Procolobus pennantii pennantii (Waterhouse, 1838)
Bioko Island, Equatorial Guinea
(2004)

The endangered Pennant's red colobus monkey *Procolobus pennantii* (Waterhouse, 1838) is presently regarded by the IUCN/SSC Primate Specialist Group as comprised of four subspecies, but their relationships within *P. pennantii,* and with other taxa of red colobus, need clarification (Groves 2001; Grubb *et al*. 2003). Future research may reveal that these four "subspecies" are better referred to as full species. *Procolobus pennantii* takes its name from the form restricted to Bioko Island, Equatorial Guinea, *P. pennantii pennantii*. This endangered subspecies probably has the most restricted range of all of Bioko's unique primates, and is now found only in the southwest of the island where it is threatened by commercial bushmeat hunting (Butynski and Koster 1994). The other three subspecies are the critically endangered Bouvier's red colobus *P. p. bouvieri* (Rochebrune, 1887) of east-central Republic of Congo; the endangered Niger Delta red colobus *P. p. epieni* Grubb and Powell, 1999, of Nigeria; and the endangered Preuss's red colobus *P. p. preussi* (Matschie 1900) of southeastern Nigeria and western Cameroon (Oates 1994, 2000; Struhsaker 2005). *Procolobus p. pennantii* and *P. p. preussi* are particularly distinct taxa in terms of their vocalizations, while the vocal repertoire of *P. p. epieni* most closely resembles those of the red colobus in Central and eastern Africa (T. T. Struhsaker unpublished data).

To the northwest of the *P. pennantii* complex of subspecies occurs the critically endangered Miss Waldron's red colobus, *P. badius waldroni* (Hayman, 1936) of southwestern Ghana and southeastern Côte d'Ivoire (Struhsaker 1999; Oates *et al*. 2000; Groves 2001; Grubb *et al*. 2003). All five of these subspecies are today close to extinction, with very restricted ranges and small numbers as a result of intensive hunting and extensive habitat degradation and loss (Wolfheim 1983; Oates 1994, 1996; Oates *et al*. 2000; Struhsaker 2005). Neither *P. p. bouvieri* nor *P. b. waldroni* have been observed alive by scientists for at least 25 years, raising concerns that they may be extinct. However, a single skin of *P. b. waldroni* in the possession of a hunter in southeastern Côte d'Ivoire in early 2002, and recent reports of red colobus in nearby Isles Ehotiles National Park (Kone 2004), give hope that at least one population of this subspecies remains (McGraw and Oates 2002; McGraw 2005).

The red colobus monkeys of West Africa and west Central Africa are probably more threatened than any other taxonomic group of primates in Africa. This is partly due to the fact that red colobus are especially sensitive to habitat degradation and vulnerable to hunters (Oates 1996; Oates *et al*. 2000; Waltert *et al*. 2002; Struhsaker 2005). None of the few protected areas in which any of these five subspecies of red colobus occur is well protected (e.g., McGraw 1998). It is a priority for the conservation of primate biodiversity in Africa to (1) immediately undertake field surveys to determine the current distributions and abundance of these five subspecies of red colobus while, at the same time, (2) rigorously protect all of those populations that are known to still exist.

Providing adequate protection to viable populations of these five subspecies of red colobus would greatly assist the conservation of numerous sympatric threatened taxa. Among primates, these include: the mainland Preuss's monkey *Cercopithecus preussi preussi*; Bioko Preuss's monkey *C. p. insularis*; Bioko red-eared monkey *C. erythrotis erythrotis*; golden-bellied crowned monkey *C. pogonias pogonias*; Roloway monkey *C. diana roloway*; Bioko black colobus *Colobus satanas satanas*; white-naped mangabey *Cercocebus atys lunulatus*; mainland drill *Mandrillus leucophaeus leucophaeus*; Bioko drill *M. l. poensis*; western chimpanzee *Pan troglodytes verus*; and Nigeria chimpanzee *P. t. vellerosus*.

If a concerted effort is to be made to save all of the diversity present within red colobus, then the major international conservation NGOs will need to focus their efforts on this taxonomic group and work closely with national conservation NGOs and national protected area authorities. For *P. p. bouvieri* and *P. b. waldroni*, however, it may already be too late.

Thomas M. Butynski, John F. Oates,
W. Scott McGraw & Thomas T. Struhsaker

Tana River Red Colobus

Procolobus rufomitratus (Peters, 1879)
Kenya
(2002, 2004)

The gallery forests of Kenya's lower Tana River are home to two Critically Endangered primates, the Tana River red colobus and the Tana River mangabey, *Cercocebus galeritus* Peters, 1879. Along with six other species of primates, they inhabit small patches of forest along a 60-km stretch of river, from Nkanjonja to Mitapani. While the other species of monkeys have geographically larger distributions, the red colobus and mangabey are found nowhere else. These two species are offered some protection in approximately 13 km² of forest within the 169 km² Tana River Primate National Reserve. Forest loss to agriculture has increased greatly over the last 15 years or so, resulting in a loss of roughly 50% of the original vegetation. Local communities continue to degrade the remaining forest for products used in the construction of homes and canoes, the collection of wild honey, and the topping of palms to make palm wine. One result of this widespread loss and degradation of habitat is that the populations of the red colobus and the mangabey are believed to have each declined to fewer than 1,000 individuals. A 5-year World Bank/GEF project begun in 1996 was originally designed to relocate several hundred families that presently live within the reserve, but financial support was withdrawn well before completion of the project due to poor project management. This left responsibility for the protection of the Tana River's remaining forests and primates entirely to the Kenya Wildlife Service. Further losses have resulted from the failure of the Tana Delta Irrigation Project's (TDIP) rice-growing scheme (under the administration of the Tana and Athi Rivers Development Authority – TARDA) to protect either the habitat or the primates in the 14 Tana River forest patches under its management. This rice-growing scheme was financed by the Japan International Cooperation Agency (JICA). Additional new threats are now on the horizon with a proposal to establish a large sugar cane plantation in the Tana Delta. This new plantation will not only result in a large influx of people to the area, it may directly destroy natural forest. On the positive side, (1) more than 250 families cultivating within the Tana River Primate National Reserve were, in 2005, voluntarily relocated to Kipini (about 90 km away), (2) there appears to be an increasing concern for forest and biodiversity conservation among the people of the Lower Tana River, and (3) a major focus of action among community-based organizations over the next few decades is likely to be tree planting. Given the current level of threat, however, it will likely take many years before there is sufficient change on the ground to reverse the long-standing decline of the Tana River red colobus and the Tana River mangabey populations.

Thomas M. Butynski

White-naped Mangabey

Cercocebus atys lunulatus (Temminck, 1853)
Ghana and Côte d'Ivoire
(2000, 2002, 2004)

The Upper Guinean forests of West Africa have been reduced to less than 10% of their original size, drastically limiting and fragmenting the habitat available for West Africa's forest primates, including the white-naped mangabey, *Cercocebus atys lunulatus*. Terrestrial mangabeys (genus *Cercocebus*) are close relatives of mandrills; both live in multi-male societies and forage predominantly for hard-object foods on the forest floor (Fleagle and McGraw 2002). This species is distinguished by its gray-brown coat, white inner limbs and underside, long black stripe on its back, and the white patch on the back of the head. Found east of Côte d'Ivoire's Sassandra River and west of Ghana's Volta River, the white-naped mangabey spends the majority of its time on the forest floor but uses the canopy as well. Their ability to use the ground allows them to live in a broad range of habitats including swamp and agricultural areas. Nevertheless, the most recent surveys have confirmed their presence in only a few of the remaining forest patches in the Guinean forest zone; these include Ankasa Resource Reserve, Dadieso Forest Reserve, and Yoyo Forest Reserve in Ghana (Magnuson 2002); and Marahoué National Park, Dassioko Forest Reserve, Niegre Forest Reserve, and forest east of the Ehi Lagoon in Côte d'Ivoire (McGraw 1998; McGraw and Oates 2002; Kone 2004). While the forests have become smaller and more fragmented, hunting pressure has increased. Oates *et al.* (1996/1997) and McGraw (1998) suggest that one of the greatest barriers to their conservation is lack of local support. Recent civil conflict in Côte d'Ivoire has also made this a challenging area in which to work.

White-naped mangabeys have a geographic distribution similar to that of the Critically Endangered Roloway guenon, *Cercopithecus diana roloway* (Schreber, 1774), and conservation efforts for both should be coordinated. The Roloway monkey occupies forested areas between Cote d'Ivoire's Sassandra River and Ghana's Pra River. Surveys in the tropical forests of Ghana and Côte d'Ivoire have documented its steady decline. In 2001 they were still found in Ghana's Ankasa Resource Reserve, Dadieso Forest Reserve, Krokosua Hills Forest Reserve, and Yoyo Forest Reserve. However, their presence could not be confirmed in a number of forests where they were found in 1995/6 (Oates *et al*. 1996/1997; Abedi-Lartey and Amponsah 1999), including Bia National Park—where they were abundant 25 years ago (Asibey 1978). In Côte d'Ivoire they are now known to occur in only one of the protected areas: the Yaya Forest Reserve on the western bank of the Comoe River (McGraw 1998). With the mangabeys, Roloways have also been reported in the swamp forest east of the Ehi Lagoon, but they are quite scarce there (McGraw and Oates 2002). The establishment of systematic hunting patrols, and elevating the status of forests containing mangabeys and Roloway monkeys to that of national park, are measures that could help secure their future as well as that of a number of other threatened primates and wildlife in the region (McGraw 1998). The initiation of conservation trust funds for these last remaining forests would also be an important step to ensure the survival of their dwindling populations of primates (Oates *et al.* 1996/1997). Since 2001 a group of European zoos involved in the breeding programs (EEPs) of the white-naped mangabey and the Roloway monkey decided to collaborate under the name of WAPCA (West African Primate Conservation Action), together with CEPA (Conservation des Espèces et des Populations Animales, France) and ZGAP (Zoologische Gesellschaft für arten- und Populationsschutz, Germany) for the conservation of these primates in Côte d'Ivoire and Ghana. First steps were taken in Ghana in 2001, and the first survey was carried out in Côte d'Ivoire in 2004.

W. Scott McGraw, Lindsay Magnuson,
Rebecca Kormos & William R. Konstant

Sanje River Mangabey

Cercocebus sanjei Mittermeier, 1986
Tanzania
(2000, 2002, 2004)

The Sanje mangabey, discovered in 1979 (Homewood and Rodgers 1981; Groves 1996), is endemic to the Udzungwa Mountains of Tanzania, the southern-most and largest forest block of the Eastern Arc Mountains. The fragmented relict forests of the Udzungwas (*c.*1,017 km² of forest) hold 11 species of primates. In addition to the Endangered Sanje mangabey, there are two other threatened endemic or near-endemic species of monkey, making these mountains arguably the most important single site in Africa for the conservation of primate diversity. There are likely fewer than 1,300 Sanje mangabeys, in two populations that are located about 85 km apart (Ehardt *et al.* 1999, 2005; Ehardt 2001). The largest population (~60%) occurs within the recently established Udzungwa Mountains National Park (UMNP), while the second is confined to Udzungwa Scarp Forest Reserve. This forest reserve, separated from UMNP by fire-maintained grassland, is significantly impacted by hunting, and by habitat degradation and loss. Until recently, a third population was believed to exist in Ndundulu Forest Reserve, but surveys in 2004 confirmed that the earlier reports by ornithologists (Dinesen *et al*. 2001) were based on misidentification of the primates present there. This has led to scaling down of the already low combined population estimate and to increased efforts promoting the expansion of the boundaries of UMNP to include the inadequately protected forest reserves to the west and south of the UMNP. Additional activities directed toward conservation of the Sanje mangabey include ecological and demographic research (Ehardt *et al*. 2005) to assess its habitat requirements and conservation status. These data indicate that the Sanje mangabey feeds on seeds, nuts, and invertebrates on the forest floor, in addition to fruit, a diet characteristic of other species of *Cercocebus,* as well as of the closely related *Mandrillus* spp. The characteristic of spending ~50% of its time on the forest floor, however, subjects the mangabey to risk from snares set for hunting of other animals such as duikers, a concern justified in finding an adult Sanje mangabey trapped by a snare in 2004. Continued research documenting the conservation ecology and habitat of the Sanje mangabey should contribute to improved management of the two remaining populations, and will support efforts to expand the park and reduce forest fragmentation through the establishment of effective corridors.

Carolyn L. Ehardt & Thomas M. Butynski

The Eastern Gorillas

Gorilla beringei Matschie, 1903
Democratic Republic of Congo, Rwanda, Uganda
(2000, 2002, 2004)

The eastern gorilla is the world's largest living primate, one of the best studied, and unfortunately, one of the most threatened. Approximately 385 eastern gorillas, well-known as the mountain gorilla, survive in the Virunga Volcanoes (375 km², 700–4,000 m a.s.l.) where they are protected in three national parks — Virunga National Park (Democratic Republic of Congo — DRC), Parc National des Volcans (Rwanda), and Mgahinga Gorilla National Park (Uganda). Another 320 or so gorillas live in the Bwindi Impenetrable National Park, Uganda (320 km², 1,500–2,300 m a.s.l.). The Virunga Volcanoes and Bwindi Impenetrable Forest are surrounded by dense human settlements and agricultural lands on some of the most fertile volcanic soils in the world. Nonetheless, these two sites are among the best-protected in Africa. As such, both populations have increased in recent years. The vast majority of eastern gorillas, however, live over an area of roughly 15,000 km² in eastern DRC. These belong to a distinct subspecies; Grauer's gorilla, *G. beringei graueri* Matschie, 1914. The number of eastern gorillas in DRC was estimated at 8,660–25,500 individuals (in at least 11 populations) in 1995, with about two-thirds living in the Kahuzi-Biega and Maiko national parks. There has been considerable insecurity and civil strife in eastern DRC in recent years, with the result that gorillas in this region have likely declined in number — perhaps dramatically. The entire region over which eastern gorillas live has experienced devastating human conflicts in recent decades, with an estimated human mortality of almost 5 million people. Despite these problems, a number of NGOs (including Dian Fossey Gorilla Fund International [DFGFI], the International Gorilla Conservation Program [IGCP], and the Wildlife Conservation Society [WCS], and others) in concert with the national parks authorities of the three habitat countries and local communities have worked to maintain long-term support for the conservation of the eastern gorilla and successfully establish this species as the premier tropical forest tourism attraction in Africa.

Annette Lanjouw, Thomas M. Butynski &
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Cross River Gorilla

Gorilla gorilla diehli Matschie, 1904
Nigeria and Cameroon
(2000, 2002, 2004)

Until very recently, the Cross River gorilla (*Gorilla gorilla diehli*) had been the most neglected of the four subspecies of gorilla presently recognized. It was originally named in 1904 as a distinct species, *Gorilla diehli*, based on a few specimens collected in what was then the German colony of Kamerun, close to the Nigerian border at the headwaters of the Cross River. The Cross River gorilla was subsequently reclassified as a local population of western lowland gorilla (*Gorilla gorilla gorilla*), until its distinctive features were recognized again by Sarmiento and Oates (2000). Present populations are restricted to densely forested hills and mountains across the Nigeria-Cameroon border, of which some are surrounded by sizeable human communities. The most northern and western gorilla, the Cross River gorilla is separated by about 300 km from western lowland gorillas (and around 200 km from the recently discovered Ebo gorilla population). Current surveys suggest that there are between 250–300 Cross River gorillas remaining, with the population fragmented across 10 or more hill areas, most of them not legally protected. The only exceptions are the subpopulations in Afi Mountain Wildlife Sanctuary and in the Boshi Extension Section of Cross River National Park, Okwangwo Division in Nigeria. The conservation status of the habitat in other areas, especially the Mbe Mountains (Nigeria) and the Takamanda and Mone River Forest Reserves (Cameroon), needs to be improved.

A number of important conservation efforts on behalf of the Cross River gorilla have been launched over the past few years. Notable is the recent commitment from host governments to protect Cross River gorilla habitat. In collaboration with local governments, the Wildlife Conservation Society supports Cross River gorilla conservation and research programs in both Cameroon and Nigeria. In Cameroon, field studies confirmed the gorilla's presence in the Mone River Forest Reserve and the Mbulu Forest, areas contiguous with the Takamanda Forest Reserve. A number of other recent surveys are investigating their presence in areas east of Mone and Mbulu. As part of an overall land-use plan, the government of Cameroon has proposed upgrading the protected status of Takamanda to a national park, and creating a Gorilla Sanctuary on Kagwene Mountain in eastern Mbulu. Objectives of the Nigerian program include determining the extent of the gorilla's distribution within national park boundaries and assessing potential population links with the Takamanda gorillas, examining options for establishing formal conservation management of the community-controlled Mbe Mountains, and working with other organizations to improve the protection of the Afi Mountain Wildlife Sanctuary. Further conservation priorities for Cross River gorillas include developing land-use plans for the Takamanda-Mone-Mbulu area in Cameroon, and the Afi-Mbe-Okwangwo area in Nigeria. More general actions needed include a review and evaluation of the impact of a road development program in Cameroon, and the maintenance and expansion of basic research into the ecology, distribution, and population biology of these gorillas, as well as the strengthening and expansion of conservation education and awareness programs at all levels. It is also necessary to build the capacity of relevant institutions in Nigeria and Cameroon, and to ensure that local community needs are incorporated into the development of management strategies, including the study of options for alternative livelihoods.

Jacqui Sunderland-Groves & John F. Oates

Neotropical Region

Black-faced Lion Tamarin

Leontopithecus caissara Lorini and Persson, 1990
Brazil
(2000, 2002, 2004)

For more than a century and a half, biologists heard rumors of an unknown primate living in seaside forests on the far southeastern coast of Brazil. Despite expeditions throughout the 20th century, nothing conclusive was found — until in 1990, two Brazilian researchers, Maria Lorini and Vanessa Persson, surveyed the island of Superagüi in the state of Paraná and discovered the black-faced lion tamarin, the fourth and least-known species of the genus *Leontopithecus*. Named *Leontopithecus caissara* after the *caiçaras*, the local people of the island, the black-faced lion tamarin survives only in low-lying coastal forests, including the specialized dune forests known as *restingas* and the swamp forests called *caxetal* on the island and mainland. Probably never common or widespread, today there are fewer than 400 black-faced lion tamarins, surviving in less than 300 km² of remnant forests. Recent surveys by IPÊ – Instituto de Pesquisas Ecológicas indicate a population of about 180 individuals on the island of Superagüi (11,000 ha) in the Superagüi National Park (33,928 ha), the most representative population. The researchers also found that its geographic range on the mainland is much more restricted than was previously thought. Like other lion tamarins, *Leontopithecus caissara* feeds mainly on small fruits and invertebrates, including insects, spiders, and snails. They also drink the nectar of certain flowers, and will eat the leaf bases of young bromeliads, as well as certain seasonally available mushrooms. In addition to sometimes sheltering in clumps of bromeliads, the lion tamarins depend on these sturdy plants to provide habitat for their invertebrate prey, which they feel out and catch with nimble, grasping fingers. Bromeliads are thus a vital part of lion tamarin habitat, and their dense presence in untouched primary forest — such as the coastal forests and *restingas* of Superagüi — is one reason why this rare habitat is crucial to the survival of *L. caissara* and the other lion tamarins.

John M. Aguiar, Alexandre T. Amaral,
Cláudio B. Valladares-Padua & Fabiana Prado

Buff-headed Capuchin or Yellow-breasted Capuchin

Cebus xanthosternos Wied-Neuwied, 1826
Brazil
(2000, 2002, 2004)

Unlike the majority of the highly adaptable capuchin monkeys, the buff-headed capuchin, endemic to Brazil's Atlantic Forest region, is seriously threatened with extinction. There are no reliable estimates of remaining populations, but the forests of its natural range in northeast Brazil (Bahia and extreme northern Minas Gerais) have been largely devastated, and it is hunted as well. Adults are relatively large (about 6 pounds) and provide sufficient meat to warrant the cost of a shotgun shell, while the young are popular as pets. It has been extirpated over a large part of its former range. Surveys begun in 2002 and, supported by Conservation International, the Instituto de Estudos Sócioambientais do Sul da Bahia — IESB (Ilhéus, Brasil), the European zoos involved in the breeding program (*C. xanthosternos* EEP), Conservation des Espèces et des Populations Animales — CEPA (Schlierbach, France), the Zoological Society for Conservation of Species and Populations (Zoologische Gesellschaft für arten- und Populationsschutz, Germany — ZGAP) (München, Germany), and the Disney Conservation Fund, are providing a clearer understanding of its status. Although more widespread than previously believed, the remaining populations are extremely small and isolated and still subject to hunting, and there is no forest large enough to support a viable population. The largest single block of forest in their known range, the Una Biological Reserve in Bahia, is estimated to protect a population of 185 individuals. In 1992, the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) set up an International Committee for the Conservation and Management of the species, which is promoting conservation action *in situ*, besides a captive breeding program based on the numerous individuals that are kept as pets in Brazil. At the beginning of 2004, there were 85 animals being maintained in 13 zoos and breeding facilities in Europe and Brazil.

Maria Cecília M. Kierulff, Jean-Marc Lernould,
William R. Konstant, Gustavo Canale, Gabriel Rodrigues
dos Santos, Carlos Eduardo Guidorizzi & Camila Cassano

Brown Spider Monkey

Ateles hybridus brunneus Gray, 1872
Colombia
(2004)

There are two recognized subspecies of the variegated or brown spider monkey, *Ateles hybridus* (I. Geoffroy, 1829). *A. hybridus brunneus* is restricted to Colombia, occurring between the lower Ríos Cauca and Magdalena in the Departments of Bolívar, Antioquia, and Caldas, and the nominate form, which occurs east from the right bank of the Río Magdalena extending into western Venezuela. Both are Critically Endangered due to loss of habitat (conversion to agricultural land, fragmentation) and hunting. The large size, slow reproductive rate (single offspring at 3- to 4-year intervals) and generally low population densities of spider monkeys make them especially vulnerable to hunting. *Ateles h. brunneus* has a small geographic range in a region where forest loss, degradation, and fragmentation is widespread. A refuge remains, however, in the Serranía San Lucas in southern Bolívar, identified as an important site for the establishment of a national park. There is also a population in northern Antioquia that has yet to be investigated. A park in the Serranía San Lucas would protect a number of species endemic to the Nechi center (or refugium), including two other threatened endemic primates, the white-footed tamarin, *Saguinus leucopus*, and the woolly monkey, *Lagothrix lagothricha lugens*. However, the region has been a center of civil unrest for years, and census work there would be hazardous, because guerilla groups have placed antipersonnel mines in some parts of the mountain range. Although civil unrest is limiting opportunities for surveys and conservation action, it is probably the reason why there is still forest remaining, considering the rapacious destruction of the forests elsewhere in the brown spider monkey's range.

Thomas R. Defler, Alba Lucia Morales-Jiménez, &
José Vicente Rodríguez-Mahecha

Northern Muriqui

Brachyteles hypoxanthus (Kuhl, 1820)
Brazil
(2000, 2002, 2004)

The two muriqui species (*Brachyteles hypoxanthus* and the southern muriqui, *B. arachnoides*) are the largest primates in South America and both are endemic to Brazil's Atlantic Forest region. They live in multi-male groups that can reach more than 50 animals, and were once widespread through the forests of southeast Brazil, from the northern part of the state of Paraná, through São Paulo, Rio de Janeiro, and Espírito Santo to coastal Bahia. Both have suffered from hunting and the destruction of their forests since the 16th century. The northern muriqui, occurring in Minas Gerais, Espírito Santo, and Bahia, is the more threatened of the two, its numbers being lower and its populations smaller and more fragmented than those of the southern muriqui which, although also endangered, has benefited from refuge in the relatively intact and inaccessible forests of the Serra do Mar in Rio de Janeiro and São Paulo. The largest known population of the northern muriqui today is in the forests of the Caratinga Biological Station, an 890-ha private reserve in the state of Minas Gerais (in 2004 numbering approximately 225 individuals). Karen Strier (University of Wisconsin–Madison) has led a research program there since 1983, which has provided invaluable insights into their demography, ecology, and behavior. A second major field site is now being set up in Santa Maria de Jetibá, Espírito Santo, by Sérgio Mendes and his colleagues from the state's federal university. Recent surveys in the Rio Doce State Park (Minas Gerais) and the Caparaó National Park (on the border of Minas Gerais and Espírito Santo) are indicating the occurrence of populations which may be as large as, or even larger than, those at Caratinga. Besides the Caparaó National Park and the Augusto Ruschi Biological Reserve, surveys over the last few years have located northern muriquis in 12 localities in the municipality of Santa Maria de Jetibá in Espírito Santo. The Serra do Brigadeiro State Park (Minas Gerais) also protects a significant population, estimated at more than 100 animals. Groups have also been found in two forests in northeastern Minas Gerais by teams from the Minas Gerais State Forestry Institute. One was rapidly turned into a large federal protected area, the Mata Escura Biological Reserve, and the other, extending across the border into Bahia (Alto Cariri), is currently under study for the creation of a protected area as well. These are the northernmost localities where the species is known to survive today. In 2001, a survey by a team from the Federal University of Minas Gerais also confirmed the survival of a small population of at least 13 in the Fazenda Córrego de Areia, municipality of Peçanha, eastern Minas Gerais, and they also occur in the Ibitipoca State Park in the south. The total known population today is estimated at between 700 and 1,000 animals.

Karen B. Strier, Sérgio L. Mendes,
Jean Philippe Boubli & Luiz G. Dias

Asia

Horton Plains Slender Loris,
Ceylon Mountain Slender Loris

Loris tardigradus nycticeboides (Hill, 1942)
Sri Lanka
(2004)

Four taxa of slender loris, spindly nocturnal primates characterized by short soft fur, no tails, long limbs, and woeful and enormous eyes, are endemic to the critically endangered rainforests of Sri Lanka. Although all taxa have been classified as Endangered, those found in the island's Wet Zone, where only 3% of rainforest remains, are the most imperiled. Restricted to a potential range of no more than 250 km², or, more realistically, 30 km², the Ceylon Mountain (or Horton Plains) slender loris (*Loris tardigradus nycticeboides*) is the most extraordinary of the already specialized slender loris taxa. This cold-adapted slender loris' pelage is so thick, it obscures its ears and thickly clothes the animals' otherwise pencil-thin limbs, adapting it to its life in the montane rainforests, where temperatures may drop to -4ºC. In 1980, the meticulous expert on Sri Lanka's mammals, W. W. Phillips, wrote that the Ceylon Mountain slender loris "would appear to be the rarest of all mammals in Sri Lanka (p. 127)." In fact only four confirmed sightings have been made since 1937, despite several recent systematic surveys in its restricted range by researchers from the Nocturnal Primate Research Group, Oxford Brookes University, and Wildlife Heritage Trust of Sri Lanka. Although the Horton Plains National Park is officially protected, gem mining, collection of fuelwood, agricultural encroachment, the pet trade, forest diebacks in the park, and stochastic effects on the small isolated forest patches to which it clings, continue to threaten this rarest of Sri Lankan primates.

K. Anna I. Nekaris

Pagai Pig-tailed Snub-nosed Monkey or Simakobu
Simias concolor Miller, 1903
Indonesia
(2002, 2004)

The genus *Simias* is known only from Indonesia's Mentawai Islands, a small archipelago situated off the west coast of central Sumatra. Until humans arrived approximately two millennia ago, its only predators were probably large constricting snakes and birds of prey. Today, however, hunting and forest conversion are two substantial threats to the four indigenous Mentawai primates, all of which are endemic to these islands. *Simias concolor* was originally considered monotypic, but is now believed to include two subspecies, *S. c. concolor* from the Pagai islands and Sipora, and *S. c. siberu* Chasen and Kloss, 1927 from the island of Siberut. The common English name of this large monkey is derived from its short pig-like tail and its shortened nose, which very much resembles that of the Tonkin snub-nosed monkey (*Rhinopithecus avunculus*) of Vietnam, another Critically Endangered species. *S. concolor* lives in relatively small social groups with usually one male and one or more females and offspring. *S. concolor* occurs in the few small remaining forest patches on the islands of North and South Pagai and Sipora, and in the large national park on Siberut. It may still occur in a few forest patches on small islets off southern South Pagai Island. However, of the four Mentawai primates, *Simias* is the most sensitive to deforestation, having significantly lower densities in logged forests than in unlogged. Thus, while *Simias* still survives in spite of human encroachment, hunting, and habitat disturbance, the vast majority of its remaining natural habitat lies outside of officially protected areas. These areas are in logging concessions and could very well be lost in the near future.

Lisa Paciulli, Agustin Fuentes & William R. Konstant

Miller's Grizzled Surili
Presbytis hosei canicrus Miller, 1934
Indonesia (E. Central Kalimantan)
(2004)

All four subspecies of the Asian colobine monkey *Presbytis hosei* are endemic to north Borneo. The high forehead and crest linking it with the white-fronted surili (*P. frontata*) from the southern part of the island, mark the crested grizzled surili, *P. h. sabana* (Thomas, 1893) from eastern Sabah (East Malaysia) as the most divergent subspecies. Its western neighbor, Everett's grizzled surili, *P. h. everetti* (Thomas, 1893), is unique to the genus in being sexually dichromatic. The bandanna-like white tract of hair across the forehead of juveniles and male adults is reduced to a white spot in female adults. In the southeastern subspecies, Miller's grizzled surili (*P. h. canicrus*), all adults and juveniles much resemble adult female *P. h. everetti*, but have no frontal white spot. *P. h. canicrus* is known only from the northeast Indonesian part of Borneo as far south as the Kutai National Park, the only protected part of its recorded range (Brandon-Jones 1997). Only an estimated 5% of the forest in this national park has escaped timber concessions, illegal settling, industrial development, and fire (Meijard and Nijman 2000). This leaves *P. h. canicrus* probably critically endangered or even extinct, although no surveys have been undertaken. The western subspecies, Hose's grizzled surili, *P. h. hosei* (Thomas, 1889), is even more likely to be extinct as most of its distribution coincides with that of the oilfields that straddle the frontier between Sarawak (East Malaysia) and Brunei. *Presbytis h. hosei* resembles *P. h. everetti*, but the female retains her juvenile color at maturity (Brandon-Jones 1997). There is a slim chance that *P. h. hosei* survives in the northern part of the Similajau National Park in central coastal Sarawak (Duckworth 1995, 1998). Populations may also exist in Brunei, which have been much less subject to hunting and deforestation, but they are likely to be intermediate with *P. h. everetti*. The reputed medicinal value of the bezoar stones sometimes formed in the gut makes this species a target even for hunters uninterested in its meat.

Douglas Brandon-Jones

Delacour's Langur
Trachypithecus delacouri (Osgood, 1932)
Vietnam
(2000, 2002, 2004)

Delacour's langur is one of the most highly endangered of Southeast Asia's colobine monkeys. The species is endemic to Vietnam. During the decades following the discovery of the species in 1930 there was only scanty information on its existence and distribution. The first sightings of living Delacour's langurs were reported in 1987. The most important, and for some subpopulations the only, factor for the decline in numbers is poaching, which is not primarily for meat, but for bones, organs, and tissues that are used in the preparation of traditional medicines. Nineteen isolated wild populations of Delacour's langur have been confirmed over 10 years of surveys and monitoring by the Frankfurt Zoological Society. The total population comprises 280 to 320 individuals. The recorded numbers of animals hunted over the 10 years totaled 320, an annual loss of more than 30 individuals, but the real number is undoubtedly higher. Sixty percent of all existing Delacour's langurs occur in isolated populations with less than 20 animals. The loss of these subpopulations, and consequently 60% of the whole population, is foreseeable without management, strict regulations, and law enforcement. Four areas where Delacour's langurs are protected are Cuc Phuong National Park, Pu Luong Nature Reserve, Hoa Lu Cultural and Historical Site, and the newly established Van Long Nature Reserve, which is believed to harbor the largest remaining population of about 50 to 60 animals. This population is well protected due to patrols and close cooperation between the provincial forest protection authorities and Frankfurt Zoological Society. Monitoring surveys in 2003 and 2004 in Cuc Phuong National Park and in Pu Luong Nature Reserve show declines in numbers. Efforts to save this species are being led by Tilo Nadler, manager of the Vietnam Primate Conservation program of Frankfurt Zoological Society and director of the Endangered Primate Rescue Center at Cuc Phuong National Park, established in the 1990s primarily to safeguard the future of this and other endangered Vietnamese primates.

William R. Konstant & Tilo Nadler

Golden-headed Langur or Cat Ba Langur

Trachypithecus poliocephalus poliocephalus (Trouessart, 1911)
Vietnam
(2000, 2002, 2004)

This rare Asian colobine monkey is known only from Cat Ba, the largest of more than 3,000 islands located in northeastern Vietnam's Halong Bay. The greatest part of the islands' mountain range, like most of the smaller offshore islands, is covered by tropical moist limestone forest. Local livelihoods are built upon subsistence agriculture and more recently on a growing tourism industry, supplemented by hunting of wildlife and the collection of firewood, medicinal plants, honey, and other forest products. Poaching has been the major threat to the golden-headed langur and has resulted in a population decline from an estimated 2,500–2,800 langurs in the 1960s to a mere 53 individuals by 2000 — a 98% decline in 40 years. Langurs were poached mainly for the preparation of traditional medicines. After the implementation of strict protection measures, for the first time in decades the population of the golden-headed langur increased to a minimum of 59 individuals at present. However, population fragmentation and low reproductive output also threaten them. The remaining population is subdivided into seven isolated subpopulations. Some of these are all-female groups. Allwetter Zoo, Münster, and the Zoological Society for the Conservation of Species and Populations (ZGAP), München, have been carrying out a conservation program for the golden-headed langur on Cat Ba since November 2000. The aim is to provide for protection, reduce population fragmentation, and increase public awareness in collaboration with Vietnamese authorities with support from Conservation International, among other NGOs. Protection of the golden-headed langur has been designated a priority project of Fauna and Flora International's newly created Flagship Species Fund. The closely related white-headed langur, *T. poliocephalus leucocephalus* Tan, 1957, is also Critically Endangered due to hunting and habitat destruction (expansion of sugarcane plantations). It inhabits seven isolated karst regions that cover 60–80 km² (in a total distribution of approximately 400 km²) in Guangxi Province, China. The karst formations are found in three separate and isolated protected areas: the Fusui and Chongzuo rare and precious animal reserves, and the Longgang National Nature Reserve. Estimated total population is about 600–800 animals. In 1998, populations in Longgang and Fusui were found be in decline. A more recent survey (January 2003) in Fusui, financed by the Asian Development Bank, however, has indicated some recovery since then. Numbers in Chongzuo have risen from less than 100 to more than 200 individuals since Professor Pan Wenshi of Peking University established a biological research program there in 1996. Chongzuo currently has the second largest population after Fusui and represents an example of how scientific presence can contribute significantly to wildlife conservation strategies. Dr. Chia Tan, a research fellow for the Zoological Society of San Diego, is working with the Peking University team to conduct ecological and behavioral studies and education campaigns at Chongzuo.

William R. Konstant, Roswitha Stenke, Tilo Nadler,
Roland Wirth, Zhaoyuan Li & Martina Raffel

Western Purple-faced Langur

Semnopithecus vetulus nestor Bennett, 1833
Sri Lanka
(2004)

Endemic to Sri Lanka, this langur is restricted to a small area of the wet zone in the west of the country, most of which is threatened due to human activities (crops, infrastructure and industry, settlements, deforestation and forest fragmentation, and hunting). Colombo, the capital city of Sri Lanka, is in the center of its very limited range. Hill (1934) indicated that it was common around the capital, but this is no longer the case. Forest cover in Sri Lanka has declined drastically since the late 1950s, and the area of occupancy of this langur has been reduced to a highly fragmented 1,900 km² (Molur *et al.* 2003). Although still quite numerous (>10,000), the declines in numbers are expected to have been precipitous — estimated at more 80% in three generations due to urbanization and development. They are highly arboreal and need good canopy cover, and there are possibly less than three forests that can support viable populations, none of which are protected areas set aside for conservation. The human-modified areas that sustain much of the langur population, such as gardens and rubber plantations, are under private ownership and changing rapidly due to human population expansion and development; large trees are cut down and entire forest patches are destroyed for housing and development. This severely restricts home ranges, isolating the groups, and resulting in escalated conflict with humans and low juvenile recruitment rates (Dela 1998). Long-term studies by Dela (1998) have shown that this taxon is unique in having subpopulations adapted to a diet high in mature/ripe fruit, a feature as yet unrecorded for any other colobine, and are dependent on fruits cultivated by humans. Its geographical range has a very high human population density, and home ranges are being compressed due to loss of tree cover. Censuses are urgently needed to identify forest areas for conservation and to better quantify the decline of subpopulations in space and time, and to provide a better understanding of their demographics (especially reproductive rates, population turnover, and dispersal) in the extremely disturbed habitats where they survive today.

Jinie Dela & Noel Rowe

Grey-shanked Douc
Pygathrix cinerea Nadler, 1997
Vietnam
(2000, 2002, 2004)

Colobine monkeys of the genus *Pygathrix* are native to Southeast Asia. Until only a few years ago, just two distinct taxa were recognized: the red-shanked douc, *Pygathrix nemaeus*, named by Linnaeus in 1771, in the northern part of central Vietnam; and the black-shanked douc, *P. nigripes*, from southern Vietnam and eastern Cambodia, described exactly a century later by Milne-Edwards. From August 1995 through January 1998, however, six male specimens of a new and distinctive *Pygathrix* were confiscated by Vietnamese forest protection authorities and placed at the Endangered Primate Rescue Center at Cuc Phuong National Park. The animals had evidently originated in central Vietnam. The grey-shanked douc appears to be restricted to mountainous regions of Vietnam's Quang Nam, Quang Ngai, Kon Tum, Gia Lai, and Binh Dinh provinces, where it is threatened throughout by hunting and habitat loss. Hunting is with guns as well as baited traps. Forest loss within at least part of its range is attributable to the expansion of fruit tree plantations, illegal logging, and firewood collection. Surveys and research on this recently discovered primate were conducted by the Frankfurt Zoological Society, led by Tilo Nadler, manager of the Vietnam Primate Conservation program of Frankfurt Zoological Society and director of the Endangered Primate Rescue Center at Cuc Phuong National Park. The continuation of this work should provide recommendations for the establishment of special "Species Protection Areas," with links between protected areas. Most of the grey-shanked doucs occur in two large areas in central Vietnam, each comprising four protected areas of differing status. The population is highly fragmented and estimated at 600–700 individuals.

William R. Konstant & Tilo Nadler

Tonkin Snub-nosed Monkey
Rhinopithecus avunculus Dollman, 1912
Vietnam
(2000, 2002, 2004)

The Tonkin snub-nosed monkey is one of four unusual, large Asian colobine monkeys of the genus *Rhinopithecus*, all of which possess a characteristic turned-up nose. The three other species are endemic to China, while the Tonkin snub-nosed monkey is found only in northern Vietnam. This species was discovered in 1910, collected on perhaps no more than two occasions over the course of the next 50 to 60 years, and subsequently presumed to be extinct by a number of primatologists until it was rediscovered in 1989. Currently, there are only three known locations with recent evidence where Tonkin snub-nosed monkeys occur. In 1992, a population was found in Na Hang District. As a result of the discovery, a nature reserve was established in 1994. Since the creation of the protected area at Na Hang, the existence of two additional Tonkin snub-nosed monkey populations has been confirmed, one in the forests of Cham Chu and another in Du Gia Nature Reserve. The total population is estimated not to exceed 300 individuals. For the largest subpopulation of Na Hang Nature Reserve, the most serious threat is posed by a hydropower and flood prevention dam project. Construction began in 2002. Some 10,000 workers will move into the area for dam construction. This will lead to increased demand for wildlife products, firewood, and increased human activities due to improved accessibility by roads and the future lake. Conservation activities carried out by several organizations have been unsuccessful, and a dramatic reduction of this subpopulation is foreseeable. The forests of Cham Chu have no protected status and are under increasing pressure due to resettlement from the Na Hang area. The only population without immediate threat is in the Du Gia Nature Reserve. There, public awareness and community participatory activities are being linked to increased protection efforts under the supervision of Fauna and Flora International (FFI).

William R. Konstant & Tilo Nadler

Hainan Black-crested Gibbon
Nomascus nasutus hainanus (Thomas, 1892)
China (Island of Hainan)
(2000, 2002, 2004)

The black-crested gibbons of Vietnam and China are among the rarest primates in the world. Their taxonomy is currently in debate, but experts now believe that there are two species — the western black-crested gibbon, *Nomascus concolor*, with up to four subspecies in China, Laos, and Vietnam, and the eastern black-crested gibbon, *Nomascus nasutus*, with two subspecies that are considered the most threatened of all the gibbon taxa (Geissmann 2003). The Hainan gibbon, *Nomascus nasutus hainanus* (Thomas, 1892) is restricted to the Island of Hainan, and the Cao Vit black-crested gibbon, *N. nasutus nasutus* (Kunckel d'Herculais, 1884), occurs on the continent in northeastern Vietnam and China. The correct scientific names of eastern black-crested gibbons are still under debate (Geissmann *et al.* 2000; Groves 2004; Brandon-Jones *et al*. 2004). They differ in their territorial calls and hair color (La Quang Trung and Trinh Dinh Hoang 2004). Further comparisons are needed besides genetic research, however, to determine whether they should be classified as separate species (Nadler 2003).

Adult male *N. n. nasutus* are black with a slight tinge of brown hair on their chest, and adult male *N. n. hainanus* are entirely black (Geissmann *et al*. 2000; Mootnick in press). The adult females on the mainland and Hainan Island vary from a buffish to a beige brown and have a black cap (Geissmann *et al*. 2000; Mootnick in press). Adult female *N. n. hainanus* have a thin white face ring that is thicker above the mouth and below the orbital ridge. Depending on the amount of humidity, female *Nomascus* can obtain a more orangey color resulting from their sweat (Mootnick, in press). There was an adult female, "Patzi," in the Berlin Zoo whose vocalizations were similar to that of *N. n. nasutus*, but her pelage differed in that she had a very long and broad black crown streak that went past the nape, and extended to the brow, tapering to a thin face ring and becoming thicker at the chin (Geissmann *et al*. 2000; Mootnick in press). This female had a narrow blackish brown chest plate slightly wider than the face, beginning at the throat and tapering at the top of the abdomen.

The Cao Vit black-crested gibbon formerly occurred east of the Red River in northern Guangdong and southwestern Guangxi provinces. It disappeared from southeastern China in the 1950s, and today it is restricted to the forests of the Phong Nam-Ngoc Khe Mountains, Trung Khanh District, northern Cao Bang Province in Vietnam (bordering China). Last seen in Vietnam in the 1960s, it was also feared extinct there, but was found again, after intensive searches in January 2002 by Fauna and Flora International (FFI) biologists La Quang Trung and Trinh Dinh Hoang (2004). They found five groups totaling at least 26 individuals in the remaining forest of 3,000 ha. Further surveys by the Vietnam Primate Conservation Programme of FFI and Trung Kanh District rangers in November 2004 indicated 37 individuals (VNA 2004). In the 1950s there were estimates of >2,000 gibbons on the island of Hainan in 866,000 ha of forests across 12 counties (Wang and Quan 1986). By 1989 the *N. n. hainanus* population was reduced to only 21 gibbons in four groups in 1,200 ha of the Bawangling Nature Reserve (Liu *et al*. 1989). William Bleisch and Yingyi Zhang found 16 individuals in three groups on Hainan Island in November 2003 (pers. comm. to La Quang Trung and Trinh Dinh Hoang 2004). Further recent surveys estimated between 12–19 individuals in three groups in the Bawangling Nature Reserve, and a fourth group sighted outside the preserve could have had between two and seven individuals (Wu *et al*. 2004). Another survey found two groups, and two lone males, comprising a total of 13 individuals (Geissmann and Chan 2004).

Gibbons generally establish long-term pair bonds, but in the Bawangling Nature Reserve there were observations of two females in the same group both carrying offspring (Liu *et al*. 1989; Bleisch and Chen 1991). This could be a result of older offspring being unable to locate appropriate mates (Wu *et al.* 2004) and limited space to establish new groups (Liu *et al*. 1989). Efforts are underway by FFI to create new protected areas in forests such as those of Che Tao, Vietnam, where local support for the protection of endangered gibbons is apparently on the rise. There is an urgent need to secure the forests on the Island of Hainan, and the survival of the few remaining gibbons there.

Alan R. Mootnick, Anthony B. Rylands &
William R. Konstant

Sumatran Orangutan

Pongo abelii Lesson, 1827
Indonesia
(2000, 2002, 2004)

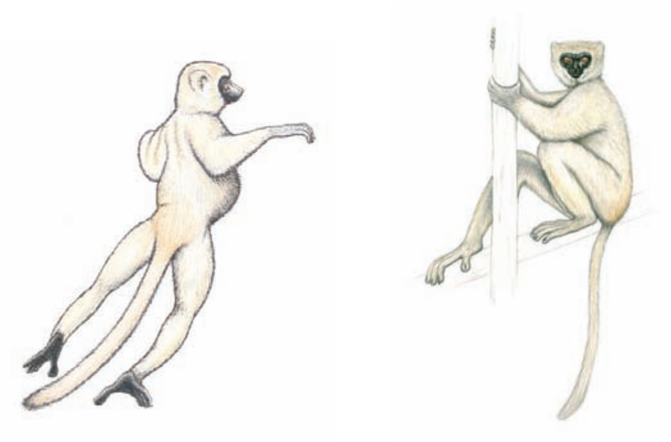
The Sumatran orangutan is one of two species of the genus *Pongo.* While the viability of both is in question, the Sumatran orangutan faces a more immediate extinction risk than the Bornean, *Pongo pygmaeus* (Linnaeus, 1760), and is considered Critically Endangered. The species is endemic to the Indonesian island of Sumatra, and is now restricted almost entirely to forests in the lowlands of Nangroe Aceh Darussalam (NAD) and provinces in North Sumatra. More than 1,500 orangutans remain in the Singkil swamp. Sumatran orangutans are estimated to total about 7,500 individuals (based largely on 2002 satellite images), living in 13 fragmented habitat units stretching from northern NAD south to the Sibolga-Tarutung-Padangsidempuan area. It has been suggested that the southernmost population may be genetically distinct from its northern relatives. The largest populations live within NAD province, where recent political turmoil has made monitoring and conservation work difficult. A large population is found in the Leuser Ecosystem, but less than half of these orangutans live within the Gunung Leuser National Park boundaries. Throughout its range, the primary threat to Sumatran orangutans is logging. Old-growth forests in Indonesia have declined by more than 80% in the last 25 years, and broad surveys throughout the species' range have demonstrated that orangutan populations have plummeted in the region's severely logged areas. Of the 13 identified orangutan populations on Sumatra, only seven are estimated at 250 or more individuals. Six of these relatively large populations have experienced between 10% and 15% annual habitat loss due to logging. Villagers and immigrants from nearby areas such as Nias Island and refugees from NAD accelerate habitat loss through encroachment and conversion of land for agriculture. Hunting often occurs when orangutans steal fruit from gardens at the forest edge and are shot by farmers. Some refugees hunt orangutans for meat, but this generally only occurs in the far south of their range (Sibolga). Key conservation interventions necessary for Sumatran orangutan survival include expanding the moratorium on logging concessions beyond NAD, improving patrols and law enforcement, stopping illegal logging, promoting forest restoration, halting road construction, addressing human-orangutan conflict, and providing connectivity in the landscape to allow for genetic exchange. At current rates of habitat destruction from logging, a further 50% of Sumatran orangutans will vanish in a decade. However, there is as much reason to believe the rate of decline will increase as there is for mitigation of this threat; solutions to conserve the remaining lowland primary habitats are urgently needed.

Susie Ellis, Mark Leighton & Ian Singleton

Madagascar

Greater Bamboo Lemur
Prolemur simus (Gray, 1871)

White-collared Lemur
Male (left), Female (right)
Eulemur albocollaris (Rumpler, 1975)



Silky Sifaka
Propithecus candidus Grandidier, 1871

Perrier’s Sifaka
Propithecus perrieri Lavauden, 1931

Africa

Mt. Rungwe Galago
Galagoides sp. nov.

Pennant’s Red Colobus
Procolobus pennantii pennantii (Waterhouse, 1838)

Africa, *continued*

Tana River Red Colobus
Procolobus rufomitratus (Peters, 1879)

White-naped Mangabey
Cercocebus atys lunulatus (Temminck, 1853)

Sanje River Mangabey
Cercocebus sanjei Mittermeier, 1986

The Eastern Gorillas
Gorilla beringei Matschie, 1903

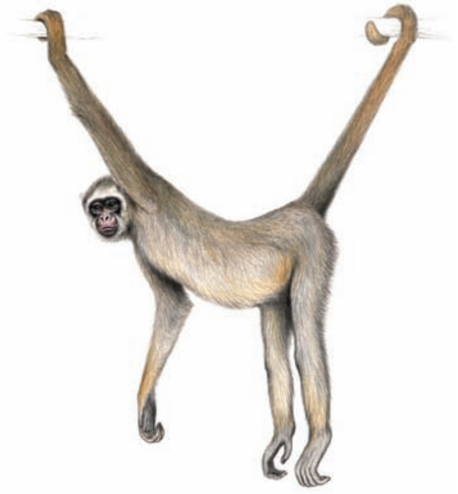
Cross River Gorilla
Gorilla gorilla diehli Matschie, 1904

Neotropical Region

Black-Faced Lion Tamarin
Leontopithecus caissara Lorini and Persson, 1990

Buff-headed Capuchin or Yellow-breasted Capuchin
Cebus xanthosternos Wied-Neuwied, 1826

Brown Spider Monkey
Ateles hybridus brunneus Gray, 1872



Northern Muriqui
Brachyteles hypoxanthus (Kuhl, 1820)

Asia

Horton Plains Slender Loris,
Ceylon Mountain Slender Loris
Loris tardigradus nycticeboides (Hill, 1942)

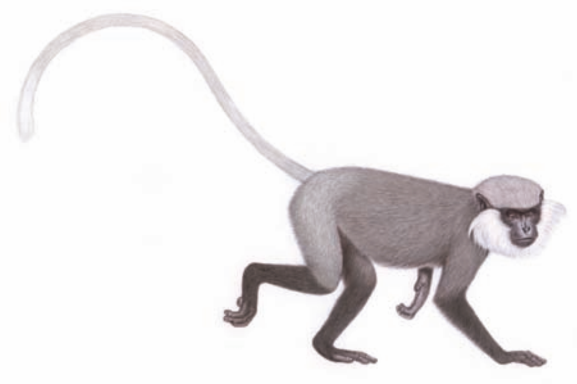
Pagai Pig-tailed Snub-nosed Monkey
or Simakobu
Simias concolor Miller, 1903

Miller’s Grizzled Surili
Presbytis hosei canicrus Miller, 1934

Asia, *continued*

Delacour's Langur
Trachypithecus delacouri (Osgood, 1932)

Golden-headed Langur or Cat Ba Langur
Trachypithecus poliocephalus poliocephalus
(Trouessart, 1911)



Western Purple-faced Langur
Semnopithecus vetulus nestor
Bennett, 1833

Tonkin Snub-nosed Monkey
Rhinopithecus avunculus Dollman, 1912

Grey-shanked Douc
Pygathrix cinerea Nadler, 1997

Hainan Black-crested Gibbon
Nomascus nasutus hainanus (Thomas, 1892)

Sumatran Orangutan
Pongo abelii Lesson, 1827

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White-collared Lemur

Eulemur albocollaris (Rumpler, 1975)

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Cebus xanthosternos Wied-Neuwied, 1820

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Loris lydekkerianus nycticeboides Hill, 1942

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Simias concolor Miller, 1903

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Trachypithecus poliocephalus poliocephalus (Trouessart, 1911)

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Trachypithecus poliocephalus leucocephalus Tan, 1957

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On a New Species of Titi Monkey, Genus *Callicebus* Thomas (Primates, Pitheciidae), from Western Bolivia with Preliminary Notes on Distribution and Abundance

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Abstract: This paper describes a new species of titi monkey, *Callicebus aureipalatii*, recently discovered in the Madidi protected area of northwestern Bolivia. Descriptions are based on observations, photographs and video material, and the subsequent collection of two specimens. Preliminary surveys and notes on habitat associations indicate that *C. aureipalatii* is limited in distribution to the western side of the Río Beni. It is found in the Andean foothills and immediately adjacent lowland forests. Line transect studies at four sites and subsequent extrapolations based on available suitable habitat suggest that population densities are sufficiently high to ensure the protection of this species within the confines of the Madidi protected area. This finding is discussed with reference to the general lack of knowledge regarding titi monkey distributions in Bolivia.

Resumen: Este artículo describe una nueva especie de mono tití, *Callicebus aureipalatii*, recientemente descubierto en el área protegida Madidi en el noroeste de Bolivia. Las descripciones están basada en observaciones, fotografías y video, y la colección resultante de dos especimenes. Evaluaciones preliminares y notas sobre uso de hábitat indican que *C. aureipalatii* tiene una distribución limitada al oeste del Río Beni. Se encuentra en el pie de monte andino y el bosque de tierras bajas adyacente. Estudios de transectas lineales en cuatro sitios y subsecuentes extrapolaciones basadas en cantidad de hábitat disponible, sugieren que las densidades de población son suficientemente altas para asegurar la protección de esta especie dentro de los límites del área protegida Madidi. Este descubrimiento es discutido en referencia a la falta de conocimiento general sobre la distribución de los monos tití en Bolivia.

Key Words: Primates, Madidi, Amazonia, neotropics, river boundaries

Introduction

Neotropical primate taxonomy is constantly changing, with the regular discovery of new taxa (Ayres 1985; Ferrari and Lopes 1992; Mittermeier *et al*. 1992; Silva and Noronha 1998; Van Roosmalen *et al*. 1998; Ferrari *et al*. 1999; Kobayashi and Langguth 1999; Van Roosmalen *et al.* 2000, 2002). The use of morphological, genetic, and molecular data is also revealing important differences between populations previously thought homogenous; for example, *Alouatta sara* (Stanyon *et al*. 1995). The most recent review of the Platyrrhini (Rylands *et al*. 2000) argued that for conservation purposes it is preferable to adopt a "splitting" approach to formal taxonomy to ensure that all possible taxa are accounted for in associated action plans. This approach has been particularly relevant to the smaller and extremely diverse neotropical taxa such as the Amazonian marmosets (*Mico*, formally *Callithrix*), the ranges of which are often delineated by the larger Amazonian tributaries (Van Roosmalen *et al*. 1998, 2000).

A recent taxonomic review of the titi monkeys (*Callicebus*) resulted in a list of 28 species (Van Roosmalen *et al*. 2002). It drew on previous efforts over the last 15 years (Hershkovitz 1988, 1990; Kobayashi and Langguth 1999; Groves 2001), introduced two new taxa, and argued that river barriers (Ayres and Clutton-Brock 1992) are a major cause of speciation for this genus. Titi monkeys are small primates (*c*.1 kg), are unable to swim, and apparently visit flooded forests only during high waters (Van Roosmalen *et al*. 2002).

Until recently the northern part of the La Paz Department, Bolivia, was relatively unexplored with very little biological information available for the region. Current information, nevertheless, suggests that Madidi is the most biologically diverse terrestrial protected area in the world (Remsen and Parker 1995; CARE/WCS/IE/SERNAP 2003). For example, over 900 bird species have already been registered within the park despite large areas never having been visited by biologists (CARE/WCS/IE/SERNAP 2003). Furthermore, in recent years western Bolivia has provided a series of range extensions for rare or threatened species (Gottdenker *et al*. 2001; Tarifa *et al*. 2001; Hennessey 2002a), new Bolivian records (Hennessey and Gómez 2003; Rios *et al*. 2004), as well as vertebrate species potentially new to science (Wallace and Painter 1999; Hennessey 2002b). In this paper we describe a new species of titi monkey found in the Madidi protected area and surrounding lowlands in northwestern Bolivia, and provide preliminary information regarding its distribution and ecology.

Methods

Species description

In August and September 2002 we filmed and photographed five groups of an unidentified *Callicebus* in the Tuichi Valley. This material provided sufficient evidence to justify the collection of a type specimen in February 2003. A description was then made using two specimens collected along the Río Hondo within the Natural Area of Integrated Management section of the Madidi protected area in northern La Paz Department, Bolivia, as well as video and photographic footage from groups in the Tuichi and Hondo valleys and the Alto Madidi site farther north (Fig. 1). The specimens were deposited in the Colección Boliviana de Fauna, part of the Museo Nacional de Historia Natural based in La Paz, Bolivia.

Distribution

Distributional information on the titi monkey was gathered from observations collected during general mammalian biodiversity surveys conducted in the northern La Paz region between 1999 and 2004. Six sites were surveyed (Fig. 1); Río Hondo (14º37′30″S, 67º43′06″W), Río Tuichi (14º33′10″S, 67º43′19″W), Río Quendeque (14º59′14″S, 67º46′59″W) Río Undumo (13º44′22″S, 68º21′42″W), the Asariamas region (14º12′38″S, 68º30′05″W), and Alto Madidi region (13º37′18″ S, 68º44′33″W).

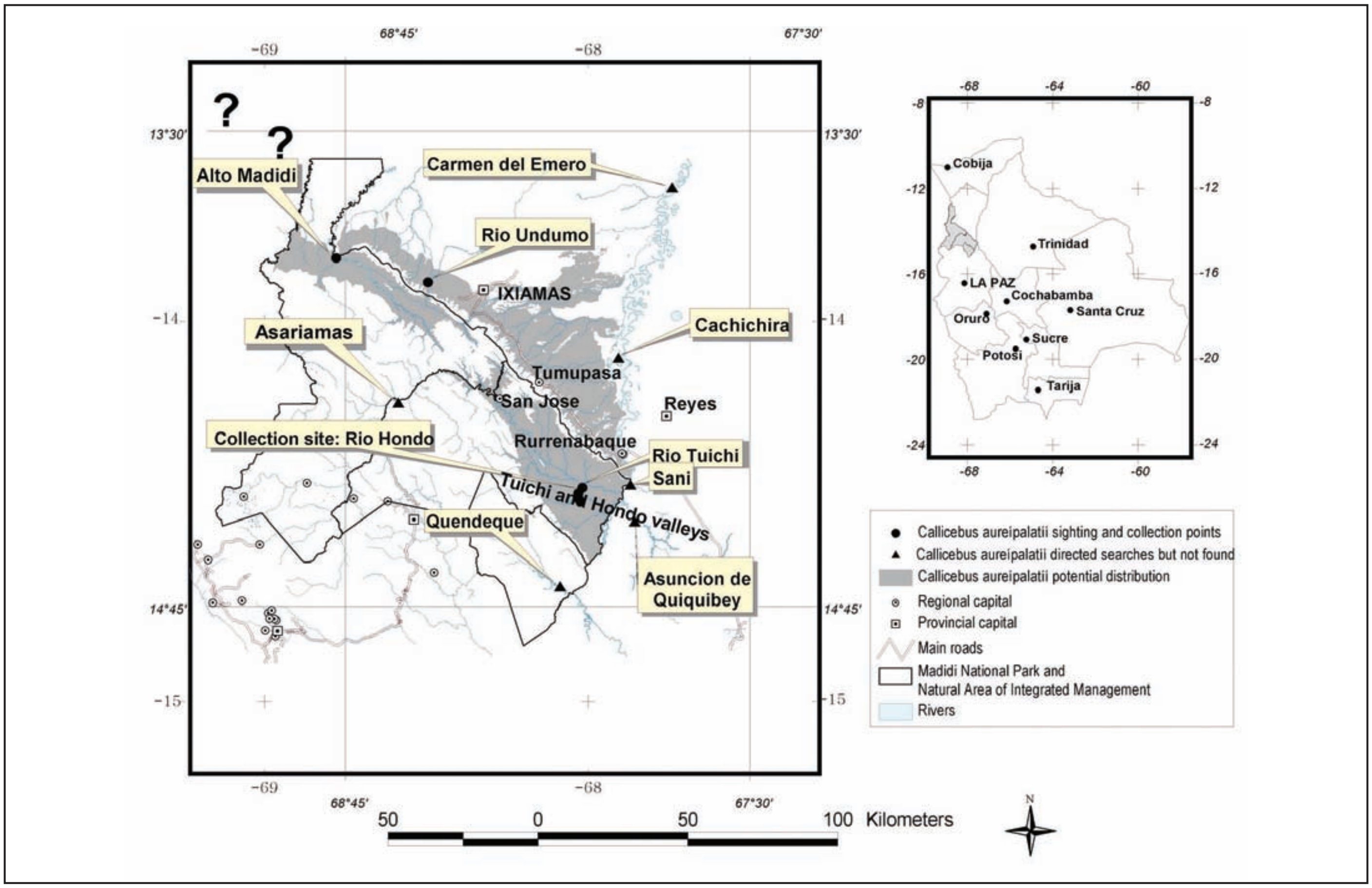

Figure 1. Known and hypothetical *C. aureipalatii* distribution in northern La Paz Department, Bolivia.

Table 1. Sampling effort and relative abundance of *C. aureipalatii* at four sites in western Bolivia.

Study site	Trail (km)	Transect (km)	Total # sightings	Groups per 10 km	Individuals per 10 km	Average group size
Río Hondo	31.1	172.8	10	0.97	1.73	3 ±0.8
Río Tuichi	20.9	130.1	7	0.41	1.48	2.75 ±0.96
Río Undumo	20.4	102.0	6	0.60	1.35	2.3 ±1.2
Alto Madidi	16.8	144.6	7	0.48	1.25	3 ±0.2

We also conducted a literature search for the region to identify possible locations for the species, as well as directed searches for *Callicebus* at six sites (Fig. 1): the eastern and western sides of the Río Beni at Cachichira and Carmen del Emero, and Asunción del Quiquibey and Sani in the Pilón Lajas Biosphere Reserve and Indigenous Territory on the western side of the Río Beni.

Density and habitat preferences

Line transect methodologies were employed to survey the Río Undumo, Asariamas, Río Tuichi, Río Quendeque, Alto Madidi, and Río Hondo sites (Gómez *et al*. 2001, 2003; Ríos *et al*. 2001). Diurnal transects were typically run by two observers in fair weather conditions between 06:00 and 11:30 and from 15:00 to 18:00, along trails newly cut by the survey team. Transect speed ranged from 1–2 km per hour and depended on trail conditions and associated noise levels. Periods of walking were regularly interspersed with brief "listening stops" to increase the probability of detecting more cryptic species. The following information was recorded for all primates encountered: species, group size (and where possible age/sex composition), date and time detected, observation duration, transect position, habitat type, and the perpendicular distance from the transect trail to the estimated geometric center of the group. Trail and transect effort are detailed in Table 1. Results were analyzed using DISTANCE techniques and accompanying software (Thomas *et al*. 2001).

Callicebus aureipalatii sp. nov.

Holotype: Adult male, skin, skull and complete skeleton (CBF7511, Collectors: Robert Wallace, Rodolfo Nallar, Jesús Martínez, Fortunato Espinoza, Lucio Ocampo and Remberto Chiguapuri, 2003). Colección Boliviana de Fauna, Museo Nacional de Historial Natural, La Paz, Bolivia. Collected 27 February 2003 on the northern bank of the Río Hondo (14º37′59″W, 67º42′27″S).

Paratype: Adult female, skin, skull and complete skeleton (CBF7510, Collectors: Robert Wallace, Rodolfo Nallar, Jesús Martínez, Fortunato Espinoza, Lucio Ocampo and Remberto Chiguapuri, 2003). Colección Boliviana de Fauna, Museo Nacional de Historial Natural, La Paz, Bolivia. Collected 25 February 2003 on the southern bank of the Río Hondo (14º38′23″W, 67º42′27″S).

Type locality: Campamento Roco Roco, Río Hondo, Madidi National Park and Natural Area of Integrated Management, La Paz Department, Bolivia (14º37′30″S, 67º43′06″W).

Figure 2. The Madidi titi monkey, *Callicebus aureipalatii* sp. nov. Illustration by Annika Felton.

Diagnosis: A species of the *C. moloch* group (*sensu* Hershkovitz 1990; Groves 2001) as defined according to broad distributional and physical characteristics. Using the Van Roosmalen *et al*. (2002) classification, this new species shows physical similarities with the *C. cupreus* group (crown and cheiridia dominated by pheomelanin hair pigments, orange ventrally sharply contrasting with agouti body coloration, cheiridia reddish), however, available information on distribution suggests it borders *C. brunneus* (a member of the *C. moloch* group according to Van Roosmalen *et al*. 2002) to the north. This species is distinguished by a golden crown due to golden tipped hairs with dark longer base, dark forehead with slightly less golden coloration; deep orange throat and ventral area; deep orange burgundy limbs from elbow and knees to hands and feet; dark tail with clear paler whitish tip (Figs. 2–6). Distinguished from *C. brunneus* by a distinct golden coloration on the crown, deep orange throat coloration; sharply contrasting sideburns and underside, and orange to burgundy cheiridia; from *C. cupreus* by a distinct golden coloration on the crown and deep orange throat coloration, and from *C. dubius* by a distinct golden coloration on the crown, deep orange throat coloration, and lack of the white forehead stripe. *C. olallae*, *C. modestus,* and *C. donacophilus*, all members of the *C. donacophilus* species group (Van Roosmalen *et al*. 2002) and found exclusively on the eastern side of the Río Beni, display clear white ear tufts and are characterized by a uniform dorsal and lateral body color. These taxa lack differential crown coloration and contrasting lateral coloration on the limbs, and are characterized by a uniformly colored tail with no obvious white tip.

External characteristics of holotype: Dorsal and lateral body to neck, lateral forelimbs to elbow and lateral hind-limbs to knee light brown non-uniform color due to agouti-banded hairs that are grey brown at the basal half, then changing to banded grey brown with lighter brown, and ending in a light brown tip. Laterally, forelimbs and hind limbs from elbows and knees colors gradually change to deep orange burgundy

Figure 3. *C. aureipalatii*, new species. Views of the male holotype (CBF7511). Photographs by R. B. Wallace.

Figure 4. *C. aureipalatii*, new species. Views of the male holotype (CBF7511). Photographs by R. B. Wallace.

Figure 5. Details of the adult male holotype *C. aureipalatii* (CBF7511): a. tail and hind feet, b. hind legs, c. hind foot. Photographs by R. B. Wallace.

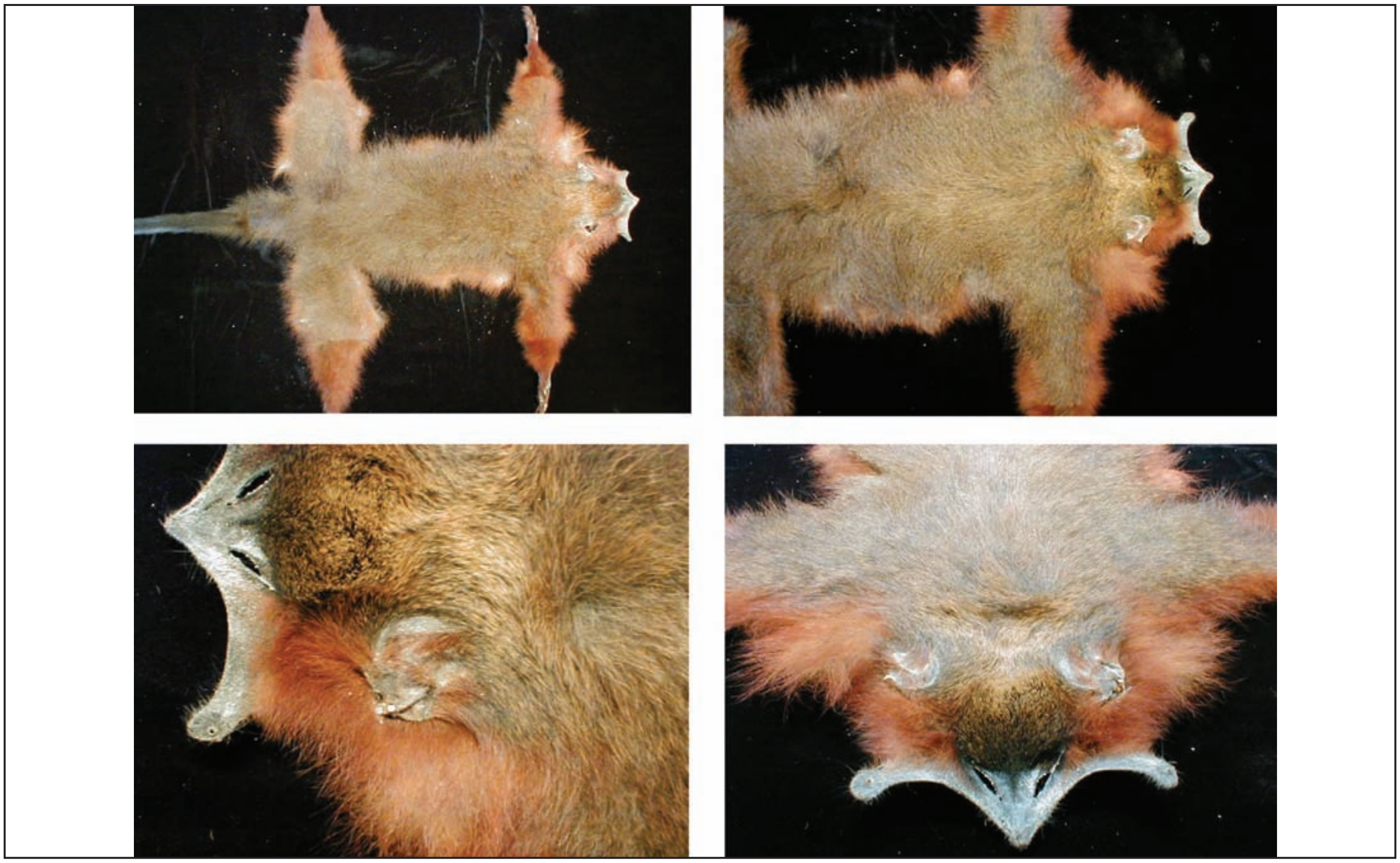

Figure 6. Dorsal views of the adult male holotype of *C. aureipalatii* (CBF7511). Photographs by H. Gómez.

through initial mixing of orange hairs. At hands color change becomes more definite to a deep burgundy and these hairs lightly cover hands dorsally. Feet very thickly covered with dark burgundy colored hair. Body ventrally pale orange largely due to low hair density. Hair density increases from groin area toward abdominal and chest regions, considerably denser at neck. Ventral hairs are a deep orange color that deepens as hair density increases and extends to cheek regions as far as the base of the ear. Forelimbs and hind limbs ventrally the same orange color as far as the feet where the color deepens slightly in the hands and more strikingly in the feet. Tail brown to black dorsally, paler black to light brown ventrally with banded hairs (pale base and dark tip). Tip of tail clearly whitish pale with white hairs at very tip (female specimen hairs *c*.52 mm long and male specimen *c*.81 mm). Crown extending to an area just above ears shows clearly defined golden tipped *c*.16 mm hairs that are banded in dark and light brown phases at the base with a *c*.4.5 mm golden tip. Forehead appears slightly darker due to shorter hairs (*c*.9.5 mm) with smaller golden portions. No clear line distinguishing crown area. Facial skin black with a few whitish hairs in the nasal region; whiskers and eyebrows black; paler ears with hairs on tops of ears golden tipped and hair around ear orange; pupils black and irises coffee colored. During transect observations, filming and collection activities in more than 15 different social groups only one animal showed variation to the holotype description above, being slightly paler.

Measurements: See Tables 2 and 3.

Etymology: This species is named *Callicebus aureipalatii* in recognition of a major financial contribution from GoldenPalace.com to FUNDESNAP (Foundation for the Development of the National Protected Area System). This funding will go exclusively toward the long-term conservation of the Madidi National Park and Natural Integrated Management Area where the species was discovered.

Table 2. Measurements (in mm) of specimens of *C. aureipalatii.*

Measurement	Adult male	Adult female
Head and body (mm)	817	800
Tail (mm)	524	480
Hind foot (mm)	102	93
Ear (mm)	36	33
Weight (gm)	1,000	900
Neck circumference (mm)	90	90
Hind leg (mm)	249	247
Fore leg (mm)	207	212
Testicles (mm)	15 × 11 (both)	

Figure 7. Skull of the adult male holotype of *C. aureipalatii* (CBF7511), and mandibles of the male holotype and female paratype (CBF7510). Note variation in the coronoidal forms of male (right) and female (left) mandibles. Photographs by R. B. Wallace and H. Gómez.

Table 3. Cranial and dental measurements (mm) of two specimens of *C. aureipalatii* following Kobayashi (1995).

Cranial measurements	**Adult male**	**Adult female**
Nasion – Rhinion	8.20	10.33
Rhinion – Prosthion	13.43	11.70
Nasion – Prosthion	20.44	22.49
Left maxillofrontale – Right maxillofrontale	3.48	
Left frontomalare orbitale – Right frontomalare orbitale	29.08	
Left zygomaxillare superior – Right zygomaxillare superior	24.75	
Left frontomalare orbitale – Left zygomaxillare superior	13.10	12.52
Left zygomaxillare superior – Left zygomaxillare inferior	13.47	15.06
Greatest width across outer margins of orbit	34.28	
Left zygion – Right zygion	39.28	
Greatest width across narrowest part in postorbital portion	29.31	
Left euryon – Right euryon	33.80	33.71
Prosthion – Bregma	48.32	47.82
Nasion – Bregma	31.49	28.74
Bregma – Lambda	25.76	26.24
Prosthion – Lambda	61.94	62.66
Basion – Bregma	31.37	31.62
Left zygomaxillare inferior – Right zygomaxillare inferior	29.43	
Left kondilion laterale – Right kondilion laterale	32.74	
Left koronion – Right koronion	33.87	
Infradentale – Left kondilion laterale	40.78	41.42
Infradentale – Gnathion	11.79	
Greatest length between left koronion and base of mandibular	35.66	36.82
Dental measurements		
PM3–M3	16.65	-
I–M3	24.45	-
PM3–M3	16.10	16.40
M1–M3	9.25	8.95
I2–I2	9.80	-
C1–C1	13.60	-
M1–M1	18.35	-
M3–M3	18.55	-

Figure 8. *Callicebus* specimen from Los Amigos, southern Peru. Photograph by Jenna Lawrence.

Vernacular Name: This species is locally known by the generic names for titi monkeys in the region — luca luca or lucachi. The company GoldenPalace.com refers to the monkey as the GoldenPalace.com monkey, and other English names currently in use include the golden palace monkey and the Madidi titi monkey.

Geographic Distribution: *Callicebus aureipalatii* was present at four of the line transect survey sites: Río Tuichi, Río Hondo, Alto Madidi, and Río Undumo (see Fig. 1). The literature review revealed a further 15 sites in the immediate vicinity of the known distribution where an unidentified *Callicebus* had been registered: Chalalán, Tumupasa, Capaina, Buena Vista, Santa Fe, Carmen Pecha, Bella Altura, Napashi, Santa Rosa de Maravilla, Altamarani, San Antonio de Tequeje, Carmen del Emero, Esperanza de Enapurera, Tres Hermanos, and Cachichira (Sarmiento *et al*. 2001; CIPTA/WCS, unpubl. data). According to our surveys, *Callicebus aureipalatii* is found exclusively on the western side of the Río Beni, a major tributary of the Amazon and one of the largest rivers in Bolivia. The known and hypothetical distribution of this species is shown in Figure 1. In addition, literature and structured informal interviews with local indigenous communities along the Río Quiquibey suggest that the genus *Callicebus* is now absent from most of the Pilon Lajas Biosphere Reserve and Indigenous Territory (Barrera *et al*. 1994; Rumiz and Townsend 1999) apparently wiped out because of its use as fishing bait (Ascensión de Quiquibey, pers. comm.). Nevertheless, a group of unidentified *Callicebus* monkeys were heard calling in the Sani vicinity (14º35′41″W, 67º29′47″S) of Pilon Lajas in March 2003 (F. Espinoza, pers. comm.).

Habitat: The Río Tuichi and Río Hondo valleys are adjacent tributaries of the Río Beni and are enclosed by the last foothills of the Andes in northwestern Bolivia. The region is characterized by a marked dry season between April and November with annual precipitation of approximately 2,230 mm. Vegetation appears similar to that of the Beni alluvial plain forests found at the base of the Andes in this region. The forest is characterized by relatively open canopies with a large proportion of palms such as *Iriartea deltoidea*, *Scheelea princeps*, *Astrocaryum* sp., *Socratea exhorriza*, and *Jessenia*, as well as large emergent and canopy tree species such as *Ceiba pentandra*, *Sterculia* sp., *Cabralea canjerana*, *Rinorea viridifolia*, *Pseudolmedia* sp., and *Pentaplaris davidsmithii* (Flores *et al*. 2002; pers. obs.). *Callicebus aureipalatii* has been observed in the lowland plain forests of the Río Tuichi and Río Hondo valleys and the Alto Madidi lowlands, as well as the piedmont or foothill forests of the region in the

Río Tuichi, Río Hondo, Alto Madidi, and Río Undumo study sites. Sightings to date are altitudinally distributed between 200 and 500 m a.s.l., although surveys are lacking in the humid tropical forests between 500 and 1,000 m a.s.l. that might be suitable habitat for *Callicebus*. Based on distributional and habitat use data we used a simple GIS model using habitat type, potential river boundaries, and elevation to provide a preliminary estimation of potential habitat for *C. aureipalatii* (Fig. 1). A total of 4,256 km² were estimated to be suitable using this model.

Relative abundance and density: Relative abundance data for the four sample sites are presented in Table 1. In general, there is a little variation across the transect survey sites where titi monkeys were recorded. It is worth mentioning that an examination of the data suggests a fairly localized distribution across wide areas at these survey sites. Overall mean and modal group size was three (mean: SE 0.19). Distance sampling analysis of 902 km of line transect data from the Río Hondo, Río Tuichi, Alto Madidi, and Río Undumo study sites revealed an overall density of 6.2 animals/km² (Hazard Rate Model; n = 33 transect sightings; 95% Confidence Limits: 2.7–14.2 animals/km²). These results combined with the habitat availability model provide a crude population estimate of around 26,400 animals (95% Confidence Limits: 11,491–60,435 animals).

Discussion

The recent and comprehensive taxonomic review of the genus (Van Roosmalen *et al*. 2002) recognized 28 species. Hershkovitz (1988, 1990) emphasized that "primary differentiation among species and subspecies of *Callicebus* is in coat color," and we suggest that the differences detailed herein for *C. aureipalatii* are sufficiently distinct from neighboring congeners (*C. brunneus*, *C. dubius*, *C. cupreus*, *C. donacophilus*, *C. modestus* and *C. ollalae*) that species status should be afforded.

This species represents the first new primate discovery for Bolivia in the last 60 years (Anderson, 1997). The populations described in this study were assumed to be of *C. brunneus* (Hershkovitz 1988; Emmons and Feer 1999) or *C. olallae* (Van Roosmalen *et al*. 2002). Van Roosmalen *et al*. (2002) made an error in the maps for the hypothesized populations of *C. olallae* and *C. modestus* that were depicted as occurring exclusively on the western side of the Río Beni. Both these species were actually collected on the eastern side of the Río Beni within 52 km of each other (Anderson 1997; see Figure 633, pp. 316; Hershkovitz 1990, see Figure 23, pp. 47; Felton *et al*. 2006) in the vicinity of the town of Santa Rosa in the Ballivian province.

Indeed, surveys conducted in 2002 by the research team confirmed the presence of titi monkeys fitting the description of both of these taxa in the Santa Rosa region (Felton *et al.* 2006) and, although the precise distributional situation of these taxa has yet to be resolved, available information strongly suggests that they are confined to the eastern bank of the Río Beni (Martinez and Wallace unpubl. data). This study, therefore, further suggests the importance of rivers as distributional boundaries for the genus *Callicebus* and highlights the need for future surveys to focus on both sides of a given river. In this light, further investigation as to the identity of the Sani population, as well as structured informal interviews along the Palos Blancos–Yucumo–Rurrenabaque road would be critical in confirming the apparent absence of *Callicebus aureipalatii* on the eastern side of the Río Beni.

Data from southern Peru are scarce and surveys on both sides of the Río Heath are a priority in order to determine the western limit of this species' range. The northern range limits for *C. aureipalatii* are currently unknown and we predict that they may reach as far as the southern bank of the Río Madre de Dios. Current knowledge indicates that *Callicebus aureipalatii* is distinct from populations north of the Madre de Dios, where animals do not display a golden crown or deep orange throat coloration. These populations have previously been considered to be *C. brunneus* (Hershkovitz 1988), although Van Roosmalen *et al*. (2002, see Figure 1, pp.5) classified them as *C. dubius*. Recent primate surveys in the Cobija region of Pando have photographed *Callicebus* displaying a white-tipped tail but with no golden crown, and Pando monkeys also lack the characteristic *C. dubius* white stripe across the forehead (Sandra Suarez, pers. comm., Noel Rowe, pers. comm.).

Film footage of titi monkeys from Los Amigos (12º34′15″W, 70º06′02″S), a northern tributary of the Madre de Dios in southern Peru (Nissen and Trolle, 2003), and photographic evidence from an uncollected specimen at the same site (J. Lawrence, unpubl. data; Fig. 8) lend further support to the hypothesis that *C. brunneus* extends into northern Bolivia and southern Peru (Hershkovitz 1988, 1990) and provides additional evidence that the new species described here is not found north of the Río Madre de Dios.

It is unclear whether *C. aureipalatii* belongs to the *cupreus* or *moloch* species groups as defined by Van Roosmalen *et al*. (2002), and genetic studies may be required to determine the correct lineage, particularly as *C. cupreus* has 46 diploid chromosomes and *C. brunneus* has 48 diploid chromosomes. Given the information that we have been able to gather regarding *Callicebus* populations immediately north of the Río Madre de Dios, it seems that the distribution maps detailed by Van Roosmalen *et al*. (2002) for *C. brunneus, C. dubius,* and *C. cupreus* may need to be broadly revised. Indeed the true status and distribution of *C. dubius* remains doubtful (Groves 1992, 2001).

Examination of relevant *Callicebus* specimens at the American Musuem of Natural History in New York included one specimen (AMNH262650) purchased from a hunter in Chive (12º23′S, 68º35′W), a small town on the Río Madre de Dios at the border of the departments of La Paz and Pando and very close to neighboring Peru. It is unclear on which side of the Río Madre de Dios the specimen was collected and at the

Figure 9. Specimens examined at the American Museum of Natural History; a. *Callicebus brunneus* series from Brazil; b., c., d., dorsal views of specimen (AMNH262650) collected in Chive, Madre de Dios, Bolivia. Photographs R. B. Wallace and H. Gómez.

AMNH it is classified as *C. brunneus* despite being markedly different from the main *C. brunneus* series collected in Brazil. Although the specimen displays some broad similarities with *C. aureipalatii*, for example, the rufous coloration on the limbs and general body coloration, neither the orange throat coloration nor golden crown are evident (Fig. 9). In short, further research is required to determine the taxonomic status of *Callicebus* populations in Pando Department, Bolivia.

This finding, along with other recently published information (Wallace *et al*. 1996; Wallace and Painter 1999), underlines the poorly known status of Bolivian primate distributions. We suggest that a thorough review of *Callicebus* distribution in Bolivia is urgently required in order to assess the need for additional conservation measures. A GIS-based analysis of forest cover in the Beni and Pando departments of Bolivia, in conjunction with surveys on both sides of major rivers, might enable targeting of major blocks of forest for future investigation. The need for an examination of genetic material, particularly of the *C. modestus* and *C. olallae* populations (Felton *et al*. 2006), would also be a critical aspect of a thorough review.

The density estimate for *C. aureipalatii* is similar to the majority of estimates available in the literature for congeners (density ranges, 2.7–400 individuals per km²; Robinson *et al*. 1987; Pinto *et al*. 1993; Peres 2000; Chiarello and de Melo 2001; Price *et al*. 2002). Although the density extrapolation across the known distribution is simplistic, the results strongly suggest that the conservation of a significant population of this primate is ensured within the confines of the Madidi protected area and its official five-kilometer-wide buffer zone. However, potential threats to the lowland portion of Madidi, including such as petroleum exploration and subsequent exploitation, hydroelectric programs, and planned road construction, will need to be monitored in the future with special attention given to this species.

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Identification, Behavioral Observations, and Notes on the Distribution of the Titi Monkeys *Callicebus modestus* Lönnberg, 1939 and *Callicebus olallae,* Lönnberg 1939

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Abstract: We conducted field surveys for titi monkeys (*Callicebus* spp.) in the vicinity of the original collection sites of two poorly known species, *Callicebus olallae* and *Callicebus modestus*. Two distinct *Callicebus* forms were photographed and filmed, and according to an examination of existing literature as well as the original specimens, these represent *C. olallae* and *C. modestus*. They occur in patchy and fragmented grassy woodlands and appear to be at least locally threatened by hunting. Both were known from single locality collections and the taxonomic distinctiveness of these forms urgently needs to be further investigated, as does their true conservation status.

Resumen: Llevamos a cabo evaluaciones de campo para monos titi (*Callicebus* spp.) en la proximidad de los lugares originales de colecta de dos especies poco conocidas, *Callicebus olallae* y *Callicebus modestus*. Fueron fotografiados y filmados dos tipos distintos de *Callicebus* que de acuerdo a una revisión de la literatura existente, así como los especimenes originales, representan a *C. olallae* y *C. modestus*. Ellos viven en islas de bosque en sabanas y parecen estar amenazados localmente por la cacería. Ambas especies eran conocidas a partir de una sola localidad y colecta. Su singularidad taxonómica, así como el verdadero estado de conservación de estos primates, necesitan ser investigados urgentemente.

Key Words: *Callicebus*, Bolivia, titi monkey, taxonomy

Introduction

Titi monkeys (genus *Callicebus*) are small Neotropical monkeys that range in body mass from 0.8 to 1.4 kg (Smith and Jungers 1997), possess non-prehensile tails, and are primarily frugivorous (Hershkovitz 1990). They are found in the Atlantic forest of Brazil and throughout the tropical forests of the Amazon, Orinoco, and upper Paraguay basins (Hershkovitz 1988). In Bolivia, titi monkeys inhabit the departments of Pando, Beni, and Santa Cruz, northern La Paz, and eastern Cochabamba (Hershkovitz 1988; Anderson 1997).

In 1937 and 1938, A. M. Olalla collected individuals of this genus near Santa Rosa, Department of Beni. One adult and one subadult male were taken from the vicinity of El Consuelo, 12 km east of Reyes (Patterson 1992); and an adult male was collected near La Laguna, 5 km from Santa Rosa (Anderson 1997). In 1939, Einmar Lönnberg determined that the two El Consuelo specimens represented a new species — *Callicebus modestus* — with the single La Laguna specimen representing another new species — *Callicebus olallae*. It was Lönnberg's opinion that despite the proximity of the two collection sites (about 65 km), the specimens "appear to be so different that they certainly must be considered as representing two different species" (Lönnberg 1939).

Based on these specimens *C. modestus* is characterized as having light-brownish or reddish-agouti upper and outer body parts (agouti refers to hairs that possess alternating bands of color); a reddish-brown-agouti crown, forehead, sideburns, and beard; well developed white ear tufts, short white hairs on the face, and a blackish-agouti tail (Lönnberg 1939; Van Roosmalen *et al.* 2002). In contrast, *C. olallae* has a thin fringe of black hair on the sides of the head and across the forehead; non-agouti rufous back and limbs with lighter rufous on the flanks and hind quarters; hairs with black tips on the head and neck; weakly developed whitish ear tufts; short white hairs on the face and a dark-agouti tail (Lönnberg 1939). The features that best separate these two species are the relative conspicuousness of the ear tufts and the agouti coloration of *C. modestus* (Anderson 1997).

Morphological measurements of the two holotype skins (Anderson 1997) revealed that *C. modestus* is smaller than *C. olallae* in total length (715 cm vs. 750 cm), and in the length of the hindfoot (90 cm vs. 100 cm), but has a longer tail (400 cm vs. 340 cm). Cranial measurements were originally used by Lönnberg (1939) to further differentiate these species. The *C. modestus* skull is unusually elongated (Hershkovitz 1988, 1990) and possesses the smallest braincase volume among the Cebidae (Kobayashi 1995; note that *Callicebus* is now in the family Pitheciidae [Groves 2001]). However, as no subsequent collections have been made of either species, the continued taxonomic distinctiveness of *C. modestus* and *C. olallae* relies solely on the repeated measurements and descriptions of the same 65-year-old adult skulls and skins.

In this report we provide the first documentation of *C. modestus* and *C. olallae* in the wild since their discovery. We photographed and filmed titi monkeys in the vicinity of the original collection sites of A. M. Olalla, as well as other nearby locations. Furthermore, we discuss differences in group size, as well as current conservation status, habitat use, and the vulnerability of these populations to hunting.

Methods

Surveys were conducted between 26 September and 4 October 2002, with our efforts concentrated in four locations (Fig. 1): Puerto Santa Cruz on the Río Yacuma (14º00′S, 66º58′W), La Laguna (14º03′S, 66º51′W), Petaca (14º07′S, 66º49′W), and Naranjal (14º05′S, 66º56′W). We interviewed local people regarding where titi monkeys could be found and, with the exception of La Laguna, all survey locations were chosen on the basis of local knowledge.

Surveys involved visiting the sites from 06:00 to 10:00, and waiting for or inducing calls using playback recordings of titi monkey duets. The first group encountered was induced to call using recordings of *C. aureipalatii*. The first group's response calls were recorded for playback to all subsequently encountered groups. *Callicebus* groups were approached, or alternatively approached us, at which time slide photos (Canon EOS 35mm) and digital video (Digital HandyCam 700X) were taken. The location of each group was recorded using a Geographic Positioning System (GPS) (Garmin 12XL).

Individuals were classified as adult, juvenile, or infant, and sex was noted when possible. Infants were defined as individuals carried by an adult, whereas juveniles were noticeably smaller than other unaccompanied individuals. Adults were full-sized individuals that either carried young, or participated in duets or both. Sexes are grossly indistinguishable (Hershkovitz 1988), although adults carrying offspring on their backs can safely be classified as males (Wright 1984; Tirado Herrera and Heymann 2004).

To help us determine the identity of *Callicebus* monkeys encountered we visited the Royal Museum of Natural History in Stockholm, Sweden, and examined and photographed two of the original specimens from 1937–38 (*C. modestus* #A612105; *C. olallae* #A632187).

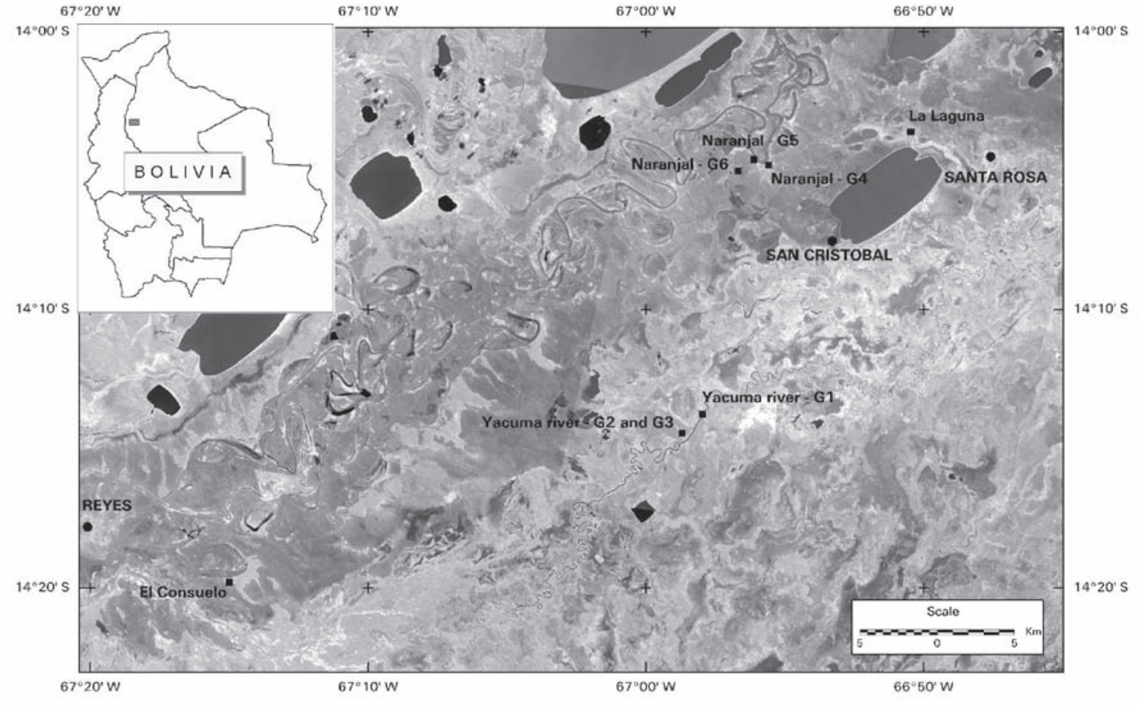

Figure 1. Localities for *C. modestus* and *C. olallae* in southwestern Beni Department, Bolivia.

Results

Occurrence and group composition

Six groups of closely associating individuals of the genus *Callicebus* were encountered. They were photographed and filmed, and given a number depending on their order of sighting. Groups began calling at approximately 07:00 and continued calling for about 30 minutes. Calling was often sporadic and sometimes recommenced at approximately 08:30. One group was heard calling at 11:30. Groups 1–3, each consisting of two individuals, were located at Puerto Santa Cruz on the north side of the Río Yacuma (Fig. 1, Table 1). No calls were heard from the south side of the river and local farmers had no recollection of them ever occurring there. Groups 4–6 were located near Naranjal (Fig. 1), and consisted of more individuals per group than Groups 1–3 (Table 1).

No titi monkeys were heard or encountered at La Laguna or Petaca. Local residents in Santa Rosa and San Cristobal indicated that titi monkeys used to be present around La Laguna until 1998, but had apparently been exterminated by hunting. The owners of Petaca did, however, say that titi monkeys could still be heard calling irregularly from within the different forest islands in the area. In general, local distributions appear to be patchy, although at certain locations, for example Naranjal, titi monkeys appeared relatively abundant with five groups heard calling within a radius of approximately 1.5 km.

Pelage color

Individuals from Groups 1–3 were characterized by rufous on their back, limbs, and chest, with lighter rufous on the outside of limbs; dark brown-red forehead, sideburns, and beard; small white ear tufts; pale throat; blackish hands; creamy underparts; and a sharply contrasting blackish, uniformly colored, tapering tail (Figs. 2 and 3). The anterior base of the tail was pale orange. The fur appeared short and spiky. The face had white hairs on the muzzle.

Monkeys of Groups 4–5 had a grey-brown-red agouti back and upper limbs; light red-brown forehead, sideburns and beard; well-developed white ear tufts; dark hands with sparse whitish fur; reddish underparts and chest; a greyish, uniformly colored non-tapering tail, darker than dorsum (Figs. 4 and 5). The fur appeared dense and frizzy. There were whitish hairs above the nose and eyebrows and on the muzzle.

Table 1. Composition and location of the six encountered groups of *Callicebus*. See Figure 1 for locations.

Group	Location	Adults	Juveniles	Infants	Total
1	Yacuma	2			2
2	Yacuma	2			2
3	Yacuma	1	1		2
4	Naranjal	3	1	1	5
5	Naranjal	6		1	7
6	Naranjal	4			4

Figure 2. Photographs of wild titi monkeys matching the original descriptions for *C. olallae.* Photograph by Mileniusz Spanowicz.

Figure 3. Revised illustration for *C. olallae*. Illustration by Stephen D. Nash.

Figure 4. Photograph of wild titi monkeys matching the original description for *C. modestus*. Photograph by Mileniusz Spanowicz.

Figure 5. Revised illustration for *C. modestus*. Illustration by Stephen D. Nash.

The pelage color of most of the individuals of Group 6 was similar to that of Groups 1–3 in that they had a rufous non-agouti back and chest, creamy under-parts, and a pale throat, although they resembled Groups 4–5 by having conspicuous white ear tufts and pale hands. One distinctly colored individual in this group appeared lighter and possibly had grey-red agouti fur on the back. All individuals of Group 6 also had a denser layer of white hairs on the face and a whitish anterior base of the tail.

Museum specimens

An examination of the holotypes (Fig. 6) suggests that Groups 1–3 were *C. olallae* and Groups 4 and 5 were *C. modestus*. In contrast to the illustration provided on page 10 of Van Roosmalen *et al.* (2002) the *C. olallae* holotype does not have a conspicuous black face ring. Our examination of the original specimens does, however, concur with the descriptions provided by Lönnberg (1939) and Hershkovitz (1990).

Notes on behavior and feeding

All groups appeared to be diurnal and principally arboreal, as is consistent with this genus. They were found in dry, open woodland vegetation with dense tangles of vines and thorny understorey plants. The thorny tree species Naranjillo (*Styloceras columnare*, Buxaceae) was characteristic of the vegetation type in both locations. *Callicebus olallae* was observed eating the seeds of the Mapajo tree (*Ceiba pentandra*, Bombacaceae). One adult in each of Group 1 (*C. olallae*) and Group 6 (unidentified) were observed to display an aggressive behavior involving standing up on their hind legs and moving the upper body up and down while waving their arms at us. A male *C. modestus* of Group 4 broke off a stick and threw it in our direction.

Discussion

Hershkovitz (1988) suggested that all *Callicebus* species can be readily separated by color pattern alone. We observed two distinct members of the genus *Callicebus* that, using our observations of the holotypes and the criteria of Lönnberg (1939) and Hershkovitz (1990), we identified as *C. olallae* and *C. modestus*. In contrast to the geographic distributions for these species described and mapped in Van Roosmalen *et al.* (2002), they were only located, and to our knowledge have only ever been located (Lönnberg 1939; Anderson 1997), to the east of the Río Beni.

Callicebus olallae was located along a 2-km stretch of riparian vegetation on the northern side of the Río Yacuma, near Puerto Santa Cruz, 22 km from the original Olalla collection site (Fig. 1). The only locality where we found *C. modestus* was at Naranjal, west of the highway, near the township of Santa Rosa, 45 km from the original Olalla collection site (Fig. 1). The unidentified group of *Callicebus* (Group 6), which we encountered on the east side of the highway at Naranjal, possessed a pelage that combined aspects of both *C. olallae* and *C. modestus*. Although individuals had prominent white ear tufts, they lacked the agouti pelage so characteristic of *C. modestus*. Their faces were also almost entirely covered with white hairs, giving individuals a striking and unique appearance. An adult of this group displayed the same aggressive behavior as an individual in Group 1 (*C. olallae*) involving standing up on his hind legs and moving the upper body up and down while waving its arms at us. We have not seen this behavior reported for other *Callicebus* species, although a similar behavior has been observed in the white-faced saki, *Pithecia pithecia*, also a member of the family Pitheciidae. The appearance of the unidentified group raises questions as to whether sympatry, or even hybridization, occurs between *C. modestus* and *C. olallae*, as found in other New World primates (e.g., *Saguinus*; Peres *et al*. 1996).

Although we can be confident that we have found individuals that are representative of the two species originally classified by Lönnberg in 1939, this does not imply that we are certain of the taxonomic distinctiveness of *C. modestus* and *C. olallae*. The identification of individuals that possessed characteristics in keeping with both *C. modestus* and *C. olallae* certainly raises questions regarding their taxonomy. There is also reason to question previous views that these species are parapatric (Hershkovitz 1988), as no rivers or watersheds separate the populations observed in this study. It is our opinion that the proximity of the original collection site for *C. olallae*, and the current known distribution of *C. modestus*, suggests that they share at least part of their respective geographic ranges. Nevertheless, further investigation is needed to establish whether these species may be genetically isolated by stretches of open grasslands. Similarly, variations in the composition and structure of vegetation across forest patches should be determined in order to assess possible differences in habitat preferences between the two. We concur with Anderson (1997) that further information is needed to determine the taxonomic distinctiveness of *C. modestus* and *C. olallae*. Preferably this would consist of taking genetic material from existing museum specimens or wild populations. For the moment we are cautious to argue for further specimen collections from the wild due to uncertainty regarding their remaining numbers.

The size of the groups we observed for both *C. olallae* and *C. modestus* covered the full range of group sizes known for other members of this genus (Wright 1984; Pinto *et al.* 1993; Bennett *et al.* 2001; Bicca-Marques *et al.* 2002). In our sample, *C. olallae* were observed in small family units of two individuals with either two adults or an adult male with offspring. In contrast, *C. modestus* groups were at the upper limits for this genus consisting of five to seven individuals. Only *C. personatus* (*v*. Pinto *et al.* 1993) and *C. cupreus* (*v*. Bennett *et al.* 2001; Bicca-Marques *et al.* 2002) are also known to have groups of up to seven individuals. Female *Callicebus* have only one offspring per year (Tardif 1994; for an exception see Knogge and Heymann 1996), and reproductive maturity is reached after approximately three years (Robinson *et al.* 1987). Assuming that *Callicebus* groups are family units it appears that at least several individuals in *C. modestus* groups, in addition to the parents, had reached reproductive maturity. Hence, it appears that mature offspring may be staying with their natal group and are, therefore, similar in this sense to the *C. cupreus* studied by Bicca-Marques *et al.* (2002). It is also possible that these large groups of *C. modestus* result from limited dispersal opportunities in the fragmented landscape of Naranjal.

Figure 6. Photograph of original specimens of *C. olallae* (No. A632187) and *C. modestus* (No. A612105). Photograph by Olavi Gronwall.

Groups of *C. modestus* and *C. olallae* were known to local residents, and observed by ourselves, only in pockets of remnant vegetation surrounded by grazed woodland on cattle ranches. Some cattle ranchers actively discouraged hunters from entering their lands and this may have assisted the continued presence of titi monkeys and other wildlife in the region. For example, the only location where we found *C. modestus* close to the village of San Cristobal was on a ranch where owners prohibited hunting. Our surveys were brief, but it seems likely that the population of *C. olallae* at La Laguna, the original collection site for this species by A. M. Olalla on 12 February 1938, is now extinct. No individuals were encountered or heard, despite our searches of the area and attempts to induce calling using playback. San Cristobal residents confirmed that *Callicebus* and black howler monkeys (*Alouatta caraya*) previously inhabited the area but were recently extirpated due to excessive hunting.

A study of *Callicebus melanochir* in eastern Brazil suggested that, although the species preferred undisturbed habitat, groups continued to use resources in disturbed areas (Heiduck 2002). Within the fragmented habitat of our study both *C. olallae* and *C. modestus* appeared to be surviving by being able to travel on the ground between remnant forest patches. We were told by a farmer in Naranjal that he had watched groups, most likely *C. modestus*, cross grassland gaps of 300–400 m to reach patches of surrounding forest. We also found an adult male *C. olallae* and young in a single isolated tree (*Stylocercas columnare*), the canopy of which was at least 6 m from the closest neighboring canopy, suggesting that they reached the tree from the ground. Terrestrial travel, although risky in terms of predation, would certainly be beneficial to the continued survival of both species in these patchy habitats. It remains to be seen, however, whether this increasingly fragmented landscape can sustain populations of *Callicebus* in the long term, particularly given the proposed improvement of the existing main road to an asphalted thoroughfare as part of the Bolivian national transport network.

Callicebus modestus and *C. olallae* are currently classified as Vulnerable in the IUCN Red List of Threatened Species (Rylands and Tarifa 2003). At present, both species are known only from single localities. The original population of *C. olallae* found at the type locality La Laguna is presumably extinct due to hunting. Given their apparently restricted and patchy distribution, and the threat they face from over-hunting and proposed infrastructure development, further information regarding the range and population size of *C. modestus* and *C. olallae* is urgently required.

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A Survey of Primate Populations in Northeastern Venezuelan Guayana

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Abstract: The region of the Guiana Shield is extraordinarily rich in biodiversity. Little is known, however, of the biogeography and conservation status of its diverse primate taxa. The aim of this study was to conduct a rapid survey of primate populations in the northeastern-most part of the state of Bolívar, Venezuela, near the border with Guyana. A previous study had indicated that the white-faced saki (*Pithecia pithecia*), wedge-capped capuchin (*Cebus olivaceus*), and red howler monkey (*Alouatta seniculus*) were present in this area. It had also been suggested that black spider monkeys (*Ateles paniscus*), golden-handed tamarins (*Saguinus midas*), and night monkeys (*Aotus*) may be present in this part of the Venezuelan Guayana. Forty-nine sites of the Río Cuyuní basin were surveyed. Pre-existing forest trails were walked and the Río Cuyuní was also censused by boat. Interviews with local people at all the sites indicated that the only primates inhabiting this region are *A. seniculus*, *C. olivaceus,* and *P. pithecia. S. midas* is not present (or is extremely rare) in the northeastern part of the state of Bolívar. References to night monkeys may well refer to *Potos flavus*. The presence of an isolated population of *Ateles* remains uncertain. Cattle ranching, mining, hunting, logging, and the pet trade are major threats to the primates in this part of Venezuela. Further primate surveys should be conducted in the western Guiana Shield.

Resumen: El macizo de las Guayanas representa una de las regiones de mayor biodiversidad en el Neotrópico. Sin embargo, aún es poco conocido la biogeografía y estado de conservación de sus diversas especies de primates. Por tal motivo, el principal objetivo de esta investigación fue conducir un reconocimiento de poblaciones de primates en la parte más noreste del estado Bolívar (Venezuela), cerca del borde internacional con Guyana. Un estudio previo indicó que monos viudita (*Pithecia pithecia*), monos capuchinos comunes (*Cebus olivaceus*), y araguatos (*Alouatta seniculus*) estaban presentes en esta área. Posteriormente, se sugirió la posible existencia de monos arañas negros (*Ateles paniscus*), tities manos doradas (*Saguinus midas*) y monos de noche (*Aotus* spp.) en esta parte de la Guayana venezolana. Cuarenta y nueve sitios de la cuenca del Río Cuyuní fueron reconocidos. Se caminaron trillas pre-existentes en el bosque además de navegar el Río Cuyuní con fines de censar dichas poblaciones de primates. Además, se realizaron entrevistas con habitantes de cada sitio. Los resultados indican que las especies de primates identificadas para esta región son *A. seniculus*, *C. olivaceus,* y *P. pithecia. S. midas* no parece estar presente en la parte más noreste del estado Bolívar, y si existe debe ser extremadamente raro. Por otra parte, las referencias de la existencia de *Aotus* spp. pueden reflejar confusión con otros mamíferos nocturnos como el cuchi-cuchi (*Potos flavus*). La presencia de alguna población aislada de *Ateles* permanece incierto. Finalmente, la ganadería extensiva, minería, cacería, tala, y comercio de monos como mascotas representan las mayores amenazas de los monos de esta parte de Venezuela. Más reconocimientos de poblaciones de primates deben ser realizados en el oeste del escudo guayanés.

Key Words: *Alouatta seniculus*, *Pithecia pithecia*, *Cebus olivaceus*, distribution, conservation, Guianas

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Introduction

Neotropical forests are areas of high biodiversity (Mittermeier *et al*. 2002) but are threatened due to human activities such as logging, hunting, and deforestation (Chapman and Peres 2001). There, primates represent a major group of vertebrates that play a fundamental role in forest regeneration (Heymann 1993). In the Guianas, the biogeography and conservation status of the primates are still poorly known, although the eastern part of this region has been better documented in recent years (Sussman and Phillips-Conroy 1995; Lehman 2000; Boinski 2002). The main goal of this research was to survey primate populations in the northeastern-most part of the state of Bolívar, Venezuelan Guayana, in the western Guiana Shield (Fig. 1).

In a previous review, Bodini and Pérez-Hernández (1987) suggested that red howler monkeys (*Alouatta seniculus*), white-faced sakis (*Pithecia pithecia*), and wedge-capped capuchin monkeys (*Cebus olivaceus*) were present in this region. Ten years later, Linares (1998) reported the existence of golden-handed tamarins (*Saguinus midas*) and black spider monkeys (*Ateles paniscus*) there, although the evidence for the occurrence of these two primates remains unclear. That for *S. midas* is restricted to a general map and the name of Bochinche (Bolívar state) as the locality. Similarly, Kinzey *et al.* (1988) reported the possible presence of the night monkey, *Aotus*, in Venezuelan Guayana, but there has been no additional field research to confirm this. Kinzey *et al*. (1988) observed *Alouatta seniculus*, *Cebus olivaceus,* and *Pithecia pithecia* during their surveys in the Lago Guri–El Callao area (Venezuelan Guayana) (Fig. 1B), and local people reported what may be the night monkey *Aotus* and an *Ateles*-like monkey, but not tamarins.

The region I surveyed, located between that visited by Kinzey *et al.* (1988) and the Venezuelan–Guyanese border, represented a gap in our knowledge of the primate populations of the Guianas (Fig. 1). A survey of the Sierra de Imataca was of considerable importance due to increasing cattle ranching, agriculture, logging, and illegal mining that will result in significant forest loss and fragmentation over the coming years. My particular goals were to: a) determine the presence or otherwise of *Saguinus midas*, *Ateles paniscus*, *Aotus* and other primates; b) collect data on group size and the habitats occupied by primate species in the survey area; and c) interview local people to update our knowledge of the geographic distribution of Guayanan primates and document the human activities that may threaten them.

Methods

The reconnaissance sites were located mostly in the forested region of the Río Cuyuní basin. From north to south this area includes Río Grande, Altiplanicie de Nuria (Imataca), Tumeremo, Bochinche (Imataca), Anacoco–San Martín de Turumbán (Río Cuyuní), and El Dorado–La Fé-San Isidro; all in the northeastern part of the state of Bolívar, Venezuela, near the border with Guyana (Table 1, Fig. 1). The survey covered the Venezuelan drainage of the Río Cuyuní, one of the main tributaries of the Essequibo River in Guyana (Ven-

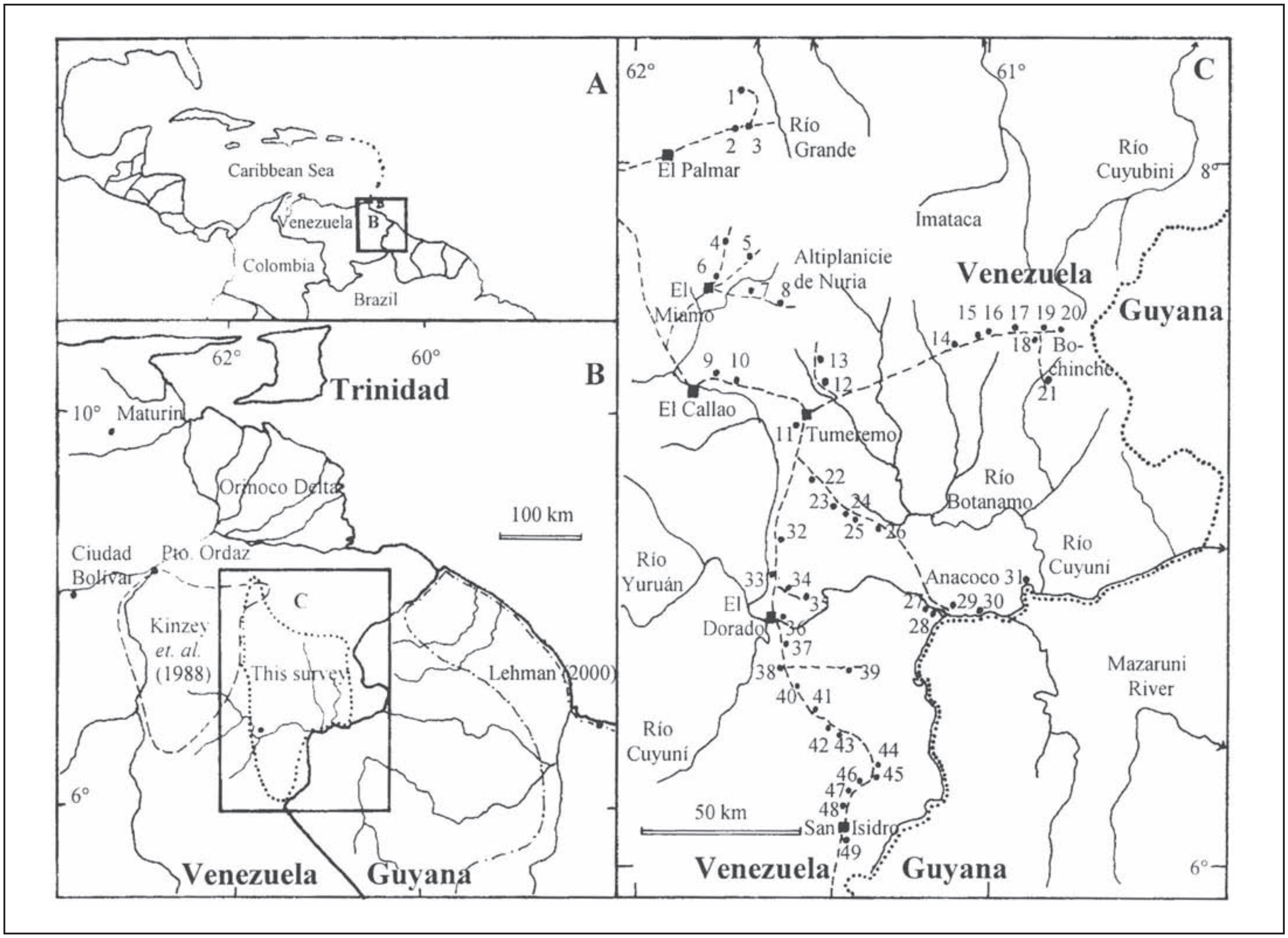

Figure 1. Location of sites surveyed in northeastern Venezuelan Guayana (see Table 1).

Table 1. Sites surveyed in northeastern Venezuelan Guayana.

Site #	Name	Coordinates
1	Maderera Río Grande	8º12´02″N; 61º43´17″W
2	El Mafao	8º06´52″N; 61º42´07″W
3	Campamento Río Grande	8º06´34″N; 61º41´33″W
4	Carrizal	7º42´46″N; 61º45´20″W
5	Fundo El Tumamo	7º44´19″N; 61º41´57″W
6	Las Casetas	7º40´03″N; 61º46´47″W
7	Cerro Merecure–Las Marías	7º37´25″N; 61º42´32″W
8	Cerro de Nuria	7º36´13″N; 61º37´15″W
9	Los Araguatos	7º22´15″N; 61º47´31″W
10	El Botalón	7º22´36″N; 61º44´56″W
11	Aeropuerto de Tumeremo	7º15´19″N; 61º31´23″W
12	La Carata	7º22´46″N; 61º29´48″W
13	Fundo El Guarán	7º26´29″N; 61º29´28″W
14	Mi Esperanza	7º28´26″N; 61º06´17″W
15	Matupo I	7º29´50″N; 61º01´29″W
16	Matupo II	7º30´08″N; 61º00´28″W
17	Bochinchito	7º30´51″N; 60º55´33″W
18	Guacancio del Prestamo I	7º30´16″N; 60º52´49″W
19	Guacancio del Prestamo II	7º30´51″N; 60º52´47″W
20	Bochinche (La Aldea, GN)	7º30´45″N; 60º48´15″W
21	Aserradero Hnos. Hernández	7º23´04″N; 60º51´00″W
22	Fundo El Corozo	7º06´10″N; 61º31´21″W
23	La Vuelta del Diablo	7º01´43″N; 61º27´01″W
24	San José de Anacoco	6º59´24″N; 61º24´19″W
25	Fundo San José de Anacoco	6º58´18″N; 61º22´24″W
26	Yaguarín	6º55´38″N; 61º17´03″W
27	Anacoco I	6º43´10″N; 61º06´55″W
28	Anacoco II	6º44´10″N; 61º07´46″W
29	San Martín de Turumbán	6º42´51″N; 61º05´45″W
30	Mark´s Place (Venezuela-Guyana)	6º44´05″N; 61º02´15″W
31	T. J´s Place (Venezuela-Guyana)	6º47´05″N; 60º55´03″W
32	Sua Sua	6º56´46″N; 61º37´01″W
33	Fundo Rancho Sicanán	6º50´01″N; 61º36´31″W
34	San Rafael	6º46´42″N; 61º34´01″W
35	Mina La Camorra	6º45´54″N; 61º32´46″W
36	El Encanto Cuyuní	6º42´56″N; 61º36´29″W
37	San José	6º37´50″N; 61º35´23″W
38	Santa Teresita I	6º32´58″N; 61º34´28″W
39	Mina La Fé	6º34´17″N; 61º27´29″W
40	Santa Teresita II	6º30´05″N; 61º33´09″W
41	Fundo Taguapire	6º26´42″N; 61º30´30″W
42	San Flaviano	6º24´25″N; 61º27´44″W
43	Km. 48	6º23´40″N; 61º26´27″W
44	San Miguel de Betania	6º17´30″N; 61º19´01″W
45	La Montañita	6º12´11″N; 61º27´24″W
46	El Granzón	6º12´36″N; 61º22´00″W
47	Los Manacos	6º12´27″N; 61º22´33″W
48	Estación Piscícola Kamoc	6º11´07″N; 61º24´31″W
49	San Isidro	6º08´36″N; 61º25¨40″W

ezuela, Instituto de Ingeniería 1992). The vegetation there is mostly tropical evergreen humid forest with continuous canopies at heights of 20–40 m (Velasco and Aguilera 1987; Huber and Alarcón 1988). The climate is sub-humid/macrothermic and humid-perhumid/macrothermic, both >24ºC (Velasco and Aguilera 1987). The region is in the Guiana Shield of Precambrian-age bedrock, with igneous and metamorphic rocks outcrops and limited, minor alluvial cover near the main drainage (Salazar and Briceño 1987). Altitudes range from 120 m a.s.l. in Anacoco and San Martín de Turumbán to 500 m a.s.l. in Altiplanicie de Nuria (Imataca) (Fig. 1).

The forests have been impacted by cattle ranching, agricultural expansion, so-called "selective" logging, and goldmining. The major sawmills there have logged between 1% and 20% of the commercial trees in their concessions (Bevilacqua *et al*. 2002). Given "current management [these] practices result in inadequate revenue capture and potentially high environmental costs" (Bevilacqua *et al*. 2002, pp.50–51). Illegal mining is also causing severe forest degradation besides health problems for the local communities (Bevilacqua *et al*. 2002). These abandoned mining "pods" are core locations for the propagation of malaria (Jorge Moreno pers. comm. 2003; Urbani pers. obs. 2003).

The survey was carried out from 30 June to 21 July 2003. A total of 49 sites were visited. Interviews were conducted at each site, and I walked pre-existing trails in secondary and primary forests, besides carrying out river censuses on the Río Cuyuni (Table 1, Fig. 1C). No transects were cut and only pre-existing trails were used (each walked just once) with the due permission of the owners or land managers. This field survey method (and the type of information recorded, see below) has been used in other rapid primate surveys in lowland South America (e.g., Heymann *et al*. 2002). Surveys covered approximately 790 km of roads, 55 km along the Río Cuyuní, and 22 km on pre-existing forest trails. When primates were seen, I recorded data on the behavioral activity, group size, height in the canopy, and sex/age composition of the group. Because of the large area to be covered in this rapid survey and the little time available, a more systematic census technique was impractical. Playback calls were used as an aid in locating tamarin populations, particularly in the Bochinche area where Linares (1998) reported them.

Interviews were conducted in 49 sites — towns and small *caseríos* (villages) located with a global positional system portable unit (Garmin GPS III) (Fig. 1C, Table 1) — to obtain information on the primate species present at each, their use by local communities (hunting, pets, use of body parts), and on perceptions of the behavior and ecology of the species. I avoided leading questions in order to avoid bias in the responses of the informants. In the initial questions I asked about the primates of the area, and their behavioral and physical descriptions, and only subsequently showed laminated color photocopies of primates in order to clarify their identity. I also included primates that have never been reported for this part of the Venezuelan Guayana (e.g., *Callicebus lugens* and *Saimiri sciureus*) to test the interviewees' knowledge. The informants were adult residents, including Amerindian *capitanes* (community leaders of the ethnic groups *Kariña* and *Pemón*), Amerindian and *criollo* (Venezuelan Creoles) local hunters, *campesinos* (*criollo* farmers), miners, loggers, local traders, Venezuelan national guards, Venezuelan and Guyanese Army soldiers, and Guyanese Carib Amerindians and Creoles.

Results

Only five primate groups were seen during the survey (Table 2). Four of these were *A. seniculus* and one *P. pithecia*. I heard red howler monkeys calls at six sites (Fig. 1C: numbers 1, 7, 21, 35, 39, and 47). The calls were heard mostly in the morning between 05:51 and 06:26, and later in the afternoon between 15:12 and 17:53.

Ninety-seven people were interviewed at the 49 sites (Fig. 1C: 1–49; Table 1). All informants indicated that the only primate taxa in the region were *P. pithecia*, *C. olivaceus* and *A. seniculus.*

The following common names were obtained from the interviews:

a) *Alouatta seniculus*. In Venezuelan Guayana: *araguato*, *arautá* (in *Pemón*, an Amerindian language). In Guyana: baboon, howler monkey.

b) *Cebus olivaceus*. In Venezuelan Guayana: *mono*, *mono corriente*, *mono normal*, *mono maicero*, *mono carita blanca*, *mono capuchino*, *mono fifí*, *mono tití*, *macaco*, *tití*; *yaracáru* and *aracarú* (in *Kariña*, a Carib Amerindian language), *iwarüka* (in *Pemón*). In Guyana: monkey, *dou jou,* and *hep* (in Carib language).

c) *Pithecia pithecia*. In Venezuelan Guayana: *mono viudo*, *viudo*, *mona viuda*, *viuda*, *viudito*, *viejito*, *arikí* (in *Kariña*), *chic* (in *Pemón*). In Guyana: white-faced monkey, *warga* (in *Akawayu*, a Carib Amerindian language).

Discussion

There was universal agreement among the informants as to the relative abundance of the three species: red howlers (*Alouatta seniculus*) > wedge-capped capuchin monkeys (*Cebus olivaceus olivaceus*) > white-faced sakis (*Pithecia pithecia pithecia*). The single saki sighting I achieved was of a multi-male and multi-female group of eight in an extremely degraded forest. There was an abandoned mining camp and evidence of a recent fire near the road. I was also told of *P. pithecia* living in a degraded forest on the outskirts of Tumeremo (*c*.10,000 inhabitants). The red howlers were seen in evergreen primary forests as well as in highly disturbed forests. These taxa were reported as the only primates present on the Guyana side of the Río Cuyuní. The informants indicated that white-faced sakis live in groups of two to nine individuals, while red howlers and wedge-capped capuchins form larger groups. I was also told that *C. olivaceus* and *P. pithecia* exploit *guama* trees (*Inga* spp., Leguminosae), and that wedge-capped capuchins tend to feed in slash-and-burn plantations.

Following the recommendation of Kinzey *et al*. (1988), I resurveyed an area they visited in 1988, on the upper Río Grande (Fig. 1C: 1–3). At the time of their study, they found white-faced sakis there. Fifteen years later, however I failed to observe any primates. I heard red howlers, and locals said that sakis and wedge-capped capuchins are often seen in the logged forest.

There was no evidence of the presence of *Saguinus midas* in the Bochinche area as reported by Linares (1998) (Fig. 1C, number 20 and adjacent sites). Here, local *Kariñas* and *criollos* identified just three primates, *A. seniculus*, *C. olivaceus,* and *P. pithecia*, with no reference of any animal similar to *S. midas*. Corroboration for the inexistence of *S. midas* in the region comes from Ochoa (2000), who worked on small mammal community structure in the Imataca region. He set up a trapping schedule for didelphids and small rodents that resulted in 10,320 trap nights (arboreal and terrestrial) using bananas as bait. The traps and bait were suitable for tamarins, but trapped none. He also spent 567 hours surveying mammals (diurnal and nocturnal) and his easternmost site was about 10 km west of Bochinche and found no evidence for the occurrence of tamarins. My attempts to locate them using *Saguinus* spp. and *S. midas* playback calls in secondary and primary forest around Bochinche also failed to detect any groups. A Guyanese Amerindian informant clearly indicated that tamarins occurred near the Essequibo River in Guyana, but not in the Río Cuyuní basin. This lends to support to Sussman and Phillips-Conroy's (1995) statement that this species does not occur west of the Essequibo River. Based on my survey, I suggest that *S. midas* is not present in the northeastern part of the state of Bolívar in Venezuela.

The possibility of *Aotus* occurring in the region, as was suggested by Kinzey *et al*. (1988) for the area of Río Grande, might be a reference to another nocturnal mammal. In many of the sites I surveyed the kinkajou (*Potos flavus*) was classified as a monkey. In the Venezuela Guayanan region it is referred to as the *mono güinche* and *ueshé* (in *Kariña*), while on the Guyanese side of the Río Cuyuní it is called night monkey or night traveler. In many cases, it was described as nocturnal, solitary, or living in pairs, *marroncito* (light brown) or *amarillento* (yellowish) and with *cara de perro* (dog-face), clearly indicating the kinkajou. An informant who knew this

Table 2. Description of primate sightings (abbreviations: A = Adult, J = Juvenile, I = Infant, F = Female, M = Male, U = Unknown).

Site #	Species	Behavior	Group size	Age/sex	Height in tree
20	*A. seniculus*	Moving	1	A/M	24 m
27	*A. seniculus*	Resting	5	A/M, A/F, A/U, J/U, I/U	20 m
28	*P. pithecia*	Moving	8	3xA/M, 4xA/F, I/U	18 m
31	*A. seniculus*	Resting	6	2xA/M, A/F, 2xA/U, I/U	20 m
39	*A. seniculus*	Moving	2	2xA/U	22 m

animal from western Venezuela called it *cuchi-cuchi*, which is the common name for *P. flavus* in the country. I also presented photographs of *Aotus* to the informants and they failed to recognize it. Bodini and Pérez-Hernández (1987) and Ford (1994) reported that the range of *Aotus* does not extend to this region. In two interviews, the three-toed sloth (*Bradypus tridactylus*) and the silky anteater (*Cyclopes didactylus*) were also classified as monkeys.

Linares (1998) indicated the presence of black spider monkeys (*Ateles paniscus*) in the Río Cuyuní area. He reported a sighting of four individuals in 1967 on the upper Río Cuyuní, and an observation in 1979 of a solitary individual near San Martín de Turumbán (Fig. 1C: number 29), which is very close to Anacoco (Fig. 1C: numbers 27, 28). In Anacoco, I saw wild *P. pithecia* and *A. seniculus* (Fig. 1C: Table 2). All informants in Anacoco and San Martín de Turumbán indicated that *Ateles* did not occur in the area. They included two Guyanese who knew black spider monkeys from the Potaro and Essequibo rivers in Guyana, but said they did not occur in Venezuela. One informant I interviewed on the upper Río Cuyuní clearly identified the three common primates of the area: *P. pithecia*, *A. seniculus,* and *C. olivaceus*, and the spider monkey. He said he had seen a pair in 1996 (Fig. 1C: number 36) and clearly described them as an *Ateles*, emphasizing their particular physical characteristics, a grayish color, and giving the Spanish name, *mono araña*. In El Dorado, I was also informed of a spider monkey-like primate, which was very rare but apparently existed in the Alto Paraguán of the Río Yuruán, a tributary of the upper Río Cuyuní (Fig. 1C). Kinzey *et al*. (1988) reported the possibility of *Ateles* near the Río Supamo, a tributary of the Río Yuruán, between the Río Caroní and the Río Cuyuní. Considering the color description of the Río Cuyuní specimen, its proximity to the Río Supamo basin, and the distribution of *A. paniscus* in Guyana, it is probable that rare, small, isolated populations of spider monkeys inhabit the Venezuelan Río Cuyuní basin, but this demands further investigation. Although reported absent from the Iwokrama Reserve west of the Essequibo River by Lehman (2000), a large population of black spider monkeys was studied in this reserve by Barth Wright (pers. comm. 2005), indicating that northwestern Guyana may be more densely populated with *A. paniscus* than previously believed, and that this species may well have crossed into this part of Venezuela (B.Wright pers. comm. 2005).

The only records of pet monkeys were four wedge-capped capuchins (*C. olivaceus*). Two were found in *criollo* villages (Fig. 1C: numbers 17, 24): an infant and an adult owned since it was young. A juvenile was being kept as a pet in a *Pemón* village, and another was in a *Kariña* village where I obtained the partial skeleton of an immature *C. olivaceus* pet (Fig. 1C: numbers 44, 18). Capuchins are the preferred primate pets in the region, and generally captured when young, after killing the mother. I was also told of a female *P. pithecia* that had been sold for about US$25, and another person informed me that white-faced saki tails are used for making key chains. Based on my interviews, primates were rarely preferred bush meat. Some locals argued that they look too much like humans, and informants alleged that rodents and ungulates, particularly agoutis (*Agouti paca*) and tapirs (*Tapirus terrestris*), were relatively abundant and preferred game animals in the region. Gold miners, on the other hand, reported hunting red howler because of its *carne roja* (red meat), but indicated that they tend to be rare near the mines.

Cattle ranching and habitat fragmentation are widespread in the region, especially in the area of Altiplanicie de Nuria-Tumeremo and the middle Río Botanamo. Forest patches are common, as are recently burned cleanings. Mining and logging are apparently reducing primate populations from the Río Botanamo to the Venezuelan-Guyanese border due to habitat loss and the creation of roads and trails in the Imataca forest, which provide for incursions of human disturbance and hunting. The consequences of such activities need to be studied in order to evaluate their effects on the primate communities and the implications for the conservation of the primates and forests of the Guianas in general.

Primate biogeographic studies are particularly needed in different areas of western Guyana, particularly in the Barama, Down Cuyuni, and Mazaruni river basins. This region is located between the east of the surveyed area in this project (the Venezuelan-Guyanese border in the Río Cuyuní basin) and the Potaro and Essequibo Rivers (Guyana), west of the regions surveyed by Lehman (2000) and Barnett *et al*. (2000). As such it fills a gap in our knowledge of the distribution and conservation status of the primates in the western Guianas. My findings reinforce the observed pattern of a gradual drop in primate diversity from east to west in the Guiana Shield, probably because of the existence of major rivers acting as biogeographic barriers such as the Essequibo (see Sussman and Phillips-Conroy 1995). It was possible to fully document the presence of only three primate species (*A. seniculus*, *C. olivaceus* and *P. pithecia*) in the northeastern part of the Venezuelan Guayana (= western Guianas), contrasting as such with the eight primates reported for eastern Guyana and Suriname (Lehman 2000; Boinski 2002). More surveys in isolated areas of the Guianas should be conducted to fully understand the primate biogeography of this broad region.

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A History of Long-term Research and Conservation of Northern Muriquis (*Brachyteles hypoxanthus*) at the Estação Biológica de Caratinga/RPPN-FMA

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Abstract: Northern muriquis (*Brachyteles hypoxanthus*) are endemic to the Brazilian Atlantic forest, and rank among the most critically endangered primates in the world. The 957-ha forest at the Biological Station of Caratinga/Reserva Particular do Patrimônio Natural – Feliciano Miguel Abdalla (EBC/RPPN-FMA), in Minas Gerais, supports a population of more than 230 individuals, one of the highest population densities known. Long-term research and conservation efforts have been underway there since 1982, during which time the behavioral ecology, reproductive biology, and life histories of members of one of the two original groups (Matão) have been systematically monitored. These data, together with a census conducted in 1999, signaled the importance of expanding the project to include the entire population at this site. Since 2002, all four of the muriqui groups that now inhabit this forest have been monitored. While continuing to provide training and research opportunities for Brazilian students, our new research initiatives are focusing on understanding the demography and ecology of this population. Analyses of vegetation structure and composition indicate that the forest at EBC is relatively species-rich compared with other tropical rainforests worldwide. Tree mortality and recruitment are relatively high and overall primary productivity, as measured by litter fall, is average for tropical forests. Given that the forest at EBC has suffered the impact of selective logging, fire, and agriculture, we believe that its high rate of turnover may be a response to past disturbance regimes, and one of the reasons muriquis are doing so well here. It has been proposed that primates that include substantial amounts of leaves in their diet may be favored by habitat disturbance if that means an increase in the availability of more palatable and more nutritious leaves. In addition, in terms of fruits, muriquis are very opportunistic feeders, not appearing to select fruits of any particular, size, shape, or dispersion syndrome. This paper reviews the history of research and conservation activities on behalf of this critically endangered species at a critically important field site.

Key Words: Northern muriquis, *Brachyteles hypoxanthus*, population viability, demography, ecology, conservation

Introduction

Northern muriquis (*Brachyteles hypoxanthus)* are endemic to the Atlantic Forest of southeastern Brazil, and are ranked among the world's 25 most endangered primates (Mittermeier *et al*. 2000; Konstant *et al*. 2002; Strier *et al*. 2005). Previously, fewer than 500 individuals were estimated to survive in only a few dozen forest fragments in the states of Minas Gerais, Espírito Santos, and southern Bahia, with the largest population (more than 200 individuals) occurring in the 957-ha forest at the Estação Biológica de Caratinga (EBC)/RPPN-FMA (19°44′S, 41°49′W) in Minas Gerais (Fig. 1; Strier *et al*. 2002, in press). Results from recent surveys, however, show that there could be as many as 1,000 northern muriquis left in the wild, and important studies of some of these newly discovered populations have recently been initiated (Mendes 2004; Dias *et al*. 2005; Mendes *et al*. 2005).

The EBC muriquis have been the subjects of systematic research since 1982, and are continuing to provide important insights into the behavior, biology, and ecology of this species. Here, we describe the history of the EBC and the Muriqui Project of Caratinga, and some of the most significant new research and conservation initiatives underway as part of this project.

History of the EBC

Discovery

The EBC is a privately-owned forest surrounded by the coffee plantations and pastures of Fazenda Montes Claros.

The forest at the EBC has long been recognized as one of the last remaining strongholds for muriquis. Both the EBC and the imperiled status of muriquis gained national attention in Brazil as a result of Aguirre's (1971) comprehensive monograph. Soon after, pioneering Brazilian conservationists, such as Adelmar F. Coimbra-Filho, then Director of the Centro de Primatologia de Rio de Janeiro (CPRJ), Almirante Ibsen de Gusmão Câmara, then President of Fundação Brasileira para a Conservação da Natureza (FBCN), and Célio Valle, then Professor of Zoology at the Universidade Federal de Minas Gerais (UFMG), attracted international attention to the plight of muriquis and the importance of the EBC by alerting Russell Mittermeier, then at World Wildlife Fund (WWF), to their status (Valle *et al*. 1982, 1983).

Zoology professors from UFMG, Ney Carnevalli and Célio Valle, first visited the EBC in 1974, establishing what became a critical collaborative relationship with the owner of the forest, Mr. Feliciano Miguel Abdalla (Valle 1992). Mr. Feliciano subsequently opened his lands to researchers and conservationists from around the world, beginning with Akisato Nishimura, from Japan, in 1977 (Nishimura 1979). In 1981, Russell Mittermeier brought Andrew Young, a Harvard University undergraduate and budding filmmaker, to the EBC to make the classic film "Cry of the Muriqui." Mittermeier's ex-graduate advisor from Harvard, Dr. Irven DeVore, narrated the film. DeVore was by that time serving as Karen B. Strier's (KBS hereafter) graduate advisor, and he encouraged her to consider studying muriquis at the EBC for her PhD dissertation. She conducted a pilot study there in 1982, and has continued her research at this site ever since.

Local infrastructure

Until 1983, researchers and conservationists visiting the EBC stayed in a small apartment adjacent to Mr. Feliciano's house, located about 2 km from the forest. Then, Mr. Feliciano donated a small abandoned house so that resident researchers could be more conveniently situated at the entrance to a dirt road that bisects one of the main valleys in the forest. FBCN and WWF renovated the house, which was inaugurated in May 1983, and inhabited, for the first time, in June of that year.

The research facilities have been improved and expanded over the last two decades. In 1992, electricity was brought in and the old veranda was converted to a third bedroom. An extension, known as the "Centro de Visitantes Célio Valle," was also built with support from Fundação Biodiversitas, an NGO based in Belo Horizonte, and the international nongovernmental organization (NGO), Conservation International (CI). In June 2002, "O Laboratório do Campo Dra. KBS," was constructed for the 20th anniversary of the muriqui project, with support from the Zoological Society of San Diego, California.

Initially, the EBC research house was administered by FBCN, then by Fundação Biodiversitas, and subsequently by the Brazil Program of CI (CI-Brasil). Eduardo Marcelino Veado, who had served as field assistant to KBS in 1983–84 when an undergraduate at UFMG, moved his family to the nearby town of Santo Antônio to become the director of the EBC in 1988, as an employee of the Fundação Biodiversitas. Subsequently, Eduardo established the Pró-Associação EBC, the NGO that now administers the EBC with support from CI-Brasil and, more recently, the Zoological Society of San Diego.

Figure 1. An adult male northern muriqui from the Jaó valley, with the town of Santo Antônio in the background. Photograph by Ítalo Mourthé, 2002.

The EBC muriquis were protected by Mr. Feliciano throughout his lifetime. In 2001, Mr. Feliciano's family transformed the forest into a Private Natural Heritage Reserve, the "Reserva Particular do Patrimônio Natural Feliciano Miguel Abdalla," or RPPN-FMA. The RPPN-FMA is administered by the Sociedade para a Preservação do Muriqui, the NGO that the Abdalla family established specifically for this purpose (Castro 2001).

Other research activities at the EBC

In addition to northern muriquis, the EBC forest supports significant populations of three other species of primates, two of which (the buffy-headed marmoset, *Callithrix flaviceps*, and the brown howler monkey, *Alouatta guariba clamitans*) are also endemic to the Atlantic forest and threatened with extinction. The third species, the black-horned capuchin monkey (*Cebus nigritus*), is also threatened and restricted to the Atlantic forest.

Systematic field studies resulting in undergraduate, Masters, and PhD theses have been conducted on all four of the primate species at the EBC (for example, Stephen F. Ferrari conducted his PhD thesis on buffy-headed marmosets [1988]; Sérgio L. Mendes his master's thesis on the brown howler monkeys [1985], and José Rímoli [2001] and Jessica W. Lynch [2001] their PhD theses on the black-horned capuchin monkeys). Together with other studies that have been carried out on the plants, birds, bats, and small mammals, the EBC has become a major research center for tropical field biology (Bernardes *et al*. 1988).

The Muriqui Project of Caratinga (MPC)

Background

In 1982, two groups of muriquis were known to inhabit the EBC forest, with a total of about 50 individuals altogether (Valle *et al*. 1984). One group, known as the Matão group, occupied the central and southern part of the forest closest to the research house. The second group, known as the Jaó group, used the northern part of the forest. Until 2002, research efforts focused almost exclusively on the Matão group, nearer to the field station. Members of the Jaó group have been sighted opportunistically in about 40% of the Matão group's home range, which increased from 168 ha in 1983–1984 (Strier 1987) to 309 ha in 1988–1999 (Dias and Strier 2003). In 1988, six males from the Jaó group began making periodic incursions on their own into Matão forest, where they accounted for 10–12% of all observed copulations involving Matão females over a 5-year period (Strier 1994, 1997). By 1991, a third group, christened Matão 2 (M2), was established by some Jaó females and the transient Jaó males. The presence of the M2 group in what had originally been the northern part of the Matão group's home range may have stimulated the Matão group to shift its expanded home range into the southern part of the forest (Strier *et al*. 1993).

Since 1983, KBS has directed systematic studies of the Matão group, focusing on the behavioral ecology, reproductive ecology, and life histories and demography. In 2001, Jean Philippe Boubli (JPB hereafter) joined the project as KBS' post-doc, with the aim of extending the research to the Jaó muriquis and investigating the ecology of the species in greater detail. Most previous research had focused on the behavior of the animals, and questions about the forest's floristics, phenology, and primary productivity and detailed analyses of the muriquis' diets, including the occurrence of seeds in their feces, were still open. In 2003, Carla de Borba Possamai, currently a master's student at the Pontíficia Universidade Católica (PUC) of the state of Minas Gerais but who participated in the Matão project from June 2001–February 2003, initiated systematic research on the M2 group and, together with students working in Jaó, on what is now a fourth group (Nadir), composed of muriquis that broke off from the Jaó group in 2002 (Strier *et al*. 2004, in press).

From its onset, the MPC has maintained a tradition of providing research and training opportunities for outstanding Brazilian students. More than 30 have participated in the Matão project since 1983. Six students, including two from the Matão project, have participated in the Jaó project since 2002 (Table 1).

One of the keys to the long-term continuity of the Matão project has been the overlapping teams of students, who participate in the selection and training of their successors. This continuity has made it possible to follow all group members over the course of their lives, including all infants that were present in 1982 and have been born since. Muriquis have distinct facial markings that permit individual identification, and each team of students helps to train their successors to ensure that each muriqui can be followed from one year to the next.

Males stay in their natal groups for life (Strier 1991a), although exceptions may arise associated with unfavorable sex ratios. For example, in addition to the six males from Jaó that began to make incursions into the Matão in 1988 and ultimately helped to establish the M2 group (Strier *et al*. 1993/1994), a subset of males in Jaó now seem to be engaged in a similar process of transferring into the new Nadir group (Boubli *et al*. 2005).

Continuous observations of the Matão group have also made it possible to follow the life histories of females, which typically transfer out of their natal groups at about 6 years of age (for exceptions, see Strier 1991a; Martins and Strier 2004). Immigrant females are nulliparous and pre-pubescent (Strier 1991a; Printes and Strier 1999; Strier and Ziegler 2000). The first documentation of female immigration occurred in 1983, while the first case of a known natal female to emigrate occurred in 1987, when the first of the female infants present in 1982 transferred into the Jaó group. The continuity of the study has permitted us to document the complete reproductive careers of all nulliparous females in the Matão group since 1983, and the onset of the reproductive careers of natal Matão females of known age that have transferred into the other groups in this population (Strier *et al.* 2002; in press).

Female muriquis reproduce approximately every 3 years, with weaning typically beginning during an infant's second year of life (>12 months). Infants maintain close contact with their mothers (Odália-Rímoli 1998), and have experienced unusually high survivorship during their first year of life compared with that of sympatric brown howler monkeys (94% versus 74% in the same 4-year period; Strier *et al*. 2001, but see Strier *et al*. in press).

One of the main thrusts of the long-term study on the Matão group has been monitoring female reproductive condition using non-invasive fecal steroid assays. From these non-invasive methods, it has been possible to document gestation length, which is 7.2 months, and ovarian cycle intervals, which average 21 days (Strier and Ziegler 1997). We have also begun to document the hormonal conditions that appear to affect the resumption of ovarian cycling and conception (or conception failure) in females (Strier and Ziegler 2005).

The long-term study of the Matão group has focused on two major priorities: 1) monitoring the viability of the population, and 2) monitoring the habitat. Both the fecal hormone study and the demography study are contributing to the long-term priority of monitoring the viability of the population.

Population viability

The Matão study group has nearly quadrupled in size over the past 22 years, increasing from the 22 members present in July 1982 to 80 members as of July 2004. The importance of monitoring the population's viability was recognized in the early 1990s, following the first Population Viability Analysis (PVA) that Strier (1993/1994) conducted based on the demo-

Table 1. Muriqui researchers at the EBC.

Year	**Matão Project**[a]	**Jaó Project**[b]	**Matão-2 + Nadir Project**[c]
2004–05	Danusa Guedes[31a] Janaína F. de Oliveira[30a]	Marcos Tokuda[5b] Ítalo M. Mourthé[4b] Fabiana Couto[3b]	Carla B. Possamai[1c—see 24a]
2003–04	Karynna T. de Souza[29a] Vagner de Souza[28a]	Ítalo M. Mourthé[4b] Fabiana Couto[3b] Janaína Mendonça[6b] Marcos Tokuda[5b]	Carla B. Possamai[1c—see 24a]
2002–03	Fernanda P. Paim[27a] Maria Fernanda F. F. Iurck[26a] Carla B. Possamai[24a]	Vanessa O. Guimarães[2b—see 21a] Ítalo M. Mourthé[4b] Fabiana Couto[3b]	
2001–02	Regiane R. de Oliviera[25a] Carla B. Possamai[24a]	Vanessa O. Guimãraes[2b—see 21a] Cláudio P. Nogueira[1b—see 9a]	
2000–01	José Cassimiro da Silva Jr.[23a] Waldney P. Martins[22a] Vanessa O. Guimarães[21a]		
1999–00	Waldney P. Martins[22a] Vanessa O. Guimarães[21a]		
1998–99	Luiz G. Dias[20a] Cristiane C. Coelho[19a] Cláudio P. Nogueira[9a]		
1997–98	Dennison Carvalho[18a] Nilcemar Bejar[17a]		
1996–97	Andréia S. de Olivera[16a] Laiena T. Dib[15a]		
1995–96	Cláudia G. Costa[14a] William A. Teixeira[11a]		
1994–95	Rodrigo Cambará Printes[13a] Maria Amélia F. Maciel[12a] William A. Teixeira[11a]		
1993–94	Lúcio P. de Oliveira[8a] Cláudio P. Nogueira[9a] Sebastião da Silva R. Neto[10a] Adriana Odália Rímoli[4a]		
1992–93	Cláudio P. Nogueira[9a] Lúcio P. de Oliveira[8a] Ana R. D. de Carvalho[7a]		
1991–92	Paulo Coutinho[6a] Fernanda Neri[5a]		
1990–91	Francisco D. Mendes[2a]		
1989–90	José Rímoli[3a] Adriana Odália Rímoli[4a]		
1988–90	José Rímoli[3a]		
1987–88	José Rímoli[3a]		
1986–87	Francisco D. Mendes[2a]		
1984–85	Karen B. Strier		
1983–84	Karen B. Strier Eduardo M.V. Veado[1a] Gustavo Fonseca		
1982	Karen B. Strier Andrew Young		
1974–81	Célio Valle and colleagues (UFMG)		

[a] Coordinated by KBS since 1985; sponsored by Célio Valle, César Ades, Gustavo Fonseca, and Sérgio L. Mendes.

[b] Coordinated by JPB since 2002; co-advised by KBS.

[c] Coordinated by Carla B. Possamai since 2003; co-advised by Robert J. Young (Professor, PUC-Minas) and KBS.

[1a]UFMG; [2a]USP; [3a]USP; [4a]USP; [5a]UF-Juiz de Fora, later UFMG; [6a]São Paulo, later UFPa; [7a]Taubaté, SP; [8a]UF-Juiz de Fora; [9a]U Guarulhos, later UFMG; [10a]UF-Viçosa; [11a]Belo Horizonte; [12a]UF-Viçosa; [13a]UFRS, later UFMG; [14a]PUC-Minas, later UFPa; [15a]UF-Uberlandia, later UFMG; [16a]Belo Horizonte; [17a]UFMG; [18a]UFMG; [19a]PUC-Minas; [20a]UFMG; [21a]UFRJ, later UFES; [22a]UFMG; [23a]UFMG; [24a]PUC-Curitiba, later PUC-Minas; [25a]UF-Viçosa, later PUC-Minas; [26a]PUC-Curitiba; [27a]UNISINOS-São Leopoldo, RS, later UFRS; [28a]UFES; [29a]PUC-Curitiba; [30a]PUC-Minas; [31a]PUC-Minas; [3b]UFMG; [4b]UFMG; [5b]USP; [6b]PUC-Minas.

graphic and life history parameters from the first decade of the study.

One of the most important insights to emerge from the PVA was the influence of infant sex ratios on the growth of the Matão group. In fact, infant sex ratios in the Matão group were consistently female-biased in each of the annual birth cohorts from 1982 through 2000, when male births began to outnumber female births. The importance of female numbers to the group's increase in size was also evident from the cumulative number of females that have immigrated into the Matão group relative to natal Matão females that have emigrated. Until the early 1990s, the number of female emigrants was offset by a comparable number of immigrants. By the early 1990s, however, the number of female immigrants began to decline relative to the number of emigrants, raising questions about whether infant sex ratios and survivorship in the rest of the population at the EBC were consistent with those being documented in the Matão group (Strier in press).

The growing disparity between immigrants and emigrants also raised questions about whether the Matão group was serving as a "source" of females in the population, and conversely, whether Matão females were dispersing into a "sink." The need for more information about whether or not the demography of the Matão group was representative of the rest of the EBC population was a major motivating factor behind the census that Strier and Sérgio Mendes organized in 1999, which involved some 15 participants, all of whom were students and colleagues who had previously conducted research on muriquis and other primates at the EBC, and were therefore familiar with the forest (Strier *et al*. 1999).

The results of the census confirmed the persistence of three muriqui groups, and demonstrated that roughly half of the EBC muriqui population resided in Jaó. Several Matão females that had emigrated to Jaó were re-sighted, some carrying infants. These findings clearly demonstrated the importance of initiating research on the Jaó group.

Fortuitously, Dr. Alan Dixson, then Director of the Center of Research for Endangered Species (CRES) at the Zoological Society of San Diego, contacted KBS for recommendations for the Millennium Post-Doctoral program that he had been instrumental in establishing there. The program has been responsible for bringing JPB into the project, and thus providing both the funding and the expertise needed to expand the scope of the MPC. Initially, JPB began working with two recent students from the Matão project, both of whom could identify familiar Matão females that had recently transferred into Jaó, and could employ the methods of age classifications established from experience with the Matão group to provide informed estimates on the ages of all immature members of the Jaó group.

In 2003, with some initial support from KBS' funds, and then supported with her own grants from the Rufford Foundation, the Primate Action Fund of CI, and the Primate Society of Great Britain, Carla de Borba Possamai initiated systematic studies of the M2 group and what had by then become the fully established Nadir group. As a result, the entire population of northern muriquis is now being monitored, with all individuals recognized by their natural markings and demographic records maintained on a continuous basis.

Continued monitoring of all four of the muriqui groups at the EBC now permit us to obtain accurate counts of their size, which are updated on a monthly basis. As of 31 July 2004, there were 226 individuals known in this population, distributed across the four groups. All of the groups have similar age-sex class compositions, suggesting that the long-term demographic data from the Matão group is representative of the demographic history of the larger population before our population-wide monitoring began.

The population-wide demographic monitoring has also made it possible to evaluate the status of the entire population for the first time. For example, 80% of the 25 infants born in the population in 2003 survived to 12 months, and roughly one-third of all adult females were carrying infants as of July 2004. Although the population-wide rate of first year survivorship in 2003 is lower than rates documented in the Matão group in prior years (Strier *et al*. 2001), the percentage of adult females carrying yearlings in the population is consistent with predictions based on the 3-year birth interval documented in the Matão group since its onset (Strier *et al*. 2004, in press).

Available habitat

The second long-term priority of the MPC has been to study the relationship between the muriquis and their forest habitat at EBC. In Strier's (1993/1994) PVA simulations of the population based on the Matão group a decade ago, it was clear that increasing the habitat available to muriquis would have a positive impact on the size of the group, and by inference, on the population's size within about 20 years. The time lag in response is due to the late age (8–9 years) at which muriqui females give birth to their first infants (Strier 1991a). Indeed, the reliability of these simulations is implied by the fact that the size of the Matão group is now exactly what it was projected to be in the PVA simulations run a decade ago (Fig. 2).

The EBC muriqui population density is one of the highest reported for muriquis (Strier and Fonseca 1996/1997). High population density in a disturbed secondary forest such as the one at the EBC is, at first, a somewhat puzzling fact. By the early 1990s, however, it was clear that muriquis routinely exploited vegetation growing at the edges of the forest, and that higher densities of muriquis occurred in disturbed forests than in undisturbed forests (e.g., Stallings and Robinson 1991; Pinto *et al*. 1993; Strier and Fonseca 1996/1997). One of the reasons for this is that the largest part of the muriquis' annual diet is composed of mature and young leaves (51%; Strier 1991b). Leaves are particularly important food items at the beginning of the dry season, when fruits and flowers, which comprise 32% and 11% of the diet, respectively, are scarcer (Strier 1991b). It has been proposed that primates that include substantial amounts of leaves in their diet may be favored by habitat disturbance if that means an increase in

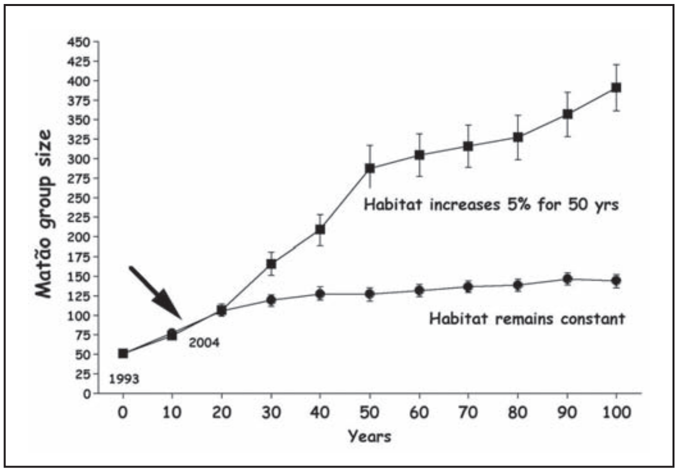

Figure 2. Effect of habitat availability on group size. From Strier (1993/1994), based on Vortex simulations conducted with input variables derived from the Matão group as of 1993, with no deleterious effects of inbreeding and female age at first reproduction = 11 years. Note that the size of the Matão group (arrow, as of 31 July 2004) is exactly what the simulations projected more than a decade ago, and that the effects of habitat availability on muriqui numbers were not expected to be evident until after 2013, or more than 20 years into the simulation. Accurate assessments of rates of habitat expansion are not presently available.

the availability of more palatable and more nutritious leaves (Johns and Skorupa 1987; Pinto *et al*. 1993; Ganzhorn 1995; Strier 2000). Rapidly growing pioneer plants, characteristic of secondary forests, may be more palatable because these plants contain fewer chemical and structural defenses (Coley *et al*. 1985; Ganzhorn 1995).

New ecological studies being conducted in the Jaó area indicate that the leaves of several *Miconia* species were among the top-ranking food items. *Miconia* is a typical plant of secondary growth and disturbed areas (Boubli *et al*. 2004, in prep.). However, as in Strier's (1991b) previous study on the Matão group, fruits, when available, are still the most sought after food items (Boubli *et al*. in prep.). Thus, we believe that one of the reasons muriquis are doing so well in the disturbed secondary forest at the EBC is that they are opportunistic in their diet, feeding on abundant food items such as the leaves of pioneer species in the genera *Miconia* and *Cecropia*. In terms of fruits, muriquis do not appear to select fruits of any particular dispersion syndrome. Instead, they consume a large variety of fruits, ranging from tiny seeded understorey fruits (e.g., *Psychotria* spp., *Miconia* spp.) that are usually preferred by birds or bats, to large seeded and hard-shelled fruits (e.g., *Spondias venulosa* and *Carpotroche brasiliensis*), usually preferred by parrots and large rodents (Boubli *et al*. in prep.).

A 15-year comparison of the Matão group's ranging patterns demonstrated an increase in the size of this group's home range corresponding to the increase in the size of the group, but no increase in the length of the group's day range (Dias and Strier 2003). This suggests that although larger groups use larger food supply areas, they do not travel farther each day to obtain sufficient food. However, there are other indications that we are now entering a critical period in terms of the estimated carrying capacity for muriquis at the EBC. Specifically, according to the original PVA estimates, the degree to which the area of suitable habitat can be increased will determine the degree to which the muriqui population can continue to grow (Strier 1993/1994). Thus, in addition to monitoring the demography of the entire muriqui population, documenting the ecology of the EBC forest and its capacity to sustain a viable population of muriquis has remained a priority.

The Forest of the EBC

With the initiation of the Jaó project, we have been carrying out a detailed ecological study of the EBC forest, which includes systematic monitoring of regeneration rates and plant part productivity. The main objective of this new endeavor has been to study the regeneration process in what is mostly secondary forest at the EBC, as well as to record any long-term changes in primary productivity that occur as the forest matures.

Floristic inventory

As a first step toward studying forest regeneration, we carried out a detailed floristic inventory of the area. In October 2001, six botanical plots measuring 500 × 10 m were laid out at randomly selected locations within the study area, totaling 3 ha. Within each plot, all trees $\geq$10 cm Diameter at Breast Height (DBH) were marked with aluminum numbered tags and had their DBH measured. In a subsample of the plots, totaling 1 ha, all trees $\leq$5 cm DBH were also tagged. Tagged trees were identified in the field by local experts and, to confirm field identification, voucher specimens were sent to specialists at the herbarium of the Federal University of Minas Gerais, Belo Horizonte.

Our data show that the EBC forest is relatively diverse in tree species, with an average of 150 species $\geq$10 cm DBH per ha and around 35 families represented. Data from several 1-ha plots throughout the neotropics reveal that the number of tree species $\geq$10 cm DBH varies from 60 to 150 and, in very rich areas such as western Amazonia, this figure goes up to 200–300 species (Richards 1996; Gentry 1990). In terms of floristic diversity, therefore, the EBC forest falls at the upper end throughout the Neotropics, although not matching the richest Amazonian areas, such as Pico de Neblina.

Leguminosae (mostly Mimosoideae) trees dominate the EBC sample, followed by Euphorbiaceae and Flacourtiaceae. The most abundant tree species in our sample is *Mabea fistulifera* (Euphorbiaceae), representing 12% of the marked trees in the plots. This species dominates the tops of the hills, forming monodominant patches of high stem density. Another abundant species is *Pseudopiptadenia contorta* (Mimosoideae), which contributes 6% of the individuals.

Average DBH for the 1,405 trees $\geq$10 cm DBH that had been tagged in the botanical plots in 2001 was 18 ± 13.24 cm, with most trees falling within the 10–20 cm DBH size class (Fig. 3). This DBH distribution at the EBC is comparable to several Amazonian sites (Gentry 1990). Average DBH was

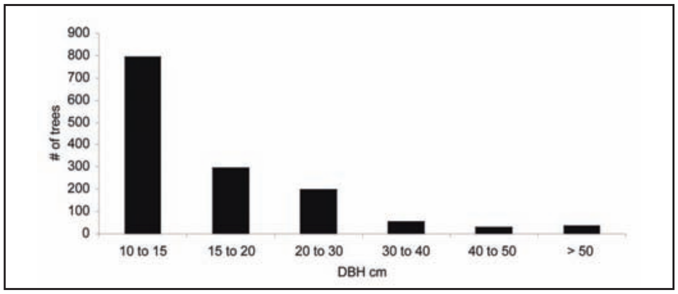

Figure 3. DBH distribution of trees ≥10 cm DBH in a 3 ha botanical sample of the EBC forest (Mean ± SD = 18.00 ± 13.24, N = 1,405).

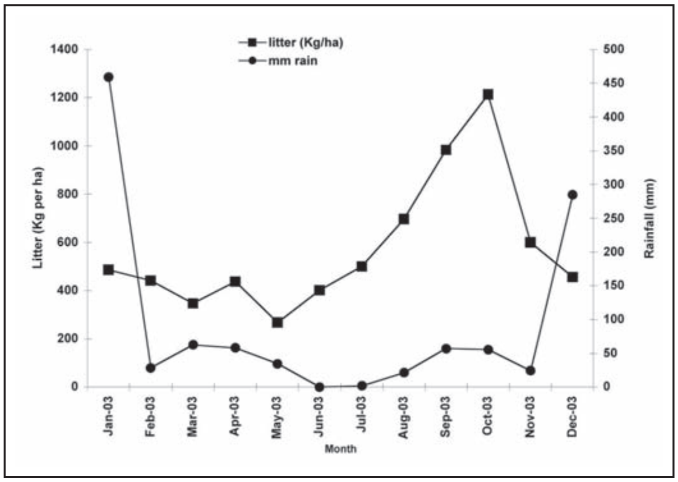

Figure 4. Primary productivity and rainfall. Productivity is measured by the amount of forest litter (leaves, flowers, fruits, twigs) collected in 100 × 1–m^2 litter traps in 2003.

smaller, however, due to the lack of large trees. There was no significant difference in the measured DBH of trees from 2001 to 2002 (t = 1.9, df = 1,370, $p = 0.06$), and the average DBH increment for the year was 0.4 ± 1.1 cm (n = 1,405).

Demography, phenology, and primary productivity

To understand the patterns of intra- and inter-annual variation in the availability of plant parts, we have also been gathering monthly phenological data on 1,753 of the 3,090 trees ≥10 cm DBH and their 1,253 associated lianas in the botanical plots, and on an additional 691 trees ≥5 cm DBH. Primary productivity has been measured by weighing forest litter collected in 100 × 1–m^2 litter traps placed at 20-m intervals in the botanical plots each month. We are also studying litter decomposition. In addition, since 2002, an annual census of all trees within the plots has been conducted to record mortality of marked trees, diameter increments, and finally to count and tag trees that recruited to the ≥5 and ≥10 cm DBH size classes.

In terms of primary productivity, we recorded a total of 6,828 kg of litter per ha in 2003 (Fig. 4). This is an intermediate value when compared with other tropical forests in the world (Proctor 1983; Boubli *et al*. 2004). The mortality rate for trees during the first 12-month study period was 2.4%, with 34 trees dying in the period of October 2001–October 2002 (Boubli *et al*. 2003).

Tree mortality rate at EBC is high when compared with other tropical rainforest sites around the globe (Phillips *et al*. 1994). In an analysis of 25 rainforest sites, Phillips *et al*. (1994) found that most sites had mortality rates of less than 2% per year, and only two floodplain areas had similar mortality rates to those found at the EBC. With 79 newly recruited trees (i.e., trees that grew to 10 cm DBH) in 2002 (or 5.6% of the total sample), the EBC forest showed a considerable recruitment rate when compared with other tropical rainforests, which usually range from about 1% to 3% per year (Phillips *et al.* 1994, Boubli *et al.* 2003).

Compared with other tropical rainforests worldwide, therefore, mortality and recruitment at the EBC have been found to be relatively high. Given that the forest at EBC has suffered the impact of selective logging, fire, and agriculture encroachment, we believe that its high rate of turnover may be a response to past disturbance regimes as it undergoes natural maturation, and not necessarily correlated with its high primary productivity. The continuation of this study will be necessary to distinguish between these two processes.

Seasonality

Rainfall at EBC has been monitored for more than 20 years, and the pattern recorded to date is of a highly uneven distribution of precipitation within the annual cycle, with most rainfall occuring between October and March, and a pronounced dry season from June through August (Strier *et al*. 2001). Interannual variation is not pronounced, although there have been years when rainfall exceeded the average by more than 50% (Strier 1999). The forest at EBC is semi-deciduous, and most trees shed their leaves toward the end of the dry season (Fig. 4). Consistent with earlier accounts (Strier 1991b), the production of reproductive plant parts appears to follow the seasonal rhythm with two peaks of flowering and fruiting a year, roughly 5 to 6 months apart (Fig. 5; Boubli *et al.* 2002, in prep.). Inter-annual variation in the height of flowering and fruiting peaks has also been recorded, but we are not expecting to correlate this with rainfall as we are investigating a long-term, supra-annual process. More data will tease apart the natural regeneration of a disturbed forest from the turnover rates of a mature forest.

Regeneration, connectivity, and community involvement

It was evident from the original PVA (Strier 1993/1994) that the continued growth and expansion of the EBC muriqui population, and thus, its long-term survival, is dependent on the availability of sufficient habitat. The EBC is an island surrounded by open pastures, and the muriquis' future here depends on the creation of new suitable forest habitat. In response to this need, the director of the field station, Eduardo Marcelino Veado, initiated a preliminary evaluation of the farming community surrounding the EBC forest in 1995. With the help of a consulting firm, interviews were conducted with neighboring landowners to begin to assess their interest in collaborating in the conservation of muriquis. Initially, priority focused on landowners whose forests were continuous

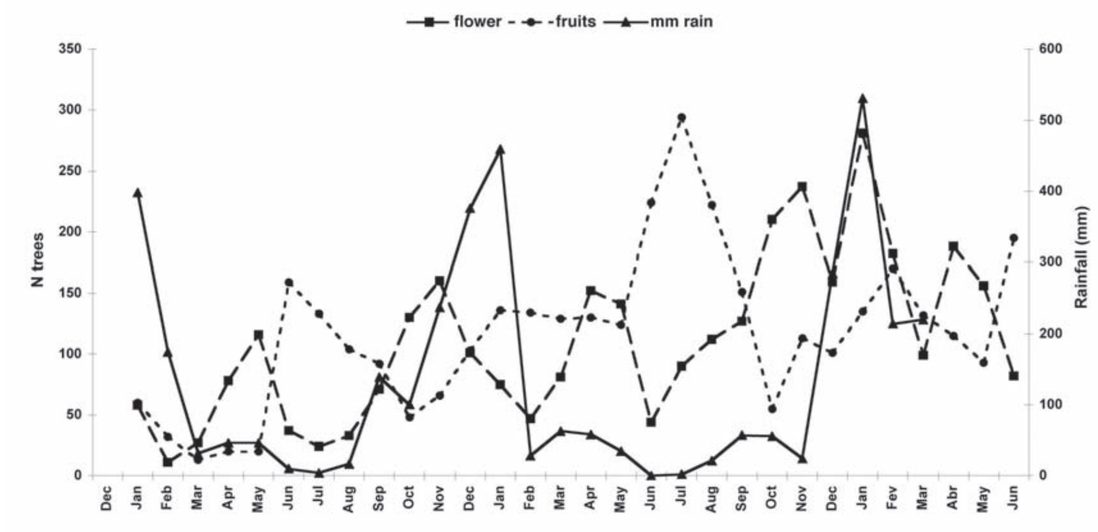

Figure 5. Multi-year (2002–2003–2004) phenology of trees ≥10 cm DBH in 3 ha at EBC.

with that of the EBC, and into which the Matão group was already making forays.

Efforts to develop reforestation projects have been underway ever since, with the ultimate goal of establishing a fauna corridor that will connect the EBC to neighboring forests and, ultimately, to a reserve near the city of Ipanema, Minas Gerais, some 20 km to the south. To achieve this goal, Eduardo Veado (2004) initiated a nursery project in 1997, which was expanded in 2003 as part of a new project, entitled 'Muriqui Conservação," funded by the Project for the Conservation and Sustainable Use of Brazilian Biological Diversity (*Projeto de Conservação e Utilização Sustentável de Diversidade Biológica Brasileira—PROBIO*) of the Brazilian Ministry of Environment and The Global Environment Fund (GEF), and coordinated by JPB. The plant nursery currently has the capacity to produce 200,000 saplings per year. In addition, to better understand the natural process of habitat recovery in the area, several regeneration experiments have been established to find the most effective way of bringing forest back into areas that had been converted to pasture. Experimental treatments include the placement of perches for birds that will bring seeds from surrounding forest, translocation of seed banks from surrounding forest fragments, and fences to exclude grazing by cattle. We know from long-term observations that pastures that had been allowed to regenerate through natural processes recovered sufficiently to be exploited by all four primates, including muriquis, within about 10 years (Strier and Mendes 2003). Our aim is to facilitate and accelerate the process.

A second major initiative to increase the extent of available habitat was also launched in 2003 under the Muriqui Conservação PROBIO project, and already it is showing promising signs of success. It focuses on the social environment for conservation, and has been executed by Francisco Pontual with assistance from Janaína Mendonça and Antônio Bragança. Following on from the initial survey of the attitudes of the neighboring landowners and their views concerning the conservation of the forest remnants within their properties, it was decided that the best way to approach the community on these matters was through a mechanism familiar to them, known as "mutirão," in which community members volunteer to work together on a project of communal interest, such as the building of a road, a bridge, or a chapel. Consistent with this practice, neighboring farmers were invited to attend technical courses on ranching and bovine nutrition provided by SENAR/MG, one of the project's partner institutions, and during these courses, also participate in our conservation "mutirão."

By the end of November 2004, more than 100 people had participated in 10 SENAR/MG courses, all with great enthusiasm and excellent community responsiveness. The relaxed group dynamics that characterized these courses provided unique opportunities to explain some important conservation goals, such as the fencing and recovery of the springs, creeks, and forests borders, which will help increase the standing water supply in the region as well. Many farmers had already noticed that local water sources are drying out, so they quickly understood that the immediate protection and recovery of degraded areas along the creeks could be of fundamental importance, not only for the expansion of habitat for the muriquis, but also for their own livelihoods. Once both the conservationists and farmers realized that they shared common goals such as these, the conservation "mutirão" could be conducted in a successful and mutually informative way. The Muriqui Conservação project is already fencing and protecting about 30 ha of private land owned by the local farmers that have joined the reforestation effort. Some 6,000 seedlings will be transplanted to help in the recovery pasture, and at least a dozen of the most influential local land owners are willing to protect more than just their water sources.

With their collaboration, we hope to not only to increase the habitat available for EBC muriquis but reduce as such the possibilities of their demise due to natural or human-induced disasters such as fires and disease. Although presently thriving, the EBC muriqui population is still small enough to be highly vulnerable to extinction due to these kinds of catastrophic events. Expanding the available habitat will permit this population to continue to grow and increase its long-term viability.

Future Directions

Until recently, the EBC muriqui population was thought to represent more than 40% of the species and was considered to be the largest and most viable population. Discoveries of other populations of northern muriquis in Minas Gerais include two that inhabit protected areas, and may be larger than the population at the EBC, and therefore promising for the future of the species (Dias *et al.* 2005). These discoveries have been accompanied by new research initiatives, which will soon be providing invaluable comparative perspectives on the behavior and ecology of the EBC muriquis. The long-term and ongoing research and conservation efforts at the EBC have been helping to provide training opportunities for young scientists, as well as insights into the basic biology and ecology of northern muriquis. The value of these efforts will continue to increase as comparative insights from other forests and populations become available, and we can pool our knowledge about muriquis and their habitats to ensure their future survival.

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English Common Names for Subspecies and Species of African Primates

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Abstract: Approximately 1,000 English-language names have been used for African primates. Grubb *et al*. (2003) chose a single common name for each species (with a few exceptions) and for each subspecies. The present paper provides the opportunity to compare these preferred names with others published in the literature. The aim is to encourage primatologists to evaluate the choice of names, to assess the principles adopted in compiling the selective list, to amend this list where they see fit, preferably in appropriate publications, and to comment on the whole exercise.

Key Words: Common names, African primates, species, subspecies

Introduction

This paper lists published English-language common names for species and subspecies of African primates in a systematic format. The aim is to provide primatologists and zoologists with the opportunity to decide whether a particular name should be chosen for each taxon, and whether the list of names previously selected (Grubb *et al*. 2003) should be accepted or modified. Readers may question the principles adopted in compiling that list, the merits of making lists of common names at all, or the selection of what are supposed to be the best of these names.

The Compilation

English-language common names for species and subspecies of African primates were found in the references listed at the end of this paper. In Table 1, the names are listed as published, except for the following alterations:

- Even if the whole name was capitalized in the original, only proper nouns (and adjectives) are capitalized here, and then with some exceptions. Anubis, Diana, Magot, Malbrouck, Mangabey, Pluto, Satan, Tantalus, and Thoth are not capitalized as (parts of) primate names. In general English usage, the common names of animal species are not proper names and do not have capital initials. There are contexts in which it may be appropriate to regard species as individuals, but when a common name can be used in the plural, one cannot justify treating it as a proper name that therefore requires it to be capitalized. This is not to deny that species names are often capitalized in titles or headings. Some authors prefer to capitalize common names, and some serial publications require this to be done — no doubt for sound reasons.
- Corrections are made to misspelled surnames such as Bate, de Brazzae, Preussis, and Vleeschower (i.e., Bates, de Brazza, Preuss, and Vleeschowers).
- Possessive forms of personal names are standardized — Peters's, Pousargues's, or Sykes's instead of Peters', etc. Some authors avoid possessives in vernacular animal names, though I have found few instances among names of African primates, "Foa red colobus" (instead of Foa's) being an example.
- Gordons' instead of Gordon's for red or bay colobus, *Procolobus gordonorum*, because it was named after the brothers Von Gordon.
- Fernando Po instead of Fernando Poo as the old name of Bioko.
- Bush-baby instead of bushbaby or bush baby.
- Night-ape instead of night ape or nightape.
- Moholi galago instead of mohol galago for *Galago moholi*. The assumption is that "moholi" is a genitive form of a nominative "mohol," whereas it is actually a noun in apposition — a version of the Tsetswana moHwele or mogwêlê.

Names for each taxon are in alphabetical order and are followed by any names applied solely to what are now synonyms (with the synonym in parentheses). Such common names may come back into use if these synonymized taxa are restored to validity. Synonyms for which no common name has been proposed are not cited. Words or letters in parentheses are used in a name by some authors but not others. Taxonomy follows that proposed by Grubb *et al*. (2003). Some subspecies are regarded as full species in other publications. For example, Groves (2001) treated *Cercocebus galeritus sanjei* as *C. sanjei* and here I list it as *C. (galeritus) sanjei* to indicate the different opinions concerning its rank. The species *C. galeritus*, therefore, has a more extensive compass or *sensu lato*, and a more restricted compass or *sensu stricto*, for which authors have assigned different names (Table 1). I draw attention to names used for more than one taxon (other than species and their nominate subspecies) and names that imply occurrence in an area where the taxon has not been found. Names selected by Grubb *et al.* (2003) are in bold.

In compiling their list, Grubb *et al*. (2003) adopted principles and made decisions that were not recorded at the time but are listed here, as follows:

- Two or more names — not a single one — were provided for each of the following species: *Macaca sylvanus, Cercocebus atys, Cercopithecus aethiops, C. diana, C. campbelli, C. pogonias, C. mitis, Pan troglodytes,* and *P. paniscus*. Choice of a preferred name is not always easy. "Common" in animal names — such as "common chimpanzee" — may be interpreted as "abundant," particularly by those for whom English is not their first language, according to Duckworth and Pine (2003), who would avoid it. If instead "chimpanzee" were the preferred name for *Pan troglodytes*, and *P. paniscus* was called "pygmy chimpanzee," "chimpanzee" would refer as well to all *Pan* species. This ambiguity is also to be avoided, but if *P. paniscus* were called "bonobo," the difficulty would not arise. However, A. Kortlandt (in litt.) found objections to the use of "bonobo" as a common name — but "pygmy chimpanzee" is not literally descriptive, so need not be acceptable either. If a decision must be made, choice of "chimpanzee" and "bonobo" as preferred names may be the least objectionable option.
- Separate names for species and nominate subspecies were provided. A nominate subspecies has often been given the same common name as the species but while its status as a subspecies can still be identifiable — for instance, *Procolobus pennantii pennantii* could be "Pennant's red colobus (nominate race)," a separate name can be less ambiguous. Where a single polytypic species is partitioned into several species, the original common name may be abandoned because it becomes ambiguous and a new name is required — an erstwhile subspecies name. Thus when the gorilla was partitioned into two species, these became "western gorilla" and "eastern gorilla," and similarly the angwantibo became "Calabar angwantibo" and "golden angwantibo."
- Surnames of people commemorated in primate nomenclature were used in the possessive form (for example, Stuhlmann's blue monkey, not Stuhlmann blue monkey).
- Where appropriate, locality names were identified topographically (Bale Mountain grivet, not Bale grivet; or Omo River guereza, not Omo guereza).
- Adjectival forms of places were avoided (Angola black-and-white colobus, not Angolan black-and-white colobus).
- "Galago" was used in preference to "bush-baby."
- "Hamadryas" was chosen because it is now widely used, although the spelling in the Oxford English Dictionary is "hamadryad."
- "Monkey" was used in preference to "guenon."
- *Cercopithecus dryas* was called the dryad monkey. Dryad — not dryas — is the accepted spelling (Oxford English Dictionary).
- "Guereza" — an Ethiopian name for *Colobus guereza* — had been used as if it were a synonym of "colobus monkey" by Forbes (1894), Elliot (1913–1914) and Sanderson (1957), but nowadays is once again applied only to *C. guereza*.

A few changes from the original list (Grubb *et al*. 2003) are made here, as follows:

- The Uganda lesser galago (*Galago senegalensis sotikae*) is known only from the type locality (the Telek River, Sotik, in Kenya) so "Sotik lesser galago" (not "Sotik River galago") would be preferable.
- The Ibean yellow baboon (*Papio cyncephalus ibeanus*) is named after IBEA, an acronym of the short-lived Imperial British East Africa Company, with which this taxon has no particular association. "Northern yellow baboon" would be preferable.
- The western gelada (*Theropithecus gelada gelada*) and eastern gelada (*T. g. obscurus*) occur respectively in the northern and southern sectors of their species' range. "Northern gelada" and "southern gelada" would be preferable names.
- *Colobus guereza percivali* is called the Mt Uarges guereza, but Uaraguess is an approved spelling, so "Mt Uaraguess guereza" would be preferable.

Altogether there are approximately 1,000 English names for 174 species and subspecies of the African primate fauna.

Discussion

The prolixity of common names for African primates (Table 1) does not appear to arise from strong preferences or differences in opinion among naturalists but rather by a failure to follow precedent, leading to a clutter of permutations

Table 1. List of scientific and vernacular names for species and subspecies of African primates. The names listed in Grubb *et al.* (2003) are in bold type. See "The Compilation" for further explanation.

Scientific names of species and subspecies	Vernacular names
Galagos and lorises (b. = bush-baby; g. = galago)	
Galagoides demidovii	Demidoff's b. or g., **Demidoff's dwarf g.**, dwarf b. or g., Prince Demidoff's b. or g.; Fernando Po g. (*poensis*); mouse g., Murray's g. (*murinus*)
G. thomasi	Thomas's b. or g., **Thomas's dwarf g.**
G. orinus	Amani dwarf g., mountain g., **mountain dwarf g.**, Southern dwarf g., Uluguru b. or g., Usambara g.
G. rondoensis	Rondo b. or g., **Rondo dwarf g.**
G. zanzibaricus	eastern lesser g., Zanzibar dwarf g., **Zanzibar g.** or b., Zanzibar lesser b.; Matundu (dwarf) g., Udzungwa dwarf g., Uzungwa b. (*udzungwensis*)
G. cocos	Diani g., Diani small g., **Kenya coast g.**, Kenya coast dwarf g.
G. granti	Grant's b. or g., Grant's dwarf g., Grant's lesser b., Grant's night-ape, **Mozambique g.**, Newala small g.
G. nyasae	**Malawi g.** or b., Malawi lesser g.
G. sp. nov. 1	**Kalwe g.**, Kalwe dwarf g.
G. sp. nov. 2	**Mt Thyolo g.**, Mt Thyolo dwarf g.
G. sp. nov. 3	**Ukinga g.**, Ukinga dwarf g.
Galago senegalensis	bushbaby, lesser b. or g., **northern lesser g.** or b., Senegal b. or g.
G. s. senegalensis	Senegal b. or g., **Senegal lesser g.**; white-footed b. or g. (*albipes*)
G. s. dunni	Abyssinian g., Ethiopian b. or g., **Ethiopia lesser g.**, Ethiopian lesser g.
G. s. sotikae	Sotik River g., **Uganda lesser g. [rejected; replace by Sotik lesser g.]**, Ugandan lesser g.
G. s. braccatus	**Kenya lesser g.**, Kenyan lesser g., Mt Kilimanjaro g. [based on erroneous supposition that this was the type locality], yellow-thighed b. or g.
G. gallarum	Boran g., Somali b. or g., **Somali lesser g.**
G. moholi	bush-baby [also for *Otolemur crassicaudatus*], lesser b., maholi g., moholi b. or g., moholi lemur, night-ape, South African g., **southern lesser g.** or b.
G. m. moholi	moholi g., **moholi lesser g.**; Mozambique g. [also for *Galagoides granti*] (*mossambicus*)
G. m. bradfieldi	**Namibia lesser g.**, Namibian lesser g.
G. matschiei	dusky b., east needle-clawed b., eastern needle-clawed b. or g., eastern needle-nailed b., Matschie's b., needle-clawed g., spectacled g., **spectacled lesser g.**
Euoticus elegantulus	needle-clawed b. or g., **southern needle-clawed g**. or b., elegant needle-clawed g., western needle-clawed g.; Du Chaillu's g. (*apicalis*)
E. pallidus	**northern needle-clawed g.** or b., pale-colored g., pallid needle-clawed g.
E. p. pallidus	**Bioko needle-clawed g.**, pale g.
E. p. talboti	**Nigeria needle-clawed g.**
Sciurocheirus alleni	*sensu lato*: **Allen's g.**, Allen's squirrel g. *sensu stricto*: Allen's squirrel g., **Bioko Allen's g.** or b.
S. (alleni) cameronensis	Cameroon g., **Cross River Allen's b.**, Cross River b., Cross River squirrel g.; Bates's g. (*batesi*)
S. gabonensis	**Gabon Allen's g.** or b., Gabon squirrel g., Gabon b. or g.
S. sp. nov.	**Makande Allen's g.**
Otolemur garnettii	black g., Garnett's b. or g., Garnett's greater b. or g., greater b. [also used for *O. crassicaudatus*], northern greater g., small-eared g., **small-eared greater g.**
O. g. garnettii	black g., Garnett's b. or g., **Zanzibar small-eared g.**, Zanzibar Garnett's greater g.; dark-tailed g., komba g. (*agisymbanus*)
O. g. lasiotis	white-tailed Garnett's greater g., **white-tailed small-eared g.** or b., woolly-eared g.
O. g. panganiensis	Pangani b. or g., Pangani Garnett's greater g., **Pangani small-eared g.**
O. g. kikuyuensis	Kikuyu b. or g., Kikuyu Garnett's greater g., **Kikuyu small-eared g.**
O. crassicaudatus	brown greater g., bush-baby, fat-tailed b., grand b. or g., great g., greater b. or g., large-eared greater b. or g., large grey night-ape, thick-tailed b. or g., **thick-tailed greater g.**
O. c. crassicaudatus	grand b. or g., great g., greater b. or g., **South African thick-tailed g.**, South African thick-tailed greater g., thick-tailed b. or g.; dusky g. (*umbrosus*); Zulu g. (*zuluensis*)
O. c. kirkii	Kirk's g., **Tanganyika thick-tailed g.**, Tanganyika thick-tailed greater g.; bay g. (*badius*), Lönnberg's g. (*loennbergi*)
O. monteiri	Monteiro's g., silver g., **silver greater g.**, silvery greater g.
O. m. monteiri	**miombo silver g.**, miombo silver greater g., Monteiro's b. or g.
O. m. argentatus	**northern silver g.**, northern silver greater g., silvery b. or g.
O. sp. nov.	**Mwera greater g.** [status questionable]
Arctocebus calabarensis	angwantibo, awantibo, **Calabar angwantibo**, Calabar potto, golden potto [name also used for *A. aureus*]
A. aureus	**golden angwantibo**, (southern) golden potto
Perodicticus potto	Bosman's potto, **potto**
P. p. potto	(van) Bosman's potto, **western potto**; (south) Nigerian potto (*juju*)
P. p. edwardsi	Cameroon potto, **central potto**, Central African potto, Milne-Edwards's potto

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Table 1. *continued from previous page*

Scientific names of species and subspecies	Vernacular names
P. p. ibeanus	East African potto, **eastern potto**
Pseudopotto martini	false potto, long-tailed potto, Martin's false potto [taken to be a synonym of *Perodicticus potto edwardsi*]
Monkeys of the tribe Papionini (b. = baboon; ma. = mangabey)	
Macaca sylvanus	**Barbary ape, Barbary macaque**, magot, rock ape
Cercocebus galeritus	*sensu lato*: agile ma., crested ma., plain-headed ma., **river ma.** *sensu stricto*: crested ma., Peters' ma., Tana ma., **Tana River ma.**
C. (g.) agilis	**agile ma.**, olive ma.; Hagenbeck's ma. (*hagenbecki*)
C. (g.) sanjei	Sanje (crested) ma., **Sanje river ma.**
C. (g.) chrysogaster	**golden-bellied ma.**
C. atys	sooty ma., **sooty ma. or white-naped ma.**, spectacled ma.
C. a. atys	smoky ma., **sooty ma.**, Western sooty ma.
C. a. lunulatus	crescent-naped sooty ma., crowned ma., white-crowned ma., **white-naped ma.**
C. torquatus	capped ma., cherry-capped ma., collared ma., **red-capped ma.,** smoky ma., white ma., white-collared ma.
Mandrillus sphinx	**mandrill**; Fernando Po mandrill (*insularis*) [the species does not occur on Bioko = Fernando Po]; Gabonese mandrill, southern mandrill (*madarogaster*); northern mandrill (supposed nominate ssp. *sphinx*)
M. leucophaeus	**Drill**
M. l. leucophaeus	**mainland drill**, southern drill; Cameroon drill, northern drill (*mundamensis*)
M. l. poensis	**Bioko drill**, Fernando Po drill
Lophocebus albigena	Black ma. [name more usually given to *L. aterrimus*], crested ma. [also for *Cercocebus galeritus, L. aterrimus*], **grey-cheeked ma.**, grey-cheeked crested ma., mantled ma., white-cheeked ma.; Johnston's ma., Johnston's grey-cheeked crested ma., (*johnstoni*), Osman Hill's grey cheeked crested ma. (*osmani*); western grey-cheeked crested ma. (nominate *albigena*); Zenker's ma. (*zenkeri*)
L. aterrimus	*sensu lato*: **black ma.**, black crested ma., crested ma., peaked ma. *sensu stricto*: black ma., black crested ma. [also for *Cercocebus galeritus, L. albigena*], Congo ma., **northern black ma.**, northern black crested ma., tufted ma., typical black ma.
L. (a.) opdenboschi	black-cheeked black ma., Opdenbosch's black crested ma., Opdenbosch's (crested) ma., **Southern black ma.**
Papio cynocephalus	*sensu lato* or *sensu stricto*: **yellow b.**
P. c. cynocephalus	eastern yellow b., **central yellow b.**, typical yellow b.; baboon (*babouin*); dwarf chacma, Zambian dwarf chacma b. (*jubilaeus*); Langheld's b. (*langheldi*); Nyasa yellow b., southern yellow b. (*strepitus*); thoth (b.) (*thoth*)
P. c. ibeanus	northern yellow b., Ibean b., **Ibean yellow b. [rejected; replace by northern yellow b.]**
P. (c.) kindae	western yellow b., Kinda b., **Kinda yellow b.**, Rhodesian long-armed b.
P. ursinus	*sensu lato*: **chacma**, chacma b., pig-tailed b., South African b. *sensu stricto*: Cape chacma (b.), chacma b., **southern chacma**; eastern Cape b., eastern chacma b. (*orientalis*); Transvaal chacma b. (*occidentalis*); Kalahari b. or chacma, Shortridge's chacma b., western chacma b. (*ruacana*)
P. (u.) griseipes	**grey-footed chacma** (b.), Rhodesia b., Rhodesian chacma (b.); Botswana chacma b. (*chobiensis*)
P. anubis	anubis b., doguera b., **olive b.**; Abyssinian b, Ethiopian olive b., doguera b. (*doguera*); Baringo b., Rift Valley b., western Kenya olive b. (*furax*); Congolese olive b. (*tesselatus*); East African olive b., Neumann's (olive) b. (*neumanni*); Nigeria b. (*nigeriae*); West African anubis b. (nominate *anubis*); western olive b. Heuglin's (olive) b., Sudanese b. (*heuglini*)
P. papio	**Guinea b.**, papion, western b.
P. hamadryas	Arabian b., hamadryad, hamadryas, **hamadryas b.**, mantled b., sacred (Anubis) b.
Theropithecus gelada	**gelada** (b.)
T. g. gelada	common gelada, northern gelada, **western gelada [rejected; replace by northern gelada]**
T. g. obscurus	dusky gelada, **eastern gelada [rejected; replace by southern gelada]**, southern gelada
Monkeys of the tribe Cercopithecini (g. = guenon; m. = monkey)	
Allenopithecus nigroviridis	Allen's baboon-like m., Allen's m., **Allen's swamp m.**, blackish-green g., swamp g.
Miopithecus talapoin	Angola(n) talapoin, dwarf g., mangrove m., southern talapoin, **southern talapoin m.**; Angola talapoin, Ansorge's talapoin (*ansorgei*); common talapoin, Gabon talapoin [does not occur in Gabon] (supposed nominate ssp. *talapoin*); Ruwenzori talapoin (*pilettei*) [does not occur on the Ruwenzori Mountains]; Vleeschouwers's talapoin, Zaire talapoin (*vleeschowersi*)
M. ogouensis	Gabon talapoin, northern talapoin, **northern talapoin m.**
Erythrocebus patas	hussar m., military m., patas, **patas m.**, nisnas m., red m.; Aïr patas (m.), Aïr red m. (*villiersi*); black-nosed patas, patas g. or m., West African patas (m.), West African red m. (nominate *patas*); Blue Nile hussar m., dancing red m., Nile patas (m.), nisnas (g.), nisnas m., (*pyrrhonotus*); Ikoma patas (m.) (*baumstarki*)
Cercopithecus aethiops	*sensu lato*: green m., grey vervet, grivet, savanna m., vervet (m.); including **green, malbrouck, and tantalus monkeys, grivets, and vervets** *sensu stricto*: common grivet m., Ethiopian grivet, **grivet** (g. or m.), tota; Abyssinian grivet, Abyssinian vervet m., Hilgert's grivet (*hilgerti*); Matschie's grivet or g., Matschie's grivet m., (*matschiei* [or *ellenbecki*])
C. (a.) djamdjamensis	Bale (Mountains) m., **Bale Mountains grivet** or vervet, Djamdjam grivet or g.
C. (a.) tantalus	**tantalus m.** or g.; Jebel Marra tantalus (m.) (*marrensis*); Budgett's tantalus (m.) (*budgetti*)
C. (a.) sabaeus	callithrix, **green m.** or g.; Werner's g. (*werneri*)

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Table 1. *continued from previous page*

Scientific names of species and subspecies	**Vernacular names**
C. (a.) pygerythrus	common vervet, **vervet**, vervet g. or m.; black-chinned vervet, Cuvier's vervet, South African vervet, southern vervet m., vervet (g.) (nominate *pygerythrus*); black-faced vervet, Bukoba green m. (*centralis*); Cloet's vervet (*cloeti*); de Beaux's grivet (*zavattarii*); desert tumbuli m., Heller's vervet, northeastern vervet (*arenarius*); East African vervet, yellow m. (*johnstoni*); Isle of Patta vervet, Manda vervet (m.) (*excubitor*); Mozambique g. or m. [same name for *C. mitis erythrarchus*], reddish-green g., russet-green or russety-green vervet (*rufoviridis*); Naivasha vervet (*callidus*); Namaqualand vervet (*marjoriae*); Okavango vervet (*ngamiensis*); Pemba vervet (m.), Zanzibar vervet (*nesiotes*); Whyte's vervet (*whytei*)
C. (a.) cynosuros	malbrouck (g.), **malbrouck m.**; Cunene vervet (*helvescens*);
C. lhoesti	east Congo l'Hoest's m., l'Hoest's g., **l'Hoest's m.**, mountain g. or m.
C. preussi	Cross's m., **Preuss's m.** or g.
C. p. preussi	mainland Preuss's g., **Preuss's m.**
C. p. insularis	**Bioko Preuss's m.** or g., Fernando Po l'Hoest's m. [but not a subspecies of *C. lhoesti*]
C. solatus	**sun-tailed m.**, sun-tailed g.
C. diana	*sensu lato*: diana g. or m., **diana and roloway monkeys** *sensu stricto*: diana (g.), **diana m.,** typical diana m.
C. (d.) roloway	**roloway m.**, roloway diana m.; palatine g. (*palatinus*)
C. dryas	Congo diana m., **dryad m.**, dryas g., dryas m.; salongo g. or m., Zaire diana g. or m. (*salongo*)
C. neglectus	chestnut-browed g., neglectus m., Schlegel's g.; Brazza's m., **de Brazza's m.** or g. (*brazzae*)
C. campbelli	*sensu lato*: Campbell's m., **Campbell's and Lowe's monkeys** *sensu stricto*: Campbell's mona, g., or m.
C. (c.) lowei	Lowe's mona or g., Lowe's mona m., **Lowe's m.**
C. mona	mona g., **mona m.**, mone, typical mona m.
C. pogonias	*sensu lato*: **crowned and Wolf's monkeys** *sensu stricto*: bearded g. or m., crested mona (m.), **crowned m.** or g., golden bellied g.
C. p. pogonias	bearded g. or m., crowned g., crowned mona m., **golden-bellied crowned m.** or g.
C. p. nigripes	**black-footed crowned m.** or g., black-footed g., black-footed mona (m.)
C. p. grayi	Erxleben's g., **Gray's crowned m.** or g., Gray's g., Gray's mona (m.); white-crowned g. (*petronellae*)
C. (p.) denti	Dent's mona or g., Dent's mona m., **Dent's m.**
C. (p.) wolfi	Wolf's mona or g., Wolf's mona m., **Wolf's m.**
C. p. or *w. wolfi*	Wolf's mona or g., Wolf's mona m., **Congo Basin Wolf's m.** or g.
C. p. or *w. elegans*	elegant mona (m.), **Lomami River Wolf's m.** or g.
C. p. or *w. pyrogaster*	fire-bellied g., **fire-bellied Wolf's m.** or g., red-bellied mona or g.
C. hamlyni	Hamlyn's g. or m., Hamlyn's owl-faced m., owl-faced g., **owl-faced m.**
C. h. hamlyni	Hamlyn's owl-faced g., **nose-stripe owl-faced m.**
C. h. kahuziensis	**Mt Kahuzi owl-faced m.** or g.
C. petaurista	**lesser spot-nosed m.** or g., lesser white-nosed g. or m., spot-nosed m., white-cheeked hocheur
C. p. petaurista	lesser white-nosed g. or m., **eastern lesser spot-nosed m.** or g., typical lesser white-nosed g., white-cheeked hocheur
C. p. buettikoferi	Büttikofer's g. or m., Büttikofer's white-nosed g., Büttikofer's lesser white-nosed g., **western lesser spot-nosed m.** or g.
C. signatus	Jentink's g., Jentink's white-nosed m. [supposedly of hybrid origin; it has been thought—perhaps wrongly—that *C. erythrogaster* is one of the parental forms]
C. erythrogaster	red-bellied g. or m., white-throated g., **white-throated m.** [names also used for *albogularis* section of *C. mitis*]
C. e. erythrogaster	**red-bellied m.** or g., red-bellied white-throated g.
C. e. pococki	**Nigeria white-throated m.**, Nigerian white-throated g.
C. sclateri	**Sclater's m.** or g., Sclater's white-nosed g. or m.
C. erythrotis	red-eared g., **red-eared m.**, red-eared nose-spotted g. or m., russet-eared g., russet-eared nose-spotted g.
C. e. erythrotis	**Bioko red-eared m.**, Bioko russet-eared g., Fernando Po red-eared g., Fernando Po russet-eared g.
C. e. camerunensis	**Cameroon red-eared m.** or g., Cameroon russet-eared g.
C. cephus	moustach m., moustache, moustached g., (true) **moustached m.**, mustached m.
C. c. cephus	blue-faced m., moustached m., **red-tailed moustached m.** or g.
C. c. cephodes	**grey-tailed moustached m.** or g.
C. c. ngottoensis	Ngotto moustached m. or g., **white-nosed moustached m.**
C. ascanius	black-cheeked white-nosed m., coppertail m., redtail (m.), **red-tailed m.** or g., white-nosed m.; black-cheeked g. or hocheur (*melanogenys*)
C. a. ascanius	**black-cheeked red-tailed m.** or g., black-cheeked white-nosed m.
C. a. schmidti	Schmidt's g. or m., **Schmidt's red-tailed m.** or g., Uganda red-tailed g. or m.; montane red-tailed g. (*montanus*)
C. a. whitesidei	Whiteside's g. or m., yellow-nosed m., **yellow-nosed red-tailed m.** or g.
C. a. katangae	Katanga black-cheeked white-nosed m., **Katanga red-tailed m.** or g.

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Table 1. *continued from previous page*

Scientific names of species and subspecies	Vernacular names
C. a. atrinasus	black-nosed m., **black-nosed red-tailed m.** or g.
C. nictitans	greater spot-nosed m. or g., greater white-nosed g. or m., hocheur (g or m.), **putty-nosed m.** or g., spot-nosed m., white-nosed g. or m.
C. n. nictitans	**Eastern putty-nosed m.**, Eastern greater spot-nosed g., greater white-nosed m., hocheur (g.)
C. m. martini	blackish hocheur, Martin's g., Martin's putty-nosed m., Martin's white-nosed g. or m.; ludio g. or m., white-chested hocheur (*ludio*); **Stampfli's putty-nosed m.**, Stampfli's greater spot-nosed g., Stampfli's g. (*stampflii*)
C. (mitis) mitis	*sensu lato*: blue m, diademed g. or m., gentle m., mitis m., samango m.; including **blue m., Sykes's m., golden m., and samango** *sensu stricto*: blue m., diademed g.; Carruthers's g. (*carruthersi*)
C. m. heymansi	**Lomami River blue m.**, Lomami River diademed g., Zaire Basin gentle m.
C. m. mitis	Angolan diademed g.; diadem (g. or m.), diademed g. or m. (*leucampyx*); black-bellied m., pluto diademed g., **pluto m.** (*pluto*)
C. m. opisthostictus	**rump-spotted blue m.**, rump-spotted (diademed) g.
C. m. boutourlinii	**Boutourlini's blue m.**, Boutourlini's (diademed) g.
C. m. stuhlmanni	blue m., Stuhlmann's diademed g., Stuhlmann's g. or m., **Stuhlmann's blue m.**; Congo diademed g., Maes's g. (*maesi*); Mt Elgon diademed g. (*elgonis)*
C. m. schoutedeni	**Schouteden's blue m.**, Schouteden's diademed g., Schouteden's g. or m.
C. (mitis) doggetti	Ankole blue m., Doggett's g., **silver m.** or g.
C. (mitis) kandti	bamboo m., Congo red m., **golden m.** or g., red Congo m.; orange-colored g. (*insignis*)
C. (mitis) albogularis	*sensu lato* (*albogularis* section of *C. mitis*): **s**amango, Sykes's m. or g., white-throated g. *sensu stricto*, as a ssp.: blue m. [also the name for other sections of the species, *sensu lato*], Sykes's m., white-throated g., **Zanzibar Sykes's m.** or g., Zanzibar white-throated g.; Kilimanjaro blue m., Kilimanjaro Sykes's g. (*kibonotensis*);
C. m. or *a. albotorquatus*	Pousargues's white-throated g., **Pousargues's white-collared m.**, Tana River Sykes's g.; Patta Island Sykes's g., Patta Island white-throated g. (*phylax*); Somali Sykes's g., Zammarano's white-throated g. (*zammaranoi*)
C. m. or *a. kolbi*	Kolb's g. or m., **Kolb's white-collared m.**, Mt Kenya Sykes's m. or g., Mt Kenya white-throated g., Sykes's m.
C. m. or *a. monoides*	maritime white-throated g. or m., Tanganyika Sykes's m., **Tanzania Sykes's m.**, Tanzanian Sykes's g.
C. m. or *a. francescae*	northern Malawi blue m., **red-eared Sykes's m.** or g.
C. m. or *a. erythrarcus*	Mozambique m., red-rumped Sykes's g.; Beira g. or m. (*beirensis*); Nyasa white-throated g. (*nyasae*); Stairs' g. or m., **Stairs's white-collared m.** (*stairsi*); Transvaal Sykes's g., Transvaal white-throated g. (*schwarzi*)
C. m. or *a. labiatus*	white-lipped g., white-lipped Sykes's g.; **samango**, samango g. or m. (*samango*)
C. (mitis) moloneyi	Lake Malawi Sykes's g., Moloney's g. or m., **Moloney's white-collared m.**
Monkeys of the subfamily Colobinae (c = colobus [or colob — archaic]; c.m. = colobus monkey; m = monkey; r. c. = red colobus)	
Procolobus verus	**olive c.** or c.m., Van Beneden's c. or guereza
P. badius	bay c. or c. m., Guinea Forest r. c., red c., **western r. c.**
P. b. badius	bay c. or guereza, **upper Guinea r. c.**
P. b. temminckii	**Temminck's r. c.**, Temminck's c. or guereza; fuliginous guereza (*fuliginosus*)
P. b. waldroni	**Miss Waldron's r. c.**, Miss Waldron's (bay) c.
P. pennantii	**Pennant's r. c.**, Pennant's c. m. or guereza, West Central African r. c.
P. p. pennantii	**Bioko r. c.**, Pennant's c. or r. c.
P. p. bouvieri	**Bouvier's r. c.**, Bouvier's c.
P. p. epieni	Delta r. c., **Niger Delta r. c.**
P. (pennantii) preussi	Cameroon r. c., Preuss c., Preuss's c., **Preuss's r. c.**
P. foai	*sensu lato*, including the following eight taxa, or *sensu stricto* including only the following six taxa: Central African r. c. [systematic status uncertain]
P. f.? oustaleti	**Oustalet's r. c.** or guereza; Powell-Cotton's c. (*powelli*) [almost the same name used for *Colobus angolensis cottoni*]
P. f.? parmentieri	**Lomami River r. c.**, Lomami r. c.
P. f.? foai	Foa's c. or r. c., **Kivu r. c.**
P. f.? ellioti	Elliot's c. or c.m. or r. c.; (*semlikiensis*) **Semliki r. c.**
P. f.? lulindicus	**Lulindi River r. c.**
P. f.? langi	**Kisangani r. c.**
P. (f.?) tholloni	Thollon c., Thollon's r. c., **Tshuapa r. c.**
P. (f.?) tephrosceles	**ashy r. c.**, bay Uganda r. c., Ugandan c., Ugandan r. c.
P. rufomitratus	red-crested guereza, **Tana River r. c.** [eastern r. c., if it includes *P. foai sensu lato*]
P. gordonorum	Gordons' r. c. or bay c., Iringa r. c., **Udzungwa r. c.**, Uhehe r. c., Uzungwa r. c.
P. kirkii	Kirk's c. or guereza, **Kirk's r. c.**, Zanzibar r. c.
Colobus satanas	**black c.** or guereza, satan c., satanic c., satanic black c.
C. s. satanas	**Bioko black c.**
C. s. anthracinus	**Gabon black c.**
C. angolensis	**Angola**(n) **c.**, Angola black-and-white c., Angolan c. or guereza, Angola pied c., Angolan black c., Angolan black-and-white c. (m.), white-epauletted black c.

continued on next page

Table 1. *continued from previous page*

Scientific names of species and subspecies	Vernacular names
C. a. angolensis	Angolan c. or guereza, mantled c., **Sclater's Angola**(n) **c.**
C. a. palliatus	**Peters's Angola**(n) **c.**, Tanzanian black c.; Sharpe's guereza (*sharpei*)
C. a. ruwenzorii	**Adolf Friedrichs's Angola**(n) **c.**, Kivu black c., Ruwenzori c.
C. a. cottoni	Cotton's c., **Powell-Cotton's Angola**(n) **c.**, Powell-Cotton's black c.
C. a. cordieri	**Cordier's Angola**(n) **c.**, Cordier's black c., Cordier's c.
C. a. prigoginei	**Prigogine's Angola**(n) **c.**, Prigogine's black c., Prigogine's c.
C. a. ssp. nov.	**Mahali Mountain Angola**(n) **c.**
C. polykomos	full-bottom m., **king c.** or m., Western black-and-white c., Western pied c.; ursine c. or guereza (*ursinus*)
C. vellerosus	Geoffroy's black-and-white c., Geoffroy's pied c., ursine c. [more usually applied to *C. polykomos*?], **white-thighed c.** or guereza, white-thighed black-and-white c., white-throated guereza; Dollman's (black-and-white) c. is a hybrid with *C. polykomos*
C. guereza	Abyssinan black-and-white c. (m.), Abyssinian c., (eastern) black-and-white c., **guereza**, guereza c., guereza black-and-white c., magistrate c., magistrate black c., mantled guereza, white-mantled c.
C. g. occidentalis	Congo guereza, magistrate c., **Western guereza**
C. g. dodingae	**Dodinga Hills guereza**
C. g. matschiei	Matschie's c., **Mau Forest guereza**
C. g. guereza	Abyssinian guereza, guereza, **Omo River guereza**, Rüppell's guereza, typical guereza; greyish-white-tailed guereza (*poliurus*)
C. g. gallarum	Neumann's (black) c., **Djaffa Mountains guereza**
C. g. percivali	**Mt Uarges guereza [rejected; replace by Mt Uaraguess guereza]**
C. g. caudatus	Kilimanjaro guereza or c., **Mt Kilimanjaro guereza**, white-tailed c. or guereza
C. g. kikuyuensis	**Mt Kenya guereza** or c.
Apes, Hominidae	
Gorilla gorilla	**western gorilla**
G. g. gorilla	coast gorilla, lowland gorilla, western gorilla, **western lowland gorilla**
G. g. diehli	**Cross River gorilla**
G. beringei	**eastern gorilla**
G. b. beringei	eastern gorilla, eastern highland gorilla, **mountain gorilla**
G. b. graueri	eastern lowland gorilla, **Grauer's gorilla**
Pan troglodytes	chimpanzee, common chimpanzee, **robust or common chimpanzee**
P. t. verus	common chimpanzee, masked chimpanzee, pale-faced chimpanzee, true chimpanzee, Upper Guinea chimpanzee, **western chimpanzee**
P. t. vellerosus	**Nigeria chimpanzee**, Nigerian chimpanzee
P. t. troglodytes	black chimpanzee, black-faced chimpanzee, **central chimpanzee**, Central African chimpanzee, choga, common chimpanzee, Lower Guinea chimpanzee, tschego, western chimpanzee; bald chimpanzee (*calvus*); gorilla-like chimpanzee, koolakamba (*koolokamba*)
P. t. schweinfurthii	long-haired chimpanzee, **eastern chimpanzee**, Schweinfurth's chimpanzee
P. t. marungensis	Marunga Mountains chimpanzee
P. paniscus	bonobo, **bonobo, gracile or pygmy chimpanzee;** dwarf chimpanzee, lesser chimpanzee, pygmy chimpanzee

and combinations. Some authors have treated nouns attributively so as to inform us of the group of animals to which they refer (e.g., samango monkey or gelada baboon) while others see no need for this (e.g., samango or gelada). Other sources of diversity include alternative stem-words (galago or bush-baby, guenon or monkey), forms of qualifiers (Angola or Angolan, moustache or moustached), neologisms without a long history in the literature and often cited as alternative names (mitis monkey, neglectus monkey), abandoned names (colob), and possible unawareness that common names have already been provided (fire-bellied Wolf's monkey or red-bellied mona for the same taxon).

Zoologists have rejected some common names for animals as misleading or unsuitable because they do not conform to their chosen principles. Where it has seemed appropriate, they have provided new names. Primatologists could follow these precedents. Acting alone, collectively, or institutionally—for instance in a committee—they could recommend which common names are to be quoted in publications on primates. From published sources they could select a leading common name for each species and recommend that it take precedence where a range of names is cited or that it is to be the sole name cited. Corbet and Hill (1991), R. W. Hayman's translation of Haltenorth and Diller (1980), Wilson and Cole (2000), Groves (2001, 2005), and Duff and Lawson (2004) have already selected single names for African primate species.

Common names for African primate subspecies have not been used very frequently. Authors have not published common names for all the subspecies to which they refer in systematic compilations (for example, Elliot 1913–1914; R. W. Hayman's translation of Haltenorth and Diller 1980; Napier 1981). Grubb *et al*. (2003) provided a complete list of subspecies names (Table 1). Some subspecies names are modified species names (*western* potto, *Kinda* yellow baboon), but if all were formed in this way, they could become too long (e.g., *white-tailed* small-eared greater galago). Other subspecies names in general use are not modified species names (e.g., white-naped mangabey, Moloney's monkey, roloway monkey). If subspecies names were altered so that they were all modified versions of species names, there would be adverse consequences. The numerous changes required would further burden the stock of published common names, and every alteration in taxonomic rank would require yet another name change.

Some authors (e.g., Duckworth and Pine 2003) prefer common names to be applied only to species, not to subspecies, on the grounds that the public may be misled or may draw false inferences about systematics, hampering their appreciation of taxonomy — subspecies could be thought to be species. However, there are positive reasons for using common names for subspecies. They could contribute to the conservation of these taxa by helping to make them more widely recognized by the public in popular articles, posters and films — as in the case of Miss Waldron's red colobus (see McGraw 2005). Using appropriate common names would more precisely identify primate taxa in contexts where scientific names of subspecies would not be appropriate. It is useful to have names for other subspecies (Table 1) should they be required for publicity material, for legends to illustrations, or for cases in which subspecies are raised to species status. If species were to be recognized as the smallest diagnosable assemblages of interbreeding organisms (Groves 2001), according to the phylogenetic-species definition ("phylogenetic species-concept"), many common names for subspecies would be needed as names for species.

Conclusions

The preferred names of species and subspecies in Table 1 and Grubb *et al.* (2003) could be regarded as a recommended list. However, conformity with this or any other list — if desired — can only be achieved through consensus. I do not wish to assert which names should be selected. Readers can see what common names have been used for African primates and, if they wish, decide which names they would prefer to use. They may not agree with some of the choices of recommended names or with some of the principles employed in their selection. They may choose different names out of the alternatives listed in Table 1 or they may wish to create some entirely new names. If the latter, it would be desirable if they explained their reasons and remembered that new names increase the load of vernacular nomenclature in the literature. More discussion on the common names to be adopted for primates is probably desirable. It would be interesting to know of the diversity of common names of primates in French, German, and other languages. To the extent that English is an international language of science, it would be desirable to achieve more stability for English-language common names.

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Geospecies and Superspecies in the African Primate Fauna

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Abstract: Primate taxa in Africa (and elsewhere) are not randomly distributed. Most are dispersed in monophyletic groups of allopatric taxa, termed superspecies, but some species cannot be allocated to superspecies because any allopatric sister species that once existed are now extinct. These two categories — superspecies and species not assignable to superspecies — are together termed geospecies. African primates belong in 33 geospecies. The number of geospecies is an index of the continent's faunal diversity and in that sense is the highest of all primate faunas, with implications for conservation strategy.

Key Words: African primates; geospecies; species; superspecies.

Introduction

Species of many kinds of animal are distributed in an ordered fashion — they tend to be represented by vicarious taxa as their phylogenetically nearest allies. The largest monophyletic lineages of allopatric species are called superspecies, a category familiar to ornithologists (Amadon 1966) and cited in the Code of Zoological Nomenclature (ICZN 1999: Article 6.2). The name of a superspecies is based on the oldest name among its included species, following the principle of priority (ICZN 1999). Mayr (1963, p.499) defined the superspecies as "a monophyletic group of entirely or essentially allopatric species that are morphologically too different to be included in a single species."

Not all species are parts of superspecies. Species that are not parts of superspecies, together with superspecies, nevertheless represent similar zoogeographical entities; each of them contributes no more than one taxon to a local fauna, no matter how little or how much they may have proliferated by cladogenesis. They were given the collective term "zoogeographical species" by Mayr and Short (1970, p.3), who stated (their emphasis) that "When several species comprise a superspecies, they are counted as *one* zoogeographical species just as is each individual species not forming part of a superspecies." The term "zoogeographical species" has now been shortened to "geospecies" (Eck 1996). A superspecies is no more than a variety of geospecies.

This paper considers the allocation of African primates (and others) to superspecies and geospecies. Illustrating how a primate superspecies is named, the example including moustached and lesser spot-nosed monkeys (#27 in Table 1) is the *Cercopithecus cephus* superspecies because *cephus* dates from 1758 and the other names of included species date from 1774 to 1904 (Groves 2001). The Code of Zoological Nomenclature (ICZN 1999) recommends that this naming should be formalized as "*Cercopithecus* (superspecies *cephus*)," and a species in this superspecies — for example, *C. erythrotis* — can be termed "*Cercopithecus (cephus) erythrotis*," but I am not sure how popular these practices would be among primatologists, and they are not mandatory. A geospecies can be named from its unique genus or sole constituent species (e.g., *Allenopithecus* geospecies or *A. nigroviridis* geospecies) or from its oldest included species name (e.g., *Cercopithecus cephus* geospecies).

Methods

The taxonomy of the African primates, including the number of species and subspecies (Table 1), follows that of Grubb *et al*. (2003). Additional genera and species recognised by Groves (2001, 2005) and Cotterill (2003) as well as the genus *Allochrocebus* (discussed in Grubb *et al*. 2003) are listed in parentheses (Table 1). Grubb *et al*. (2003) did not agree on how to allocate taxa to species in the genus *Procolobus* [*sensu lato*] from Central and East-Central Africa, and they are here provisionally allocated to *P. tholloni*. An unnamed species of *Otolemur* is no longer included in the list (S. K. Bearder, pers. comm.), while *Pan troglogytes* *marungensis* (Groves in press) is added to the list. A new species has recently been named as *Lophocebus kipunji* Ehardt, Butynski, Jones and Davenport, 2005 (in Jones *et al*. 2005), raising the total of species and subspecies to 175.

For the purposes of discussion, I use the classification of Groves (2001, 2005) and Brandon-Jones *et al.* (2004) for non-African primates, augmented by additional genera recognized by Rylands *et al*. (2000). In lists of genera, the dagger — † — indicates those in which all species or (in parentheses) only some became extinct in the Holocene within the Malagasy and Caribbean faunas.

By inspecting distribution maps (reviewed by Grubb in prep.) and the systematic literature (Groves 2001) it is possible to identify superspecies (as defined above) and those species that cannot be allocated to superspecies, both in Africa and in other continents. There appears to be no serious controversy about the relationships of African primates that could lead to changes in the categorization in this paper, but further systematic studies, particularly of galagos and *Cercopithecus dryas*, will possibly require some careful reconsideration.

Superspecies are lineages whose limits are determined by phylogeny and geography, not by species definitions or concepts, or by age. Students of primatology, therefore, may not wish to regard them as part of conventional taxonomy and classification. Indeed, there are indications that some superspecies outside Africa include more than one genus, so the category is not necessarily part of the hierarchy of classification.

Results and Conclusions

There are 20 to 22 primate superspecies in Africa, depending upon the species list adopted (Table 1). Therefore, 152 to 160 out of 175 species and subspecies are allocated to superspecies and only 15 to 23 taxa are not so allocated. Some superspecies have been recognized as such or have been called "species groups" (Grubb 1990) or simply "groups" (Grubb *et al*. 2003), though not all species groups are superspecies. The categorization of superspecies does not disturb the taxonomy of Grubb *et al*. (2003) except in the case of East African *Galagoides* species. Here I follow Groves' (2005) species-groups and allocate these to two superspecies — #3, the smaller galagos of the *G. orinus* superspecies; and #4, the somewhat larger galagos of the *G. zanzibaricus* superspecies, formerly included in a single species (Table 1).

Apart from the superspecies of African primates, there are three polytypic species with subspecies that have not so far been elevated to species rank, and eight monotypic species. None of these 11 species have allopatric sister taxa. They cannot be included in any superspecies, but nevertheless can be ranked with them as geospecies. Altogether there are 33 geospecies of African primates (Table 1). References to geospecies are most likely to be made when the whole primate fauna is being considered. Use of the term superspecies rather than geospecies depends on context.

Seventeen genera (Table 1, in bold) are coextensive with African primate geospecies and the figure is raised to 21 out of a total of 24 if *Chlorocebus*, *Allochrocebus*, and *Piliocolobus* are ranked as genera and *Procolobus* hence becomes restricted to *P. verus*. *Galagoides* and *Cercopithecus* are the only other genera including more than one African geospecies. *Macaca* includes non-African geospecies. There is apparently a tendency for both genera and geospecies to evolve over the same time span and to be of equivalent age. Genera such as *Cercopithecus* with several geospecies may have evolved differently from other genera, perhaps relatively more rapidly.

Like their constituent superspecies, geospecies are parts of lineages the limits of which are not determined by species definitions or species concepts, but by geography. Geospecies are lineages passing through an evolutionary history from the stage when they have lost allopatric sister-taxa through extinction, to the stage when they have proliferated by cladogenesis, but not so far that daughter taxa have yet become sympatric.

The "species group" (e.g., in Groves 2001; Grubb *et al*. 2003) may seem to be a similar category to the geospecies. Indeed, designated species groups include not only some superspecies but also single species lacking allopatric sister-taxa (e.g., the single species in the *Cercopithecus neglectus* species group). Species groups of African primates recognized by Grubb (1990) were effectively geospecies. Nevertheless, designated species groups are usually divisions of genera and the term is not generally used where genera are monospecific, or where there is no apparent need to recognize subdivisions among a series of congeneric species. Thus, systematists would not allocate all primate species to species groups. Species groups have not been defined, do not necessarily correspond with geospecies, have not clearly been distinguished from subgenera, and may include sympatric species — at least among non-primates. Perhaps the species group can be identified as a monophyletic division of a genus, part of conventional systematics, though Mayr (1963, p.501) preferred to restrict the term to monophyletic aggregates of species that were not all allopatric.

Primate geospecies can be recognized outside Africa. The 29 genera *Alouatta, Aotus,* †*Archaeolemur*, *Ateles*, *Avahi, Brachyteles, Cacajao, Callithrix, Chiropotes,* (†)*Daubentonia, Hylobates, Lagothrix*, *Leontopithecus*, *Lepilemur*, *Loris*, †*Megaladapis*, †*Mesopropithecus*, *Mico*, *Mirza*, *Nomascus*, *Phaner*, *Pithecia*, *Pongo*, *Propithecus*, *Pygathrix*, *Rhinopithecus*, *Saimiri*, *Semnopithecus*, and (†)*Varecia* are superspecies and therefore also geospecies. Some subgenera or groups of species designated within the seven genera *Callicebus*, *Cebus*, *Cheirogaleus*, *Macaca*, *Saguinus*, *Tarsius,* and *Trachypithecus* are superspecies. *Allocebus*, †*Antillothrix*, †*Archaeoindris*, †*Babakotia*, *Callibella*, *Callimico*, *Cebuella*, †*Hadropithecus*, *Hoolock*, *Indri*, *Lemur*, *Nasalis*, *Oreonax*, †*Palaeopropithecus*, *Prolemur*, *Simias*, *Symphalangus,* and †*Xenothrix* are 18 monospecific genera whose species hence lack vicarious representatives and are therefore also geospecies. This leaves the five genera *Eulemur*, *Hapalemur*, *Microcebus*, *Nycticebus,* and *Presbytis* for which species groups or superspecies have not been identified and for which new sys-

Table 1. List of African primate species allocated to 33 geospecies. Genera in bold are coextensive with geospecies. "Number of taxa" is the number of species and subspecies in each geospecies.

Senior species names in 33 geospecies	Other species included in geospecies	Number of taxa
1. *Galagoides demidovii*		1
2. *G. thomasi*		1
3. *G. orinus*	*G. rondoensis*	2
4. *G. zanzibaricus (G. udzungwensis)*	*G. cocos*, *G. granti*, *G. nyasae*, *G.* sp. nov 1., *G.* sp. nov. 2, *G.* sp. nov. 3	7
5. ***Galago*** *senegalensis*	*G. gallarum*, *G. matschiei*, *G. moholi*	8
6. ***Euoticus*** *elegantulus*	*E. pallidus*	3
7. ***Sciurocheirus*** *alleni (S. cameronensis)*	*S. gabonensis*, *S.* sp. nov.	4
8. ***Otolemur*** *crassicaudatus*	*O. garnettii*, *O. monteiri*	8
9. ***Arctocebus*** *calabarensis*	*A. aureus*	2
10. ***Perodicticus*** *potto*		3
11. *Macaca sylvanus*		1
12. ***Cercocebus*** *torquatus*	*C. atys*, *C. galeritus (C. agilis*, *C. chrysogaster*, *C. sanjei)*	7
13. ***Mandrillus*** *sphinx*	*M. leucophaeus*	3
14. ***Lophocebus*** *albigena*	*L. aterrimus (L. opdenboschi)*, *L. kipunji*	4
15. ***Papio*** *cynocephalus (P. kindae)*	*P. anubis*, *P. hamadryas*, *P. papio*, *P. ursinus (P. griseipes)*	8
16. ***Theropithecus*** *gelada*		2
17. ***Allenopithecus*** *nigroviridis*		1
18. ***Miopithecus*** *talapoin*	*M. ogouensis*	2
19. ***Erythrocebus*** *patas*		1
20. *Cercopithecus* (or ***Chlorocebus***) *aethiops (C. cynosuros*, *C. djamdjamensis*, *C. pygerythrus*, *C. sabaeus*, *C. tantalus)*		6
21. *Cercopithecus* (or ***Allochrocebus***) *preussi*	*C. lhoestii*, *C. solatus*	4
22. *Cercopithecus diana (C. roloway)*		2
23. *C. dryas*		1
24. *C. neglectus*		1
25. *C. mona*	*C. campbelli (C. lowei)*, *C. pogonias (C. denti*, *C. wolfi)*	10
26. *C. hamlyni*		2
27. *C. cephus*	*C. ascanius*, *C. erythrogaster*, *C. erythrotis*, *C. petaurista*, *C. sclateri*	15
28. *C. nictitans*	*C. mitis (C. albogularis*, *C. doggetti*, *C. kandti*, *C. moloneyi*, *C. opisthostictus)*	18
29. *Procolobus* (or ***Procolobus*** *sensu stricto*) *verus*		1
30. *Procolobus* (or ***Piliocolobus***) *badius*	*P. gordonorum*, *P. kirkii*, *P. pennantii (P. preussi)*, *P. rufomitratus*, *P. tholloni (P. foai*, *P. tephrosceles)*	18
31. ***Colobus*** *polykomos*	*C. angolensis*, *C. guereza*, *C. satanas*, *C. vellerosus*	19
32. ***Gorilla*** *gorilla*	*G. beringei*	4
33. ***Pan*** *troglodytes*	*P. paniscus*	6

tematic information is probably needed to decide how they can be partitioned into geospecies. Up to 68 (82%) of the 83 primate genera listed in this paper correspond with geospecies. However, these figures are provisional and some genera are allopatric sister taxa (e.g., *Cacajao* and *Chiropotes*, or *Nasalis* and *Simias*) and could be combined as members of single geospecies.

Of the four regional primate faunas, the neotropical fauna is the richest, with 210 species and subspecies (Rylands *et al*. 2000; Van Roosmalen *et al*. 2002) plus Caribbean taxa surviving into the Holocene. Asia with 187 taxa (183 recognized by Brandon-Jones *et al*. 2004; and an additional four cited by Groves 2005) is the next richest, followed by Africa with 175. Including species that became extinct in the Holocene; 81 taxa are found in Madagascar (updated from Groves 2005, and Tattersall 1982). These figures are subject to revision, and to additions from newly described taxa reported to be in press.

The approximate numbers of geospecies are in a different sequence and though provisional, validly indicate orders of magnitude. Africa leads with 33 geospecies followed by Madagascar with about 25, then the neotropics with perhaps as few as 18, and Asia, possibly with only 15. With respect to its number of geospecies, Africa has the most diverse fauna and implicitly the greater variety of ecological niches. Occurrence in non-forest habitats, and variety of body size are factors that possibly contribute to this diversity. The age of the fauna may also have contributed to it achieving its scale of ecological diversity. While there are many taxa in neotropical and Asian superspecies, their faunas have relatively few geospecies and fewer distinct niches are occupied.

The terms superspecies and geospecies name phenomena observed in nature and illuminate the geographic structure of evolutionary lineages. Recognition of superspecies and geospecies highlights an aspect of diversity that suggests that conservation has different needs in different continents;

in Africa putative refuges or centers of endemism differ in ecology, abundance, and richness from conditions in Asia and the neotropics. When areas of Africa were examined where certain geospecies had not previously been recorded, new and distinctive species and subspecies were discovered. In the last 20 years such taxa were named in 1986 (*Cercocebus [galeritus] sanjei*), 1987 (*Cercopithecus hamlyni kahuziensis*, *C. mitis heymansi*, *Procolobus tholloni parmentieri*), 1988 (*Cercopithecus solatus*), 1996 (*Galagoides rondoensis*), 1999 (*Cercopithecus cephus ngottoensis*, *C. erythrogaster pococki*, *Procolobus badius epieni*), and 2005 (*Lophocebus kipunji*). Others were described but their status has been disputed. Several have been recognized but have yet to be named (Table 1; Groves 2001; Grubb *et al*. 2003). The newly described taxa are representatives of already-known geospecies. It may be productive to carefully examine the potential habitat of each geospecies to determine whether still more primate taxa are to be discovered. This applies particularly to galagos of montane forest in East Africa.

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The Distribution and Status of Hoolock Gibbon, *Hoolock hoolock*, in Manipur, Meghalaya, Mizoram, and Nagaland in Northeast India

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Abstract: In India, the hoolock gibbon, *Hoolock hoolock*, occurs only in a small part in the northeast, south of the Brahmaputra River and east of the Dibang River. This article describes its distribution, habitat, status, and conservation in the states of Manipur, Meghalaya, Mizoram, and Nagaland. The hoolock gibbon still occurs in all four states but in much depleted numbers. It has been recorded from altitudes of less than 50 m in Meghalaya to above 2,600 m in Nagaland. The gibbon is nowhere abundant due to hunting and, except a few protected areas, it is found in scattered groups, where their survival is doubtful in the long term. A rough population estimate indicates that the total numbers could be between 1,700 and 2,200. Habitat destruction and fragmentation and poaching are the main threats. The hoolock gibbon is protected by law in India and occurs in at least 17 protected areas in these four states. The creation of more protected areas, adequate protection of existing protected areas, control of *jhum* cultivation and poaching, and awareness and involvement of churches and village headmen in conservation are recommended.

Key Words: Hoolock gibbon, *Hoolock hoolock*, northeast India, Manipur, Meghalaya, Mizoram, Nagaland

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Introduction

Formerly in the genus *Hylobates*, Prouty *et al.* (1983a, 1983b) argued for the placement of the hoolock gibbon in a separate subgenus, *Bunopithecus* Matthew and Granger, 1923, based on its distinct karyotype. Groves (2001) accepted its distinctiveness and placed it in the subgenus *Bunopithecus* accordingly, but doubted the validity of the name. Brandon-Jones *et al*. (2004) and Groves (2005) placed it in the genus *Bunopithecus* based on the findings of Takacs *et al.* 2005, while still doubting the validity of the name. Eventually, Mootnick and Groves (2005) showed that *Bunopithecus* was not applicable to the species (or to gibbons at all), and named instead a new monotypic genus, *Hoolock* Mootnick and Groves 2005.

The hoolock gibbon is the only ape found in the Indian subcontinent. Adult males and juveniles of both sexes are black with white eyebrows. When subadult, the pelage of the females changes to greyish and then to a tan color, which they retain as adults. In India, the hoolock gibbon occurs in only a small part in the northeast, where it is restricted to the south of the Brahmaputra River and east of the Dibang River (Parsons 1941; Choudhury 1987). Across the border, its range extends into a small area of southern China, eastern Bangladesh and Myanmar (Burma). Its range in northeast India was not shown correctly in Corbet and Hill (1992). The type locality of the species is the Garo Hills in Meghalaya (originally recorded as Assam), India (Harlan 1831).

A fair amount of information is now available on hoolock gibbons in northeast India (see Tilson 1979; Choudhury 1987, 1989, 1990, 1991, 2000, in press; Das 2002) and there are number of synoptic works on primates or wildlife in general which also mention the species (Pocock 1939, 1941; Prater 1948; Choudhury 1988, 1992, 1996, 1997a, 1997b, 2001, 2003b). McCann (1933) provided some information on the gibbons of Naga Hills, and likewise Alfred and Sati (1990) and Choudhury (1998) on populations in Meghalaya, Misra *et al.* (1994) on gibbons in Mizoram, and Choudhury (2003a) for Arunachal Pradesh. In this article, we describe the distribution, habitat, status, and conservation of the hoolock gibbon in four of the northeastern states: Manipur, Meghalaya, Mizoram, and Nagaland.

Study Area

The states of Manipur (23°49′–25°42′N, 93°00′–94°45′E; 22,327 km² in area), Meghalaya (25°02′–26°07′N, 89°49′–92°50′E; 22,429 km²), Mizoram (21°58′–24°30′N, 92°16′–93°25′ E; 21,081 km²), and Nagaland (25°10′–27°01′N, 93°17′–95°15′E; 16,600 km²) are located in northeast India (Fig. 1). All are hilly and mountainous. A broad valley plain (elevation about 792 m a.s.l.) extends through central Manipur. Toward the north-northwest is the Barail mountain range, and in the east and west are the Manipur Hills. Mt. Tenipu or Iso (2,995 m a.s.l.), part of the Barail range, is the highest peak in Manipur. Meghalaya is part of an Archaean plateau with undulating tablelands. Shillong Peak (1,961 m a.s.l.) is the highest point on the plateau.

In Mizoram, the highest ranges are toward the east, with Phawngpui or Blue Mountain (2,157 m a.s.l.) and Lengteng (2,141 m a.s.l.) being the highest peaks. In Nagaland, the main ranges are the Barail in the south and southwest and Patkai in the north. A high range exists along the border with Myanmar, and Mt. Saramati (3,842 m a.s.l.) is the highest point. Saramati is also the highest peak in continental Asia south of the Himalaya–Mishmi Hills. The highest peak of the Barail range is Mt. Japfu (Japvo), which reaches 3,043 m a.s.l.

Temperature generally ranges from less than 0°C in winter (notably on Mt. Saramati) to 35°C in summer (maximum). Mt. Saramati experiences snowfall in winter, as do, on occasion, some of the other peaks along the India-Myanmar border, including Mt. Japfu and Mt. Tenipu. The Tropic of Cancer passes through central Mizoram.

Figure 1. Map showing the four states in northeast India where hoolock gibbons were surveyed. Map by Anwaruddin Choudhury.

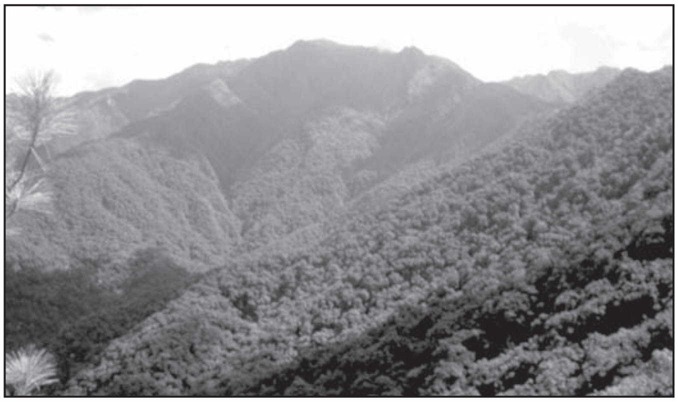

Photo 1. Mt. Saramati on the Nagaland-Myanmar border is the highest peak on the Asian mainland south of the Himalaya. Some of the finest subtropical and temperate forests of northeast India are found on its slopes. This is the last stronghold for hoolock gibbons in Nagaland. Photo by Anwaruddin Choudhury.

Methods

From 1987 to January 2005, I carried out field surveys in areas where hoolock gibbons occur in the states of Meghalaya, Manipur, Mizoram, and Nagaland as part of a broader survey of wildlife in general. The presence of the gibbon was ascertained by direct sighting or by hearing their calls, as well as through finding preserved skulls in the tribal villages and interviews of local forest staff, villagers, and hunters, using visual aids such as photos and drawings. Some of the skulls were identified at the Zoological Survey of India, Kolkata (Calcutta). Direct observations and censuses were carried out along trails, roads (by car), and rivers (by boat).

The data were obtained during numerous field surveys carried out since 1987. Manipur in April 1988, January 1996, and January 2001; Meghalaya, over a number of field trips between 1987 and January 2005; Mizoram in April 2000 and February 2001; and Nagaland in June 1996, January, February, April and October 2001, February 2002, and February 2004.

Distribution and Habitat

Manipur (Fig. 2.)

Hoolock gibbons are confined to six districts: Chandel, Churachandpur, Senapati, Tamenglong, Ukhrul, and Imphal East (only in the Jiribam sub-division). Of these, only in Churachandpur, Tamenglong, and Ukhrul do large tracts of contiguous suitable habitat remain. No forests able to sustain gibbons are left in the Manipur Valley. The species has been recorded in the following wildlife sanctuaries: Bunning, Jiri-Makru, Kailam, Yangoupokpi-Lokchao, and Zeilad (Table 1). Among the larger reserved forests and proposed reserved forests where gibbons were recorded were Irangmukh, Moreh, and Tolbung (full list in Table 1). Sizeable numbers still occur in the Shiroi and Anko (Anggo Ching) ranges, but elsewhere populations are small and scattered.

Suitable gibbon habitat in the form of tropical wet evergreen and semi-evergreen forests occur in patches in the lower and middle elevations in Manipur. *Dipterocarpus turbinatus*, *Artocarpus chaplasa*, and *Mesua ferrea* are some of the notable trees. Deciduous species are dominated by *Tetrameles nudiflora* and *Gmelina arborea*. In the higher hills, especially on the Barails, in Shiroi, and in other hilltop areas, there is subtropical broadleaf (evergreen) forest, with small areas of conifers in the eastern parts. Temperate broadleaf forest is found higher up, on Mt. Tenipu, but gibbons can no longer be found there.

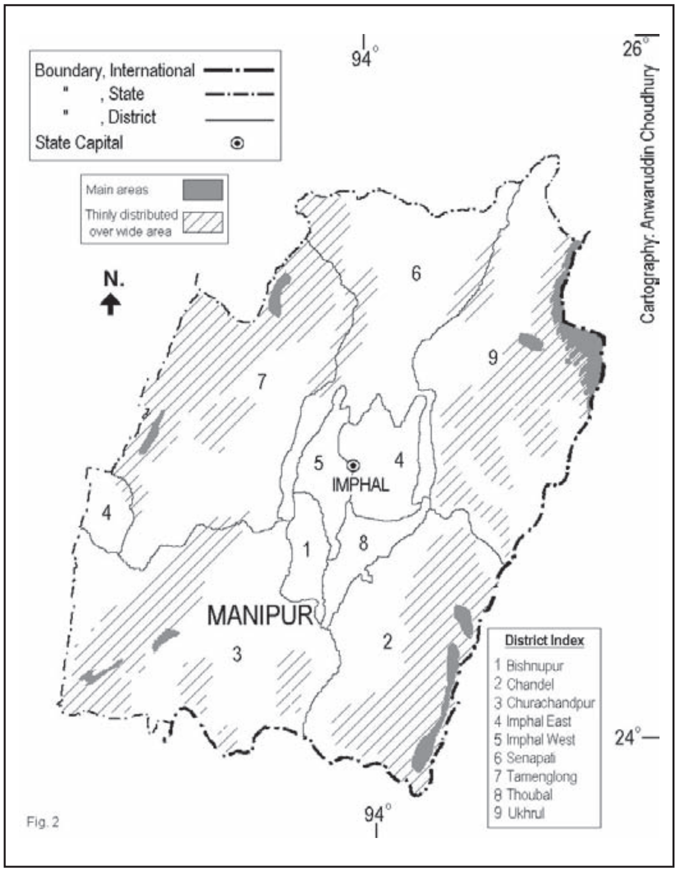

Figure 2. The state of Manipur showing the approximate range of the hoolock gibbon and the main areas where it occurs. Map by Anwaruddin Choudhury.

Photo 2. Tree felling for shifting cultivation at the edge of Lengteng, Mizoram. Photo by by Anwaruddin Choudhury.

The hoolock has been recorded at altitudes of less than 100 m in Jiri-Makru Wildlife Sanctuary to above 2,500 m in Shiroi. The known "area of occupancy" (IUCN 2004) of hoolock gibbons in Manipur is around 2,300 km².

Meghalaya (Fig. 3)

Gibbons are still found in all the districts, namely: Jaintia Hills, Ri-Bhoi, East Khasi Hills, West Khasi Hills, East Garo Hills, West Garo Hills, and South Garo Hills. The main strongholds in this state, however, are in Jaintia Hills, Ri-Bhoi, West Khasi Hills, East Garo Hills, and South Garo Hills. Protected areas where the species has been recorded are in the national parks of Balpakram and Nokrek, Nongkhyllem, and Siju wildlife sanctuaries, and some key reserved forests include Narpuh block I, Narpuh block II, Saipung (all in Jaintia Hills), Nongkhyllem (in Ri-Bhoi), Chimabongshi, Darugiri, Dambu, Songsak (all in East Garo Hills), and Angratoli, and Baghmara (both in South Garo Hills) (full list in Table 1). Elsewhere, populations were found to be small and isolated, in forest patches dispersed through *jhum* (slash-and-burn shifting cultivation of the hill tribes) fields. There are a number of sizeable, privately owned forests in the catchment of the Jadukata River in West Khasi Hills district. A few gibbons still survive in sacred groves such as those in Chiehruphi in the Jaintia Hills. There are specimens in the collections of Zoological Survey of India from Ri-Bhoi district [Manihar Basti, 13 km north of Nongpoh at 760 m a.s.l., from 8 km east and 11 km west of Nongpoh] and Garo Hills (obtained in 1870).

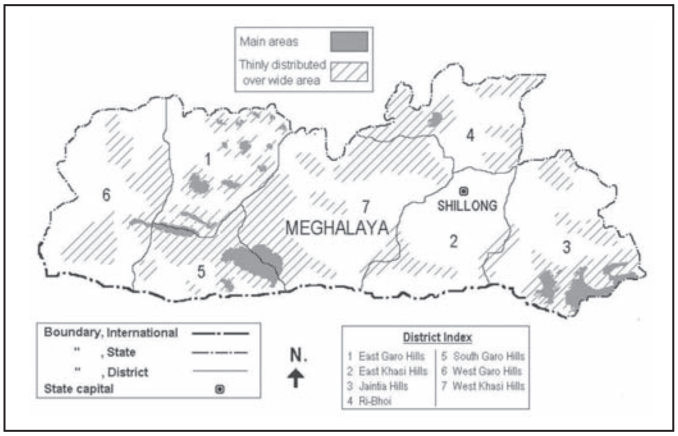

Figure 3. The state of Meghalaya showing the approximate range of the hoolock gibbon and the main areas where it occurs. Map by Anwaruddin Choudhury.

The high rainfall, south-facing slopes, gorges, and canyons are covered with tropical wet evergreen and semi-evergreen forests, and constitute important habitat for gibbons. Grasslands and pine (*Pinus kesiya*) groves predominate in the tablelands, and gibbons are absent. In northern Meghalaya, the habitat is dominated by deciduous species such as the 'sal' (*Shorea robusta*) and *Tetrameles nudiflora*. The gibbons evidently prefer the mixed patches over the 'sal'-dominated areas. Subtropical broadleaf (evergreen) forest with oaks (*Quercus* spp.) and rhododendrons (*Rhododendron* sp.) is found in the narrow stream gorges on the plateau, but gibbons probably disappeared from these areas during the early part of the last century.

In Meghalaya, the hoolock gibbon has been recorded from less than 50 m in Narpuh block I Reserved Forest (near the India-Bangladesh border where the Prang River spreads out over the plains) to above 1,400 m in Nokrek National Park. The known "area of occupancy" in Meghalaya is about 1,650 km².

Table 1. Protected Areas, Reserved Forests and other areas with known hoolock gibbon populations. Population range: A= >100; B= 50–100; C= 20–50; D= <20. NP= National Park; WS= Wildlife Sanctuary; RF= Reserved Forest; PRF= Proposed Reserved Forest.

Name of area	Area (km²)	Hoolock gibbon population range	Remarks
Manipur			
Bunning WS	115.80	C	
Jiri-Makru WS	198.00	B	
Kailam WS	157.80	B	
Yangoupokpi-Lokchao WS	184.00	B	
Zeilad WS	21	D	
Other areas: Anko range [recommended WS], Ch-as-ad PRF, Cheklaphai RF, Dampi RF, Irangmukh RF, K.N.RF, Kangbung RF, Longya RF, Moreh PRF, Shiroi proposed NP, Tolbung RF, Vangai Bongmukh RF, Yangenching RF.			
Meghalaya			
Balpakram NP	312.00	A	The area is less than 200 km² as there was some anomaly in computing.
Nokrek NP	68.01	C	
Nongkhyllem WS	35.00	C	
Siju WS	5.18	D	Contiguous with Balpakram NP
Other areas: Angratoli RF, Baghmara RF, Chimabongshi RF, Dambu RF, Darugiri RF, Dhima RF, Dibru Hill RF, Dilma RF, Emangiri RF, Ildek RF, Narpuh RF block 1, Narpuh RF block 2, Nongkhyllem RF, Rajasimla RF, Rewak RF, Rongrenggiri RF, Sacred forests in Jaintia Hills, Saipung RF, Songsak RF, Unclassed forests near Lumshnong.			
Mizoram			
Dampa WS	500.00	A	
Khawnglung WS	41.00	D	
Lengteng WS	80.00	B	
Murlen NP	150.00	B	
Ngengpui WS	110.00	B	
Phawngpui NP	50.00	D	
Tawi WS	?		Continued existence doubtful
Other areas: Inner Line RF, Ngengpui RF, Palak Dil; unclassified forest in southern Lawngtlai and Saiha districts and in western Lunglei district.			
Nagaland			
Intanki NP	202.02	B	
Fakim WS	6.42	C	Contiguous with Saramati area
Pulie-Badge WS	9.23	Extinct	Habitat in good condition but extirpated due to hunting
Rangapahar WS	4.70	Extinct	Severely degraded habitat and past hunting
Other areas: Ghosu 'Bird Sanctuary' and adjacent areas; unclassed forests in Saramati-Noklak areas; Singphan FR; Satoi area; unclassed forests of Peren and Mon districts.			

Mizoram (Fig. 4)

Hoolock gibbons occur in all the districts, namely: Aizawl, Champhai, Kolasib, Lawngtlai, Lunglei, Mamit, Saiha, and Serchhip. The main populations, however, survive in Champhai, Lawngtlai, Lunglei, Mamit, and Saiha districts. Protected areas where they have been recorded include the wildlife sanctuaries of Dampa, Khawnglung, Lengteng, and Ngengpui, and the Murlen and Phawngpui (Blue Mountains) national parks. Although gibbons could be found in the Tawi Wildlife Sanctuary in the 1980s, their present status there is not clear. They have been recorded in Inner Line (= Inner-line), and Ngengpui reserved forests, and they also occur in the now-degazetted, Palak Dil Sanctuary. Isolated groups were also found scattered along the river gorges and hilltops. There are sizeable populations in southern Saiha and Lawngtlai districts.

Gibbon habitat in this state is mostly tropical wet evergreen and semi-evergreen forest with bamboo. Bamboo has invaded much of the original tropical evergreen forest due to felling and *jhum*, and is common in the older, abandoned *jhums*. Gibbons can also be found in small forest patches in plantations of deciduous species such as teak (*Tectona grandis*). Some of the best rainforest of northeast India is found in southern Mizoram, covering parts of the districts of Lawngtlai and Saiha and has relatively good gibbon populations. *Dipterocarpus turbinatus*, *Artocarpus chaplasa,* and *Palaquium polyanthum* are some of the notable trees of the tropical evergreen forest. Subtropical broadleaf forest occurs in the higher areas in the east, especially near the peaks of Phawngpui, Lengteng, and Vapar. Deciduous species typical of the semi-evergreen forest include *Tetrameles nudiflora*, *Gmelina arborea,* and *Bombax ceiba*. The main bamboo species are *Melocanna bambusoides* (= *baccifera*) and *Steinostachyum dulloa*. In broad terms, the forests of Mizoram are classified as 'Cachar Tropical Evergreen (1B/C3)' and 'Cachar semi-evergreen (2B/C2)' (Champion and Seth 1964).

Gibbons were recorded from altitudes of less than 60 m near Bhairabi to above 2,000 m in Lengteng Wildlife Sanctuary. The known "area of occupancy" in the state is about 2,600 km².

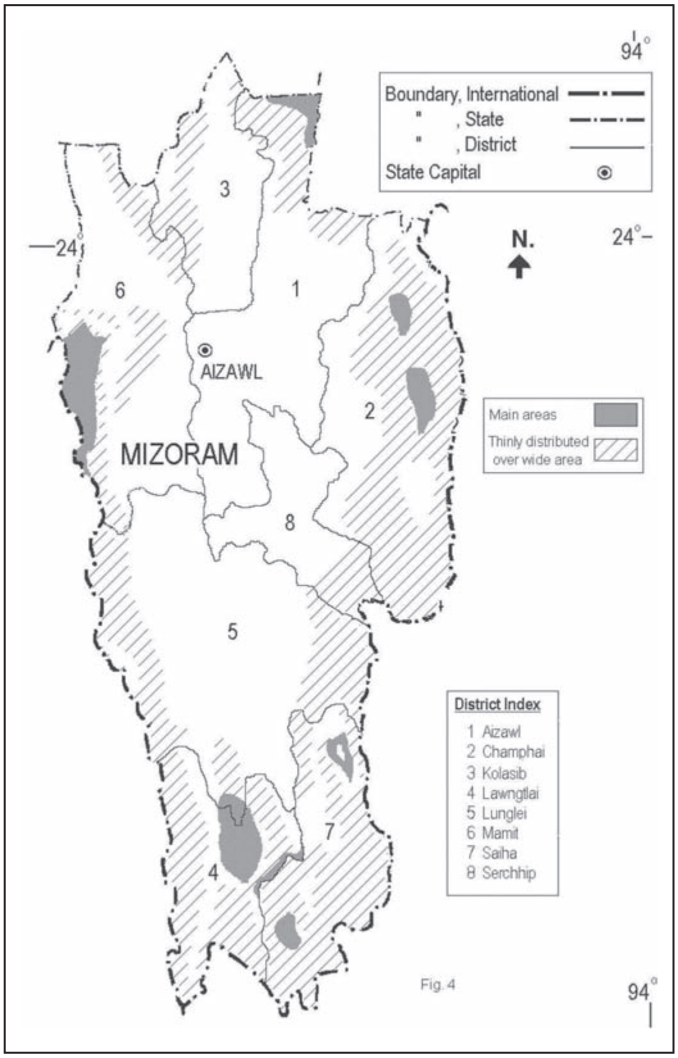

Figure 4. The state of Mizoram showing the approximate range of the hoolock gibbon and the main areas where it occurs. Map by Anwaruddin Choudhury.

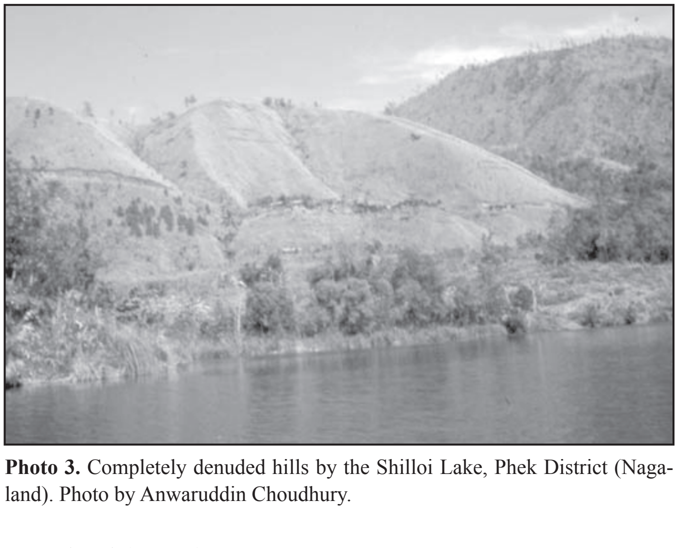

Photo 3. Completely denuded hills by the Shilloi Lake, Phek District (Nagaland). Photo by Anwaruddin Choudhury.

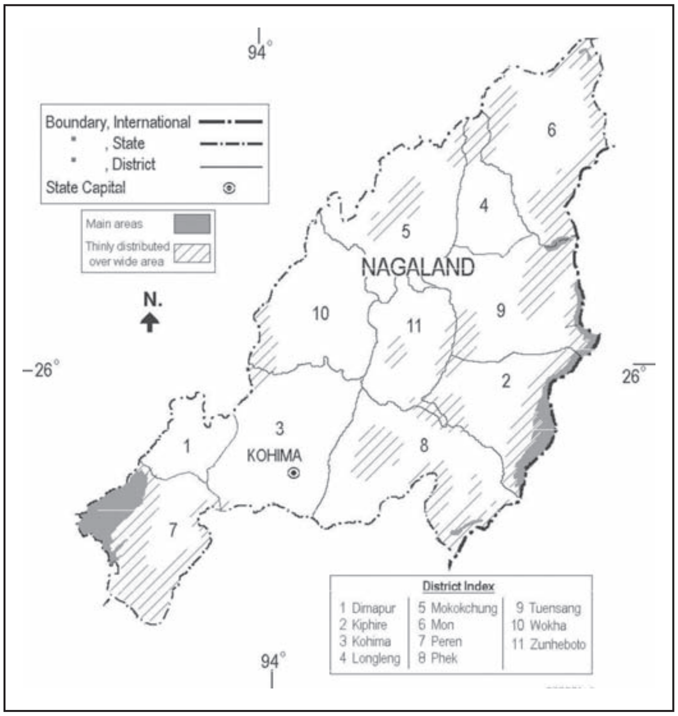

Figure 5. The state of Nagaland showing the approximate range of the hoolock gibbon and the main areas where it occurs. Map by Anwaruddin Choudhury.

Nagaland (Fig. 5)

Gibbons have been recorded in all the districts, namely: Dimapur, Kiphire, Kohima, Longleng, Mokokchung, Mon, Peren, Phek, Tuensang, Wokha, and Zunheboto. Reasonable populations in relatively large forests are found in only three, however: Kiphire, Peren, and Tuensang. They occur in Intanki National Park and Fakim Wildlife Sanctuary and the Singphan Reserved Forest, but have disappeared from Pulie Badge and Rangapahar wildlife sanctuaries. Outside the protected areas, there is sizeable habitat in Japfu-Dzukou but the gibbon is probably extinct there due to hunting. There are gibbon populations elsewhere in the Barail range (western areas), the slopes of Saramati, and along the high ridges on the Mon-Tuensang border. There is a specimen in the collection of Zoological Survey of India from Chumukedima (originally recorded as Samaguting) obtained in 1872.

Tropical wet evergreen forest occurs in patches throughout the lower and middle elevations, except in the southwest where tropical moist deciduous and semi-evergreen forests dominate. Many of the river valleys and gorges are covered with evergreen forest. *Dipterocarpus macrocarpus*, *Shorea assamica,* and *Mesua ferrea* are some of the notable tree species of the tropical evergreen forest. *Tetrameles nudiflora*, *Gmelina arborea,* and *Dillenia scabrela* occur in the deciduous forest of the southwest. Subtropical broadleaf (evergreen) forest occurs in the higher hills, especially on the Barails, in Satoi, Mt. Japfu, and on the slopes of Mt. Saramati. Small areas of conifers are found in the Kiphire and Phek districts. Temperate broadleaf forest is found at higher altitudes on Saramati, with sub-alpine vegetation on the peak. Like Manipur and Mizoram, the *jhum* has greatly altered the original vegetation types throughout Nagaland.

The hoolock gibbon has been recorded from about 150 m a.s.l. in Intanki National Park to above 2,600 m in Saramati. The known “area of occupancy” in Nagaland is around 1,400 km².

Status

Although quite widespread, the hoolock gibbon is very rare in all these states except for a few protected areas. It is nowhere abundant because of hunting. Dun (1886) mentioned that it was plentiful in Manipur, and McCann (1933) found it to be ubiquitous in the area between Mokokchung and foothills in Nagaland. Likewise it was plentiful in the Jaintia Hills of Meghalaya in the 1950s (the late Hena Choudhury, pers. comm.) but the situation is today very different.

In Manipur, the known area of occupancy of the hoolock gibbon is around 2,300 km² but excepting about 450 km² in some protected areas and inaccessible areas such as the Anko range, it is always rare. In places, lone animals or groups can be isolated by 5 or 10 km from other groups. Similarly, in Meghalaya, their distribution over about 1,300 km² is thin and scattered except for *c.*350 km² of more continuous forest. In Mizoram, the area of occupancy is around 2,600 km², but in about 2,000 km² it is encountered only in widely separated valleys and hilltops in isolated and highly fragmented populations. The situation in Nagaland is no better. Of about 1,400 km², only *c.*350 km² has continuous forest.

With very small numbers thinly distributed across large areas, population estimates are difficult to obtain. We have some idea of crude density for selected sampled sites in only six areas. In Meghalaya — 1.4 individuals/km² in the Nongkhyllem Wildlife Sanctuary and the Narpuh block I Reserved Forest, and 1.6/km² in the Darugiri Reserved Forest. In Mizoram — 0.7/km² in the Ngengpui Wildlife Sanctuary, 1.0/km² in the Lengteng Wildlife Sanctuary. In Manipur — 0.4/km² in the Yangoupokpi-Lokchao Wildlife Sanctuary (compared with 8.58/km² in parts of the Dum Duma Reserved Forest and 4.71/km² in Dangori Reserved Forest of Assam; see Choudhury, in press). No estimates were obtained for sites in Nagaland.

The mean of these samples is 1.08/km² (mean of three Meghalaya sites [1.47/km²] and of two Mizoram sites [0.85/km²]). But because of the relatively higher density in the Meghalaya sites, the mean of the sites of Mizoram and Manipur — 0.7/km²— should be taken as more typical for an overall population assessment for the 450 km² in Manipur, 600 km² in Mizoram, and 350 km² in Nagaland. For the 350 km² in Meghalaya, the estimate of 1.47/km² would be more appropriate. This indicates populations (including those that are widely scattered) of 350–500 gibbons in Manipur, 500–600 in Meghalaya, 500–600 in Mizoram, and 350–500 in Nagaland. The total comes to about 1,700–2,200 in the four states.

Conservation Problems

Habitat destruction and fragmentation

Forest destruction through tree felling, encroachment, *jhum*, and monoculture tree plantations is a major threat to the survival of the hoolock gibbon in these states. The forest cover in northeast India is disappearing at an alarming rate. More than 1,000 km² of forest was destroyed annually in the region (including Assam, Arunachal Pradesh, and these four states) during the 1970s and 1980s (data from the National Remote Sensing Agency). In Manipur, dense forest cover has declined from 50.5% of the geographical area in 1980–82 to 25.6% in 2001. During the same period, the decrease in Meghalaya was from 33.1% to 25.3%, in Mizoram from 62.6% to 42.4%, and in Nagaland from 42.8% to 32.5% (India, NRSA 1983; India, FSI 2003).

Encroachment is a major problem in the reserved forests, and *jhum* cultivation is an important cause of forest loss and fragmentation in the hilly areas throughout these states. For instance, *jhum* currently covers more than 1,800 km², or 8.2% of the 22,327 km² of the small state of Manipur. Opencast mining for coal has affected the sacred grove of Chiehruphi in Jaintia Hills. Coal and limestone mining in the Garo Hills has also destroyed important gibbon habitat. Even the single protected areas and reserved forests in Manipur have fragmented into parts. Yangoupokpi-Lokchao Wildlife Sanctuary is cut into two by a national highway. The small reserved forest of Darugiri in Meghalaya is divided into three parts by major roads, which the gibbons are unable to cross. The number of fragmented units state by state is as follows: >16 in Manipur, >20 in Meghalaya, >22 in Mizoram, and >10 in Nagaland. This is excluding the scattered groups and individuals spread all over in the abandoned *jhums* and heavily degraded tracts, for which estimate of fragmentation was virtually impossible.

Poaching

The hoolock gibbon is hunted for food by many of the hill tribes of northeast India. The Nagas, Kukis, Hmar, Paite, Biate, Mizos, Chakmas, Khasis, Lais (Pawis), Maras (Lakhers), and Reangs all kill primates for food. Poaching is severe in Nagaland, the hills of Manipur, and Mizoram, and in Meghalaya, it is mostly in Khasi and Jaintia hills. In the past, traditional weapons such as snares and self-made muzzle-loaders were used, but the last two decades has seen the increased use of automatic firearms.

Trade

Commerce in primates is not significant, but occurs. We found smoked macaque and gibbon meat on sale in a market in Churachandpur in 2001. Young gibbons are occasionally captured for pets, and small numbers are also trapped (illegally) to supply zoos.

Other problems

Other conservation issues include the destructive harvesting of bamboo for paper mills, and open-cast coal mining (in parts of Meghalaya), which destroy forests, pollute, and generally disturb the wildlife.

Conservation Measures Taken

The hoolock gibbon is protected under Schedule-I of the Wild Life (Protection) Act of India, which prohibits its killing or capture, dead or alive. Enforcement, however, is virtually nonexistent, even in the protected areas. Most locals

Photo 4. Lengteng Wildlife Sanctuary in Champhai District is a major habitat of hoolock gibbon in Mizoram. Photo by by Anwaruddin Choudhury.

Photo 5. An adult female hoolock gibbon in a *Anthocephalus cadamba* tree, common in the states of Manipur, Meghalaya, Mizoram and Nagaland. Hoolock gibbons eat the fruits and use the trees for sleeping sites. Photo by Anwaruddin Choudhury.

are unaware of its legal status. IUCN (2004) has listed it as "Endangered." It is found in at least 17 protected areas in the four states (see Table 1).

Discussion

The hoolock gibbon is strictly a dweller of dense mature forest, evergreen and semi-evergreen in the plains, foothills, and hills. The dense forest recorded by the Forest Survey of India (India, FSI 2003) includes all forests with crown cover of 40% or more (i.e., plantation forest, village woodland, and scattered patches here and there). Hence a sizeable portion is unsuitable for gibbons. In much of the dense forest where the habitat is still ideal, gibbons have long since vanished due to hunting. On the other hand, a few groups do still survive in degraded areas. Hence, unlike Assam, and except in parts of Meghalaya, the extent of dense forest may not have much bearing on gibbon abundance and distribution. In the Garo Hills, they are generally not molested and hence still occur even in small patches near villages, but due to *jhum*, there are regular micro-level changes in gibbon home ranges there. Elsewhere in Meghalaya and in the three other states, individuals isolated by or exposed due to *jhum* are hunted down within a short time.

Earlier attempts to estimate populations in these states include those of Alfred and Sati (1990) who counted 130 gibbons in the West and South Garo Hills districts of Meghalaya, however, the coverage of larger forests such as Balpakram and Baghmara was inadequate as the number of groups counted indicated.

Except for parts of the Garo Hills, where there is some degree of community protection, the gibbons have survived in a number of pockets in these states merely because of inaccessible and difficult terrain (Saramati and Anko). The density estimate of 9.03 individuals/km² in parts of the Garo Hills, Meghalaya (Alfred and Sati 1990), is today too high for an overall assessment, but probably true for village patches. Areas such as Balpakram and Baghmara do not have such high densities.

Throughout its range in these states, the gibbon is sympatric with other primates including the Assamese macaque (*Macaca assamensis*), stump-tailed macaque (*M. arctoides*), pig-tailed macaque (*M. nemestrina*), rhesus macaque (*Macaca mulatta*), capped langur (*Presbytis pileatus*), and slow loris (*Nycticebus coucang*). In Mizoram and perhaps in southwest Manipur, it is also sympatric with Phayre's leaf monkey (*Presbytis phayrei*).

Large contiguous habitats for long-term conservation are few. In Manipur — the Anko range, the Jiri-Makru Wildlife Sanctuary, Yangoupokpi-Lokchao Wildlife Sanctuary, Kailam Wildlife Sanctuary, and Tolbung Reserved Forest. In Meghalaya — Balpakram National Park, Siju Wildlife Sanctuary, Baghmara Reserved Forest complex, Nongkhyllem Wildlife Sanctuary and Reserved Forest, and Narpuh-Saipung Reserved Forests complex. In Mizoram — Dampa Wildlife Sanctuary, Ngengpui Wildlife Sanctuary and Reserved Forest, Lengteng Wildlife Sanctuary, and Murlen National Park. In Nagaland — the Saramati range and Intanki National Park.

The ultimate cause of habitat destruction is, however, the very rapid growth of the human population in these states. That of Mizoram grew from 0.33 million in 1971 to 0.89 million in 2001; in Nagaland, from 0.5 million in 1971 to 2.0 million in 2001; in Manipur, from 1.07 million in 1971 to 2.29 million in 2001; and in Meghalaya, from 0.98 million in 1971 to 2.32 million in 2001. Since the bulk of the rural population practice *jhum* as their main occupation, and new villages and hamlets appear constantly, the large-scale destruction of natural habitat seems inevitable.

Despite this depressing prognosis, we believe, however, that if hunting can be reduced through community awareness, and if protective measures are successfully put in place in the sanctuaries and parks, then the forests remaining could support viable populations of gibbons in the long term. Already in Nagaland, many village councils have declared the forests within their control as sanctuaries with good protection; for example, in Khonoma. Although the gibbons have already died out there, they could be reintroduced, and such models could help in all the states.

With the support of International Primate Protection League, USA, I carried out awareness among the church leaders in Manipur's Churachandpur, where smoked gibbon meat was sold at the local market. But such effort needs to be followed up on a long term basis.

Recommendations

A number of important known habitats for gibbons, which are outside the protected area network, should be declared as wildlife sanctuaries. They are: in Nagaland — Saramati and Satoi; in Manipur — Anko range; and in Meghalaya, the area of Nongkhyllem Wildlife Sanctuary should be extended to include the entire area of the reserved forest. Parts of Narpuh (blocks I and II), Saipung, and Baghmara reserved forests should be declared as sanctuaries. Small pockets such as the Darugiri and Songsak Reserved Forests should be declared sanctuaries for the development of eco-tourism with community involvement. It is relatively easy to see the wildlife there and they are accessible by all-weather roads. In Mizoram, the Inner Line Reserved Forest should also be accorded sanctuary status, especially the area between the Sonai (Tuirial) and Barak rivers. The Palak Dil area should be re-notified as a wildlife sanctuary.

Existing protected areas such as Intanki, Lengteng, and Yangoupokpi-Lokchao should be better protected, with increased staff and regular patrolling. Measures should be taken to control *jhum* cultivation as well as hunting for meat. Awareness campaigns should involve the churches and the village headmen to promote conservation measures and programs should be set up for the regular monitoring of the gibbon populations in select sites in the four states.

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The Pros and Cons of a Consensus List of Asian Primate Subspecies

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Abstract: For effective international implementation, conservation action and legislation should rest on a broadly accepted scientific classification. Such classifications must keep pace with advances in taxonomic research. Provision is necessary for potentially as well as currently recognized taxa. Regional classifications of primate subspecies are scarce. None was published from 1968 to 1997 for Asian primates as a whole. Napier and Napier's (1967) now outmoded (global) classification was only a list. Groves' (2001) classification caused consternation in the number of subspecies promoted to species. In response, a workshop was convened in Florida, USA, in 2000 to address this issue and to compile a consensus classification. The resulting Asian annotated list was published in 2004. Such a compilation usefully collates various taxonomic sources in a single reference citable as that adopted in reporting research results. This need not imply wholesale acceptance. Departures can be specified. The classification can, and should be, the springboard for further research. Its consensual nature tends to reduce individual bias and error and broadens the research input. Conversely, a single-authored classification might surpass it in consistency of taxonomic approach and in evading awkward compromise. By its rarity any classification risks entrenchment, discouraging further taxonomic research and encouraging antipathy toward its successors. Conflicts over the significance of genetic evidence and other questions raised during the compilation of the Asian list confirm that, like its predecessors, this list is not definitive. It should and will be superseded.

Key Words: Asian primates, taxonomy, leaf monkeys, langurs

There being no consensus on the best English common name for many species, let alone common names in other languages, effective international collaboration in wildlife conservation requires an agreed scientific nomenclature. The scientific names of well-studied animals with no close living relatives, such as the giant panda and the Indian elephant, are stable and likely to remain so, posing no taxonomic issues for the conservationist other than a possible need to define and conserve subspecies. The scientific names of other species, including high-profile ones like the orang-utan, present the conservationist with inescapable problems.

The taxonomic problem associated with the orang-utan is that genetic evidence questions its long-held treatment as a single species (Brandon-Jones *et al*. 2004). If it is divided into two species, how do we geographically split them and what is the correct scientific name for the second species? The presumption that they are separated by a sea barrier, and that the new species is called *Pongo abelii,* may be wrong. First off, a good case can be made that the name *Simia pygmaeus* Linnaeus, 1760 belongs to the Sumatran population. Linnaeus based the name on a specimen sent him by an Englishman at a time when there was intense colonial rivalry between the British and Dutch in Southeast Asia. Edwards probably obtained his specimen from the then-British protectorate of north Sumatra rather than from the then-Dutch-dominated Borneo (Röhrer-Ertl 1988). Second, the south Bornean population shares characters with the Sumatran population that distinguish it from orang-utans in the rest of Borneo (Brandon-Jones *et al*. 2004). If this south Bornean population is combined with the Sumatran one, its name *Pongo wurmbii* Tiedemann, 1808 predates and therefore has priority over *P. abelii* Lesson, 1827.

Other described species, including some primates, may be so poorly known that no common name exists. This in itself is significant only if it reflects the equivocal taxonomic status of a species. Conservation resources better expended elsewhere may be squandered on an ultimately rejected taxon. Confirming the recognizability of a taxon is more crucial than debating its status as a species or subspecies. Preoccupation with such discussion risks fatally delaying the implementation of essential conservation measures. In an ideal world all species would be conserved in their entirety. In the real world this is impractical. We should strive to conserve a sample of all the representative subpopulations of every species, be they formally described subspecies, or populations suspected but not confirmed as taxonomically distinct. Groves' (2001) conversion to the phylogenetic species concept is a dramatic but by no means unique example of changing trends in taxonomy. The biological species concept is generally slipping from favor. Today's subspecies may be tomorrow's species, and *vice versa*. We cannot afford to be complacent about the loss of any such population.

Few authors have attempted a classification of all extant non-human primate species. Fewer still have tackled the subspecies. No complete Asian non-human primate subspecies classification was published between the handbook list of Napier and Napier (1967) and the preliminary list that Eudey (1998) compiled in 1997 for her review of the *Action Plan for Asian Primate Conservation: 1987–91*. This was not through lack of innovations. Seven new Asian primate taxa were described during this 30-year interval (Rylands *et al*. 2001); taxonomic revisions continued to appear, notably Jack Fooden's monographs on the macaques; and field evidence steadily accumulated. The absence of an Asian primate subspecies classification merely reflects the absence of an authority with the expertise, resources, stamina, and perhaps sheer bloody-mindedness necessary to accept the challenge. Other than self-satisfaction, the rewards are small and the criticism can be acerbic.

Such criticism is often primarily motivated by an understandable desire to maintain the *status quo*. A long-term field biologist may be reluctant to discard or modify the scientific name of his or her study animal. The public are bemused when the scientific name of their favorite zoo animal suddenly changes. Novel classifications designed merely to promulgate a pet hypothesis or for career development deserve the indignation they tend to provoke. At times, however, even the impartial taxonomist cannot readily propose the ideal nomenclature when two or more phylogenetic interpretations conflict or when crucial historic information is elusive or lost. The primate species that still present such dilemmas belong mainly to groups that are the most taxonomically neglected, such as the Asian Colobinae. (One such case is discussed at the end of this paper.) As research progresses, the resolution of these discrepancies will gradually gain consensus and classifications will stabilize. Along the way, some name changes are inevitable. Taxonomy is a rarefied discipline and, like everyone else, its few practitioners are fallible. Modern taxonomists cannot be blamed for past neglect or incompetence. If you pressurize them to ignore such lapses, future generations will curse you for failing to resolve the issue. The longer the prevarication, the greater the eventual disruption. Animal groups should not be reclassified every week, but once every 30 years is probably too seldom.

The consensus Asian primate subspecies classification discussed in this paper derives from a workshop on primate taxonomy convened by the IUCN/SSC Primate Specialist Group at the Disney Institute, Orlando, Florida, USA, 25–29 February 2000. The workshop was partly motivated by a concern that, for want of any alternative, Groves' (2001) primate taxonomy might become the entrenched standard, despite his aversion to such an outcome, and despite the irony that this apprehension might prevent his taxonomy from achieving supremacy. Reservations about Groves' (2001) taxonomy focus on his conversion to the phylogenetic species concept. This entails promoting to species many taxa previously recognized only as subspecies. Although Groves (2001) has not discarded subspecies as a taxonomic concept and includes them in his classification, he paid little heed to populations potentially recognizable as taxa. The documentation of such populations was a priority for the workshop.

Eudey's (1998) compilation formed the baseline for the Asian primate classification with considerable input from a pre-publication copy of Groves (2001). Progress on our compendium at the workshop itself proved merely to be the tip of the iceberg, and most of the interaction was by subsequent electronic communication. Colin Groves attended the workshop as one of the "African group" (Grubb *et al*. 2003), but his later collaboration on tarsier taxonomy thoroughly earned him co-authorship of the report from the "Asian group" (Brandon-Jones *et al*. 2004). The workshop was originally intended to conclude with regional groups evaluating one another's conclusions. Sadly, time did not allow. A reconvention of the workshop in the future could remedy this omission and bring the regional classifications up to date, preferably with the results this time united in one publication.

The main advantage of the Asian list is that it is a complete contemporary classification available for citation as a single reference. It is also a convenient and valuable bibliographic repository. The IUCN/SSC Primate Specialist Group has adopted it as the basis for the 2001 Asian Primate Red List. It will remain so for forthcoming lists until research yields enough modifications to require a new one. Authors not wholly enamored by the list may still find its use more practical than cherry-picking their classification from various sources. They need only specify where, why, and how they feel inclined to digress from it. The list summarizes the current state of Asian primate taxonomy, emphasizing future research priorities. Its consensual nature tends to reduce individual bias and error and broadens the research input. Admittedly, a single-authored classification might surpass it in consistency of taxonomic approach and in evading awkward compromise.

Classifications are inevitably compendia of the most authoritative available species or species group classifications. The compilers of such compendia may therefore themselves be inputting little into the resulting classifications, except to arbitrate when more than one classification of a particular species conflict. When a compendium is co-authored, the consensual aspect is in reaching agreement or compromise in such arbitration. In practice, the inadequacies of current taxonomy demand more of such compilers than mere arbitration. Most compilers cite additional information that either elaborates, corroborates, or contradicts the selected classifications. In the case of the dusky leaf monkey *Trachypithecus obscurus*, for example, two major subspecific classifications were published almost simultaneously so neither author had benefited from the other's contribution. The deficiencies in both classifications from one (Pocock 1935) relying on a British and the other (Chasen 1935) on an Asian specimen collection precluded a straight choice between them. The only option was to present a provisional subspecies classification contrasting their approach, with compromise where possible, assisted by additional information from subsequent authors and from my own examination of the important American museum collections. Considerable further research is required on these subspecies and on those of *Presbytis rubicunda*. In his authoritative review of the rhesus macaque *Macaca mulatta*, Jack Fooden (2000) recognized only one subspecies, but genetic evidence suggests there are at least two. We tentatively recognized seven subspecies, six of them to the east of the Bay of Bengal and showing greater genetic affinity with the Japanese and Taiwan macaque species than does the South Asian subspecies. There is some internal separation of the north Indian population even in the *M. mulatta* Y-chromosome clade, which includes *M. fascicularis* populations from north of the Isthmus of Kra.

Of the Asian primates, the taxonomy of the tarsiers is most in need of investigation and revision. Myron Shekelle, Colin Groves, and I accordingly embarked on a considerable amount of original, mainly nomenclatural research. Most problematic are the Sulawesi tarsiers, which, until recently, were thought to comprise a localized, central highland species, *Tarsius pumilus,* surrounded by a generally larger, more widespread, lowland species, *T. tarsier*. In 1991, a new, centrally located species, *T. dianae,* was described. Its authors, however, erred in two respects. They neglected an earlier name, *T. dentatus*, which is probably a senior synonym, and they assumed that the type locality of the widespread species was in the north of the island. Although its exact location is debatable, available evidence places the type locality of *T. tarsier* in the south of the island (Fig. 1). This might seem of purely academic interest were it not for the subsequent discovery from playback of the duet call that the range of *T. dianae* seems to extend to the west coast, segregating the northern from the southern population, which are both distinct from it in vocalization. If the northern and the central populations are united as one species distinct from *T. tarsier*, then *T. dentatus* predates *T. dianae* as their scientific name. Its type locality (Fig. 1), however, unfortunately lies very near the suspected boundary between the northern and the central populations. This poses a problem if they are regarded as separate species. If the type locality lies to the north of this boundary, *T. dentatus* is the available name for the northern population. If it lies to the south, as seems more likely, it is a senior synonym of *T. dianae*, and the northern population would require a new name.

In the Asian list we also made an original contribution to the classification of the Indochinese leaf monkeys. This was necessitated partly by the aim to document all subspecies. One subspecies had fallen victim to misidentification and inaccurate locality information. The eccentric American taxonomist Daniel Giraud Elliot (1835–1915) is one of an elite few, bold or daft enough to have embarked on a classification of the primates as a whole. In the process, he described numerous purportedly new primates, most of which have proved to be synonyms. Some of them, however, have survived, at least as subspecies. His helter-skelter approach to describing new primates, notably in Elliot (1909), probably engendered skepticism. Whatever the explanation, another American taxonomist, Wilfred Hudson Osgood (1932) misidentified two Field Museum specimens from Laos as the silver-grey leaf monkey subspecies, *Trachypithecus barbei argenteus*, which is endemic to west continental Thailand (Fig. 2). They are actually good examples of Elliot's (1909) subspecies *T. villosus margarita*. Although Pocock (1928) examined the holotype at the Natural History Museum in London and accepted the subspecies, Osgood's (1932) misinformation evidently sapped his confidence and by 1934, Pocock (1935) had discarded it.

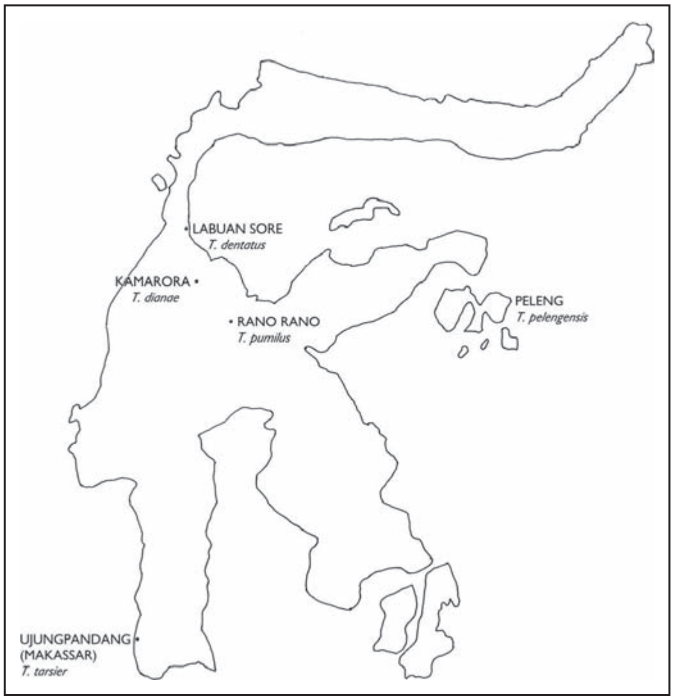

Figure 1. The type localities of tarsier species-group nominal taxa described from Sulawesi, Indonesia.

This is particularly unfortunate because, as Pocock (1928) had appreciated, *Trachypithecus villosus margarita* is in reality a key subspecies bridging the morphological gap between *T. v. germaini*, the south Indochinese silver leaf monkey and *T. barbei holotephreus*, the ash-grey leaf monkey distributed from north Vietnam to southeastern Burma (Fig. 2). It is, so to speak, the leaf monkey "missing link." Without it, Pocock (1935) abandoned his former insightful interpretation of these leaf monkeys as effectively a "ring species." With it reinstated, we can see that the silver leaf monkey, a close relative and derivative of the ebony leaf monkey, *T. auratus*, has a disjunct distribution in the Malay archipelago and south Indochina (Fig. 2). It is linked by *T. v. margarita* with

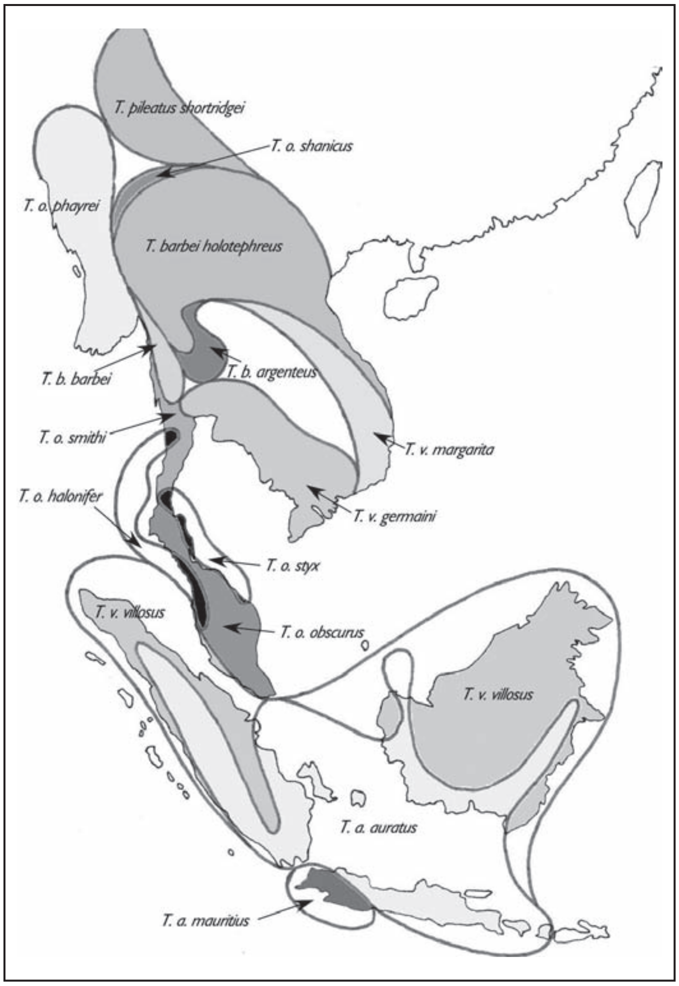

Figure 2. The geographic distribution of Southeast Asian leaf monkeys (excluding the pied leaf monkeys of China, Laos and Vietnam).

T. barbei holotephreus, which in turn, intergrades into *T. obscurus* to the west and probably into *T. pileatus shortridgei* to the northwest. In its dispersal, *T. obscurus* has headed both north into northeastern India and south into the Malay Peninsula where its arrival probably disrupted the distribution of the silver leaf monkey, formerly continuous from Indochina to the Negeri Sembilan coast in West Malaysia.

As to the fate of *T. phayrei* in this rearrangement: typical *T. phayrei* is endemic to southeast Bangladesh, west Burma and northeast India. It is a good subspecies but Pocock's (1935) rationale for treating it as a species is spurious. He rightly acknowledged that it is very similar to typical *T. obscurus* from the southern part of the Malay Peninsula. Situated between them, however, is a group of dark subspecies (Fig. 2). Pocock (1935) reasonably assigned them to *T. obscurus* but unintelligibly contended that as they differ from *T. barbei holotephreus* (which he assigned to *T. phayrei*) in much the same way they differ from typical *T. obscurus*, *T. phayrei* is a separate species. To treat these three subspecies groups as one species, as three species, or as one species sandwiched between a geographically disjunct species, would have been rational. To almost arbitrarily unite the dark subspecies with their southern rather than their northern paler neighbors is illogical. A more judicious solution is to divide the "ring species" into components reflecting their predominant pelage color: silver (*T. villosus*), grey (*T. barbei*), and brown (*T. obscurus*). We therefore treat typical *T. phayrei* as a subspecies of *T. obscurus*. *Trachypithecus obscurus* is apparently undergoing pelage color saturation in the central part of its range, leaving to the north and south paler subspecies retaining the species' earlier pelage color. Were it not for habitat destruction, the probable outcome of this saturation, which might be expected to spread north and south, would be that *T. obscurus* would eventually regain the *Semnopithecus johnii*-like pelage color of its antecedents. Such metachromic processes probably recur in cycles correlated with the glacials (Brandon-Jones 1999).

I categorize *S. johnii* as an antecedent of *T. obscurus* but incongruously assign them here to different genera. This is emphatically against my better judgment but dictated by the employment in this paper of the consensus Asian primate classification. It illustrates one of the less palatable aspects of co-authoring a consensus document and probably the major, but also the most intriguing, cause of dissension among the co-authors of the Asian list. The geneticists among us—Don Melnick, Juan Carlos Morales, and Caro-Beth Stewart—insisted the genetic evidence assigned *S. johnii* to *Semnopithecus*. I was in a minority of one in protesting that the morphological evidence links it with *Trachypithecus*.

Early in 2002, almost exactly 2 years after the Orlando workshop, I was invited to attend a South Asian primate Conservation Assessment and Management Plan (CAMP) workshop at Coimbatore in southern India (Molur *et al*. 2003). My participation was sought for general taxonomic advice and specifically to provide a sound taxonomic basis for the available data on the conservation status of the Indian langur subspecies. I had recently been doing little research on the subject, so a steep learning curve was required. During the workshop I was largely preoccupied with the Himalayan langurs, whose poorly documented subspecific distributions, particularly in Himachal Pradesh and Uttaranchal, India, were creating problems for the participants. I also heard some intriguing reports of natural hybridization between *S. entellus* and *S. johnii*. Mewa Singh kindly invited me to join a group of participants who had arranged to visit the Annamalai Hills (Tamil Nadu) at the end of the workshop. On one of our days there we managed to see all four free-living diurnal primates at close quarters, including some langurs that may well have been *S. johnii* hybrids. I was also gratified to confirm my suspicion from the under-fur of a London museum specimen that, like other *Trachypithecus* but contrary to reports in the literature, *S. johnii* has an orange (albeit a dull orange) neonatal coat. It turns black after 3 months (Sharma, in Brandon-Jones 2004).

The many questions I had attempted to answer for the workshop report (Molur *et al*. 2003) gradually metamorphosed into a taxonomic revision of the langurs of the Indian subcontinent (Brandon-Jones 2004). Its publication leaves the Asian list already superseded in some respects. The major new development arose from photographs published by Hohmann and Herzog (1985) of *S. johnii*/*S. priam* hybrids in the Nilgiris. Initially I suspected misidentification of *S. entellus hypoleucos* but other evidence in the article confirmed their hybrid status. Endemic to the Malabar tract in southwest India, *S. e. hypoleucos* was previously split into four subspecies. The two darker ones, both situated just outside the western perimeter of the range of *S. johnii*, so closely resemble the Nilgiri hybrids that they too must be hybrid populations; in their case, of *S. johnii* crossed with *S. entellus*. The paler pelage color of *S. e. hypoleucos* populations further from contact with *S. johnii* misled taxonomists into recognizing the other two subspecies (Brandon-Jones 2004).

The greatest cranial resemblance of *S. entellus* and *S. priam* to *Trachypithecus* occurs in the Sri Lankan subspecies, *S. p. thersites*. From southwest India to the Himalaya, langur skulls generally become more distinct from those of *Trachypithecus* mainly by progressive enlargement (see measurements in Pocock 1928). Pelage color and geographic variation in tail-carriage reinforce this indication that true langurs diverged from the purple-faced leaf monkey, *S. vetulus* in Sri Lanka. *Semnopithecus vetulus* in turn probably previously diverged from its close relative, *S. johnii*. This can explain their hybrid viability when langurs dispersing northwards from Sri Lanka met *S. johnii* in southern India (Brandon-Jones 2004). *Semnopithecus johnii* genes have apparently boosted the *S. vetulus* genetic heritage of langurs flanking, and north of, the range of *S. johnii*. The process is reciprocal, thus possibly exaggerating the apparent genetic divergence of *S. johnii* and *S. vetulus* from other *Trachypithecus* species. It is therefore premature to define *Trachypithecus* purely genetically and to assign *S. johnii* and *S. vetulus* to *Semnopithecus*. The evidence perhaps favours demoting *Trachypithecus* to a subgenus of *Semnopithecus* but, above all, it urges caution in inferring phylogeny from genetic evidence.

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A Conservation Action Plan for the Mentawai Primates

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Abstract: In this Conservation Action Plan, I evaluate the status of and make conservation recommendations for the four endemic primates of the Mentawai Islands: Kloss's gibbon (*Hylobates klossii*), the simakobu monkey (*Simias concolor*), the Mentawai langur (*Presbytis potenziani*), and the Mentawai macaque (*Macaca pagensis*). There are two subspecies of each of the cercopithecines. They are threatened mainly by hunting and commercial logging. This action plan follows up on the recommendations made for the Mentawai primates in the IUCN/SSC Primate Specialist Group's *Action Plan for Asian Primate Conservation: 1987–91* by Ardith Eudey, and includes data and recommendations from researchers who have studied them since 1980. I also include a brief history of conservation action in the Mentawai Islands to put these recommendations in a historical context. I recommend the following conservation status changes: Kloss's gibbon, Endangered; simakobu monkey, Critically Endangered; Mentawai langur, Endangered; and Mentawai macaque, Vulnerable. The largest populations of the four species can be found in Siberut National Park on the largest and northernmost island, but all but Kloss's gibbon have distinct subspecies on the southern islands of Sipora, North Pagai, and South Pagai, and these are urgently in need of protective measures. The national park is remote and difficult to access by researchers and tourists. I suggest the following conservation actions: 1) increased protection for the Siberut National Park, which currently lacks enforcement; 2) formal protection of the Peleonan forest in North Siberut, which is home to unusually high primate populations and is easily accessible; 3) protect areas in the Pagai Islands by cooperating with a logging corporation that has practiced sustainable logging techniques there since 1971; 4) conservation education, especially regarding hunting; and 5) the development of alternative economic models for the local people to reduce the likelihood of selling off their lands to logging companies.

Key Words: Mentawai Islands, *Hylobates klossii*, *Simias concolor*, *Presbytis potenziani*, *Macaca pagensis*, logging, Siberut

Introduction

The Mentawai Islands of Indonesia are home to four endemic primates. They are the simakobu monkey, *Simias concolor*, with two subspecies (*S. c. concolor* Miller, 1903 and *S. c. siberu* Chasen and Kloss, 1927); the Mentawai langur (*Presbytis potenziani*) with two subspecies (*P. p. potenziani* [Bonaparte, 1856] and *P. p. siberu* [Chasen and Kloss, 1927]); the Mentawai macaque, *Macaca pagensis*, also with two subspecies (*M. p. pagensis* [Miller, 1903] and *M. p. siberu* Fuentes and Olson, 1995]; and Kloss's gibbon, *Hylobates klossii* (Miller, 1903). All are considered threatened and in need of protective measures. Despite a number of studies and recommendations for particular areas in the last two decades, the status of the four species throughout the Mentawai Islands has not been thoroughly reassessed since 1980. This action plan is intended to follow up on the recommendations made for Mentawai primates in the IUCN/SSC Primate Specialist Group's *Action Plan for Asian Primate Conservation: 1987–91* (Eudey 1987). The plan includes a consideration of various conservation recommendations by Fuentes (1996/1997), Tenaza (1987, 1988), and Abegg (2004), and incorporates empirical studies on primate distribution and abundance that have been carried out by Paciulli (2004) and Whittaker (2005a).

Mentawai Geography, People and Threats

Mentawai geography

The Mentawai Islands are situated 85 to 135 km off the coast of West Sumatra, Indonesia (Fig. 1). The four islands of the Mentawai archipelago (Siberut, Sipora, North and South Pagai) have a total area of about 7,000 km². Siberut is the northernmost and largest island with an area of 4,030 km².

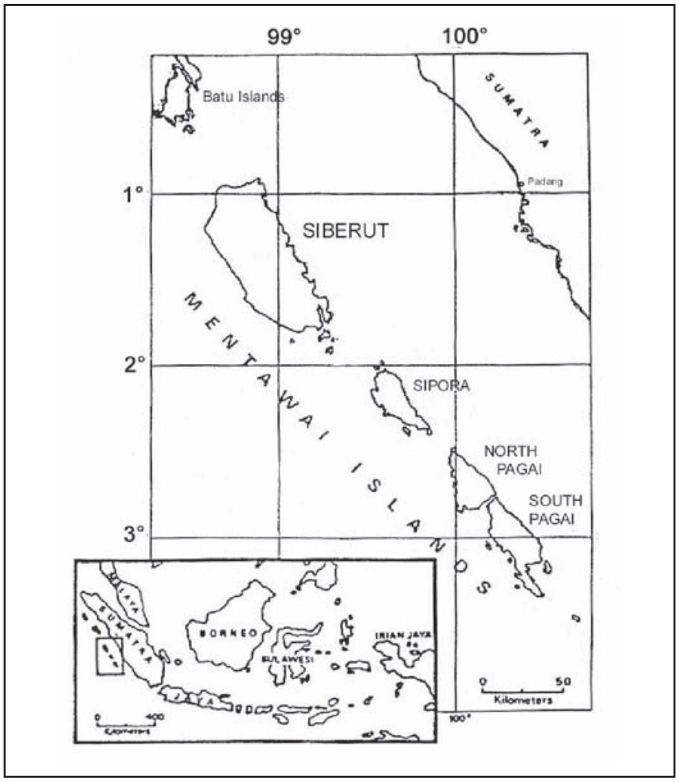

Figure 1. Map of the Mentawai Islands.

North and South Pagai are separated by a narrow strait and together have an area of 1,675 km². Sipora is the smallest island; only 845 km². The natural vegetation is largely humid tropical rainforest, with very high rainfall averaging about 4,000 mm per year (Tenaza and Fuentes 1995; Tilson 1980).

The island chain has been isolated from mainland Sumatra by the 1,500-m deep Mentawai Basin throughout most of its history, even when sea levels were low enough that the rest of Sundaland was connected (Karig *et al*. 1980; Moore *et al*. 1980; Whitten *et al*. 2000). Geological evidence indicates that the Mentawai Islands were never fully connected to Sundaland, but were joined to Sumatra by a land bridge north of Siberut, through the Batu Islands (Batchelor 1979; Dring *et al*. 1990). This long history of isolation from the mainland likely accounts for the high level of endemism: 65% of the nonvolant mammals in the Mentawai Islands are endemic at the genus or species level (World Wildlife Fund 1980).

The Mentawai people

The island of Siberut has been inhabited for about 2,000–3,000 years, and Sipora and the Pagais were likely colonized more recently, within the last 200–400 years (Loeb 1929; Nooy-Palm 1968). Mentawai tradition has it that the people migrated to Siberut from the island of Nias, located north of Siberut, and southward through Sipora and the Pagais. The clan names found in Sipora and the Pagais are traceable to southern Siberut, supporting this dispersal (Nooy-Palm 1968). Traditionally, the Mentawai people have practiced sago and taro agriculture, as well as hunting with bow and arrow, maintaining a neolithic material culture lacking pottery or woven material. Their culture has modernized somewhat in recent decades due to trade with Sumatra, immigration from Sumatra and other areas, and religious conversion by Protestant and Catholic missionaries. Siberut remains more traditional than the southern islands (Nooy-Palm 1968).

Today, the Mentawai population is about 56,000, including indigenous people and migrants. There are 25,000 people on Siberut (6.2 people/km²), 9,000 on Sipora (10.7 people/km²), and 22,000 on the Pagai Islands (13.1 people/km²) (Fuentes 1996/1997).

Overview of threats

The primates of the Mentawai Islands are dependent on the forests that are now threatened by legal and illegal logging, conversion to commercial oil palm plantations, and forest clearing and product extraction by local people. Much of the forest is highly disturbed, with numerous logging companies present on all four islands. The PT Minas Pagai Lumber Company works through half of the once entirely forested North and South Pagai, now characterized by a selectively logged mosaic of regenerating forest. Many other areas throughout the Mentawai Islands have been apportioned to smaller logging concessions and have been clear-cut.

Another major threat to the Mentawai primates is hunting. Being the largest mammals on the islands, local people hunt all four species for food. Hunting is on the increase and more widespread because of increased access to remoter forests through logging roads and trucks, and the replacement of the traditional bows and arrow with .177 caliber air rifles. Possession of firearms by civilians is illegal in Indonesia: Air rifles larger than .177 caliber are restricted throughout the country (Tenaza 1987, 1988).

Until recently, hunting was regulated by rituals and taboos, but these have been largely abandoned as the traditional animist religion has given way to Christianity (Mitchell and Tilson 1986; Tenaza 1974). Kloss's gibbon, for example, was considered sacred in the Mentawai religion, and could only be hunted for certain rituals, such as a boy's coming of age (Whitten 1982c). Catholic and Protestant missionaries have long had a presence on the Mentawais. Under President Sukarno's doctrine of *Pancasila* (Five Principles) in the 1950s, all Indonesian citizens were required to adhere to one of five "accepted" religions: Catholicism, Protestantism, Islam, Buddhism, or Hinduism (Ricklefs 1993). The traditional animist religion of the Mentawais has all but disappeared, along with the associated hunting taboos. The traditional ethic has not been replaced by the view held by many Christians that humans are caretakers of the Earth; rather, many Mentawai people I spoke with informed me that "Now we know that we were created separately from the monkeys. They are just animals, and we can eat them just like we eat cows and chickens."

This combination of religious and technological change has resulted in an increased destruction of the wildlife and the destruction of the forests far beyond any seen since the Mentawais were populated. Unfortunately, the perception of wildlife abundance by local people has not changed. When I asked local people whether they could "run out" of primates to eat, they invariably replied, "There have always been monkeys, there will always be monkeys."

The pet trade is another threat to Mentawai primates, especially the gibbons, as the young of these popular animals are sold cheaply by local people. Infants are obtained by killing the mother (Tenaza 1987, 1988).

The Mentawai Primates

The Mentawai Islands are home to four endemic primate species, including two colobines, each with two subspecies, a cercopithecine with two subspecies, and one hylobatid ape.

Kloss's gibbon, *Hylobates klossii* (Miller, 1903)

The Mentawai or Kloss's gibbon, first described as a "dwarf siamang" (Miller 1903, 1933), is now generally agreed to belong to the lar group of gibbons, genus (or subgenus) *Hylobates* (Chivers 1977; Haimoff *et al.* 1982; Creel and Preuschoft 1984; Marshall and Sugardjito 1986; Geissmann 1993; Brandon-Jones *et al.* 2004). Molecular and vocal studies have elucidated the phylogenetic placement of this species as not basal to the lar radiation but as a derived taxon (Garza and Woodruff 1992; Geissmann 1993; Zehr 1999; Chatterjee 2001; Takacs *et al.* 2005; Whittaker *et al.* 2005), though studies differ in their evidence as to which other gibbon is most closely related to the Kloss's gibbon. According to an analysis of the mitochondrial D-loop, there are no differentiated lineages within the species *H. klossii*, and thus it can be managed as a single conservation unit (Whittaker 2005a).

The snub-nosed pig-tailed langur, or simakobu monkey, *Simias concolor* Miller, 1903

The simakobu is one of the "odd-nosed" group of colobines, which otherwise includes the genera *Nasalis*, *Pygathrix,* and *Rhinopithecus*. Some morphological analyses have suggested that *Simias* has an affinity to the proboscis monkey, *Nasalis larvatus*, of Borneo, and may actually be a member of the same genus or a subgenus within *Nasalis* (Groves 1970; Delson 1975). A recent analysis of mitochondrial DNA suggests that the level of genetic difference between *Nasalis* and *Simias* is comparable to that between other colobine congenerics, such as members of the genera *Trachypithecus* or *Colobus*. Pairwise sequence differences in the cytochrome *b* gene within genera (and between *Simias* and *Nasalis*) are below 10%, while differences between genera are above 10%. Thus, *Simias* may more correctly belong to the genus *Nasalis* (Ting *et al*. 2005; Whittaker *et al*. in press). However, current classification places the simakobu monkey in its own genus, thus making *Simias* endemic to the Mentawai Islands (Brandon-Jones *et al*. 2004). Currently, two subspecies of *S. concolor* are recognized: *S. concolor concolor* Miller, 1903, on the islands of Sipora, North Pagai, and South Pagai; and *S. c. siberu* Chasen and Kloss, 1927, on the island of Siberut (Chasen and Kloss 1927; Brandon-Jones *et al*. 2004).

The Mentawai Island langur, *Presbytis potenziani* (Bonaparte, 1856)

The Mentawai Island langur is currently classified in the genus *Presbytis* based on skeletal morphology (Brandon-Jones 1993), although earlier studies have suggested an affinity with *Trachypithecus* (*v*. Washburn, 1944). The species was originally named *Semnopithecus potenziani* Bonaparte, 1856. Based on cranial, vocal, and pelage characteristics, the Mentawai langur is thought to be most closely related to *Presbytis hosei* in Borneo and *P. thomasi* in northern Sumatra (Wilson and Wilson 1976; Brandon-Jones 1993). No molecular analysis of *Presbytis potenziani* has yet been conducted. Two subspecies are recognized: *P. potenziani siberu* on Siberut, and *P. p. potenziani* on the southern islands of Sipora, North Pagai, and South Pagai (Chasen and Kloss 1927; Brandon-Jones *et al*. 2004).

The Mentawai macaque, *Macaca pagensis* (Miller, 1903)

The original description of the Mentawai macaque named it as a unique species (Miller 1903), but some later authors regarded it as a subspecies of the pig-tailed macaque, *Macaca nemestrina* (Chasen 1940; Fooden 1975). It was again granted species status by Wilson and Wilson (1976), and is currently recognized as such (Brandon-Jones *et al*. 2004; Groves, 2001, 2005). Subspecies were never formally described for *M. pagensis*, though the distinctiveness of the Siberut form compared with that on the southern islands was suggested (Whitten and Whitten 1982). The subspecies *M. pagensis pagensis* on Sipora and the Pagais and *M. p. siberu* on Siberut were inadvertently named without description by Fuentes and Olson (1995) and are still recognized (Brandon-Jones *et al*. 2004). A recent molecular analysis has suggested raising these subspecies to distinct species based on the divergence between mitochondrial haplotypes (Roos *et al*. 2003); however, this suggestion requires further study and is not generally accepted.

History of Conservation Action in the Mentawai Islands

Siberut National Park

The first protected area in the Mentawai Islands was created in 1976. The 6,500-ha Wildlife Reserve near the center of Siberut island, named "Teitei Batti," was the site of Richard Tenaza's doctoral dissertation research (Tenaza 1974). The reserve was increased in size to 56,500 ha in 1979. In 1980, the World Wildlife Fund (1980) produced "Saving Siberut: A Conservation Master Plan," based largely on the research of Anthony Whitten, Jane Whitten, and Alan House, who conducted their graduate research on Siberut on Kloss's gibbons, squirrels, and vegetation, respectively (Whitten 1980, 1982a, 1982b, 1982c). The recommendations in this publication attempted to reconcile the needs of the traditional societies living on Siberut with the need to protect the wildlife, and suggested: 1) socio-economic development, to make a more efficient subsistence economy; 2) a system of land-use zones, allowing some traditional use in some areas while creating nature reserves in others; 3) declaring Siberut Island as a United Nations Education, Scientific, and Cultural Organization (UNESCO) Man and the Biosphere Reserve; 4) making forestry practices more sustainable; 5) ecotourism; 6) wildlife management, to allow for sustainable hunting practices; 7) conservation education; and 8) a system of evaluation and monitoring to ensure the success of these measures (Whitten *et al.* 1979; World Wildlife Fund 1980).

Many of these suggestions were met in 1981–82, with expansion of the protected area to 132,900 ha, the creation of land-use zones, and a UNESCO Man and the Biosphere (MAB) Reserve. The UNESCO program seeks to reconcile biodiversity and sustainable use by protecting areas while promoting economic development that is socio-culturally and ecologically sustainable (UNESCO 2005). The reserve remains under the jurisdiction of the country in which it is located, but UNESCO provides the initial planning and coordination of appropriate authorities, and in some cases provides representatives who assist in conservation and economic development.

The nature reserve was granted National Park status in the Indonesian National Parks system in 1993, and was increased to 190,500 ha (PHPA 1995). The park is currently 1,926 km², and is divided into three land-use zones: sanctuary (465 km²), traditional use (1,017 km²), and park village (444 km²) (Fig. 2). Hunting is strictly prohibited within the sanctuary zones, and limited traditional hunting is allowed by permit in the traditional-use zones. Hunting of the gibbon *H. klossii* and simakobu *S. concolor* is banned, and logging is not permitted in the sanctuary or traditional-use zones. The three park village zones are inhabited by native Mentawai people, and no restrictions are placed on their use of the land (PHPA 1995).

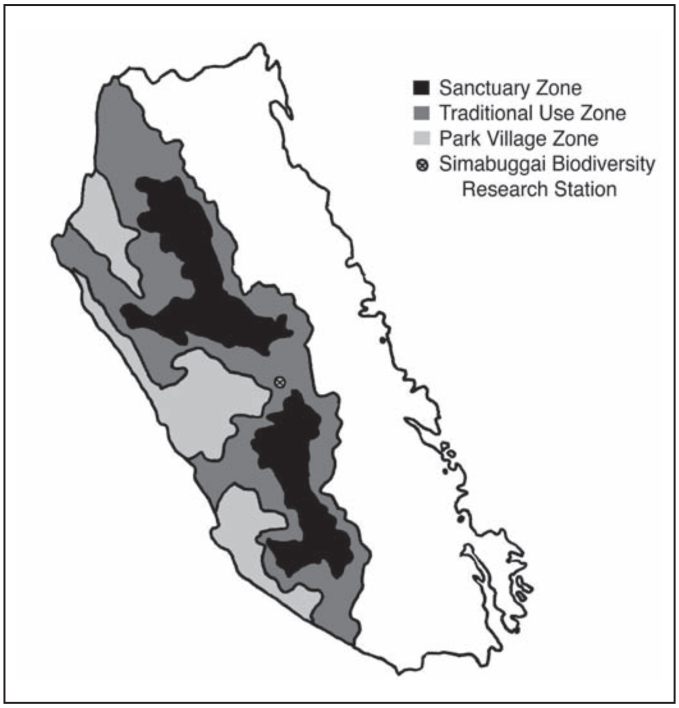

Figure 2. Map of Siberut National Park showing management zones.

In 1995, an Integrated Conservation and Development Management Plan was produced by the Biodiversity Conservation Project in Flores and Siberut, funded by the Asian Development Fund of the World Bank (PHPA 1995). This plan aimed to proceed with measures needed for the objectives first set out in the World Wildlife Fund (1980) plan, as well as to promote further research in the area. The Simabuggai Biodiversity Research Station was set up in the center of Siberut as a result and run by the Directorate General of Forest Protection and Nature Conservation within Indonesia's Ministry of Forestry. The plan also proposed the implementation of a Community Awareness, Mobilization and Extension Program (CAMEP) to improve social and economic conditions. Unfortunately, due to lack of visible success, the World Bank stopped funding this project in 2001.

Socio-economic development has taken the form of educating and empowering local Mentawai people to produce and market their own goods, as well as education about land rights and the impact of logging companies on the local economy. A UNESCO representative, Koen Meyers, has lived in Siberut for several years and is working in conjunction with the Siberut National Park to educate local people about their land rights and economics. This work is part of the UNESCO Man and the Biosphere program.

A cessation of all logging, plantations, and migrant settlement on the island of Siberut was enacted in 1993 as a condition of funding for Siberut National Park. However, logging began again a few years later (Anon. 2000), and by 2001, the entire surroundings of the Siberut National Park had been apportioned to overlapping logging concessions and oil palm plantations (Management of Siberut National Park, pers. comm.). Illegal logging permits began to be issued when the Mentawai Islands were granted the status of independent regency (*kabupaten*) within the province of West Sumatra by the Indonesian government in 1999. The *kabupaten* has no the authority to issue such permits, only the central Ministry of Forestry in Jakarta does, but allowing these illegal activities is lucrative for the local offices. Despite this, in 2004, the Mentawai regency reported zero income from forestry, despite a projected target of Rp. 2.5 billion (US$277,777), apparently due to the timber companies' refusal to pay agreed-upon fees (Bachyul Jb 2005). In April 2005, the *Jakarta Post* (Indonesia's English-language newspaper) reported that the *Bupati* (regent) revoked all permits for concessions granted in 2004–2005, possibly because of the lack of revenue (Anon. 2005).

Local Mentawai people have begun to fight back against the *Bupati* and timber companies, asserting their own land rights and refusing to allow logging (Anon. 2003). Such disputes have slowed the pace of logging in Siberut, but have not stopped it altogether.

The Peleonan Forest in northern Siberut

The Peleonan Forest in northern Siberut has recently been recognized for its unusually high density (of all four of the island's primates), and its accessibility. While Siberut

National Park is very remote, has very rugged terrain, and attracts few visitors, the 4,000-ha Peleonan forest is relatively flat and easy to reach from the North Siberut port of Muara Sikabaluan. In 2000, a team of European researchers headed by Christophe Abegg and Thomas Ziegler presented a proposal to begin the Siberut Conservation Project with plans to conduct research on the wildlife and support sustainable economic development. Since 2002, the team has leased the forest from the local clan, established a research station, and improved local river transportation by purchasing speedboats and engines to assist local people with transportation of goods for sale (Kobold *et al*. 2003).

Sipora

Sipora is the most developed of all the Mentawai Islands, and is home to the regency capital, Tua Pejat. Despite its popularity with tourists as a surfing destination, no conservation action has ever been attempted, and only 10–15% of the original forest cover remains (Fuentes 1996/1997).

The Pagai Islands

Researchers have suggested sites for protected areas for the monkeys and Kloss's gobbon in the Pagai Islands, and specifically for *S. c. concolor*, *P. p. potenziani* and *M. pagensis* not occurring on Siberu. Much of the area of the Pagai Islands is managed by a single logging company, PT Minas Pagai Lumber Corporation. The southernmost portion of South Pagai, Sinakak Islet (600 ha) was undisturbed due to its inaccessibility, and was suggested as a potential wildlife reserve (Fuentes 1996/1997; Tenaza 1987, 1988). Unfortunately, in recent years smaller logging companies have found a way to access this area and extract lumber.

A second area was suggested on North Pagai Island in the Betumonga region. This 623-ha forest was the site of dissertation research by Agustin Fuentes (1994), Sasimar Sangchantr (2004), and Lisa Paciulli (2004). In the late 1990s, Paciulli succeeded in gaining protected status from the government; the area was named Betumonga Research Area. A "research area" has very little actual protection compared to a nature reserve or national park, and after Paciulli's return to the United States in 2002, local people sold the forest to a logging company.

So far, attempts to protect undisturbed areas in the Pagai Islands have not been successful, as local villages are often eager to sell forest to small, often foreign, timber companies who clear-cut the area in exchange for a relatively small sum of cash, food supplies, and televisions. The PT Minas Pagai Lumber Corporation, an Indonesian timber company based in Padang, has controlled a large logging concession (83,330 ha) that encompasses much of the interior of North and South Pagai (total area of the islands: 1,675 km²). PT Minas has controlled this concession since 1971; the current permit expires in 2012 but may be extended. Unlike most logging companies in the Mentawais, which usually practice clear-cutting following by conversion to plantations, PT Minas manages the area with selective logging and replanting, and rotating logging areas over a few decades. An area of 7,789 ha is designated by the corporation as a Buffer Zone and Conservation Area, and another 13,256 ha as a Limited Production Forest where selective logging is practiced (PT Minas Pagai Lumber Corporation 1996). While the corporation's primary conservation interest is trees, these two areas together account for a total of 21,045 ha (210 km²) of suitable habitat for primates in the Pagai Islands. Logging roads have, however, made these forest patches far more accessible, and thus hunting has now become a primary concern for the survival of these primates and other wildlife in the Pagais.

Review of the Conservation Status of Each Species

The four Mentawai primate species were last assessed for the IUCN Red List in 2000, using version 2.3 (1994) of the Categories and Criteria (IUCN 2004). The Categories and Criteria have since been updated (Version 3.1, 2001), which could affect the categories assigned to these species. Most importantly, the criteria now distinguish between causes of decline that are "clearly reversible AND understood AND ceased" and those that "may not have ceased OR may not be understood OR may not be reversible" (IUCN 2004). This section reviews the current categories assigned, the recent information on population data, and suggests changes to conservation status for each species.

Whittaker (2005a) assessed the remaining forest in the Mentawai Islands by compiling information from existing estimates of forest cover (Fuentes 1996/1997), satellite imagery (Stibig *et al*. 2002), and interviews with representatives of PT Minas Pagai Lumber Corporation, Siberut National Park, and UNESCO. A total of about 2,700 km² of suitable forest habitat remains, most of which (2,400 km²) is located on Siberut (Table 1). Estimates of past forest cover on Siberut are based on the World Wildlife Fund (1980) survey. Past forest cover estimates for Sipora and the Pagais were not available. Commercial logging in the Mentawais had yet not begun in 1970 (Tenaza and Hamilton 1971), and the PT Minas concession was first granted in 1971. However, Tenaza and Hamilton (1971) observed extensive deforestation in the areas immediately surrounding villages in the Pagais, so the entire island area was probably not forested. Conservatively, I have estimated that by 1980, an area of forest equal to the PT Minas concession (900 km², just over half of the total area of North and South Pagai) remained in the Pagais, and that about half of Sipora was forested (Table 1).

The population estimates below are based on two recent surveys: 1) line transect surveys of all four Mentawai primates in North and South Pagai (Paciulli 2004), and 2) surveys of

Table 1. Forest estimates for the Siberut, Sipora and the Pagai Islands.

Island	Area	Forest in 1980	Forest in 2005
Siberut	4,030 km²	3,500 km²	2,400 km²
Sipora	845 km²	400 km²	100 km²
North and South Pagai	1,675 km²	900 km²	200 km²
Total	6,550 km²	4,800 km²	2,700 km²

Kloss's gibbons on all four islands using a method based on gibbon loud calls (Whittaker 2005b), which is considered by some researchers to be a more accurate method of measuring gibbon density than line transects (Brockelman and Ali 1987). These recent estimates are then compared with past population estimates in order to determine the extent of decline. The primary source for past population estimates is the World Wildlife Fund (1980) publication, "Saving Siberut: A Conservation Master Plan." In that study, average home range sizes and group sizes were determined for each species at a single site, and extrapolated to determine the population size for the entire suitable habitat area of Siberut. Finally, this number was multiplied by a correction factor (different for each species) to account for differences in hunting pressure and lack of continuity of ranges. I have further extrapolated the 1980 Siberut estimates to get a population estimate for the entire Mentawai archipelago in order to have a basis for comparison. Additional information from other sources is included when these figures appear to be over- or under-estimates. All estimates are summarized in Table 2, and detailed below.

Hylobates klossii

The IUCN Red List currently assesses Kloss's gibbon as "Vulnerable," under criteria A1c+2c and B1+2ac. Under the 1994 version of Categories and Criteria, this means that the species potentially faces "a high risk of extinction" because of a reduction in population size of ≥20% based on "a decline in area of occupancy, extent of occurrence, and/or quality of habitat," as well as a reduction in population size of ≥20% over the next ten years or three generations. Additionally, the extent of occurrence is less than 20,000 km², or the area of occupancy is less than 2,000 km², and the populations are severely fragmented and suffer from an observed, inferred, or projected continuing decline of extent of occurrence and area, extent, and quality of habitat, or a combination of these (IUCN 2004).

Kloss's gibbon was first evaluated as "Vulnerable" in 1986, elevated to "Endangered" in 1988, and downgraded back to "Vulnerable" in 1996 (IUCN 2004). However, some scientists have suggested that this species may be "Critically Endangered" due to a perceived increase in threat levels (Ardith A. Eudey; Jatna Supriatna, pers. comm.).

A recent study suggests there are 20,000–25,000 gibbons in the Mentawai Islands (18,000–21,000 in Siberut alone), down from an estimated 49,000 (or 36,000 in Siberut) in 1980 (Whittaker 2005a, 2005b). These numbers indicate a population decline of >50% in 25 years, which is approximately three generations in hylobatids (average generation time: 9.1 years) (Harvey *et al*. 1987). This decline is due to a decrease in both the area of occupancy and the quality of the habitat, due to extensive logging and forest product extraction, as well as some exploitation of the gibbons themselves for meat or pets. These causes have not ceased and may not be reversible. Therefore, under the new categories and criteria, I suggest that the status of *Hylobates klossii* should be upgraded to the category "Endangered," under the criteria A2cd, which state that the species is facing a very high risk of extinction in the wild due to "(A) a reduction in population size based on […] (2) an observed, estimated, inferred, or suspected population size reduction of ≥50% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on […] (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat and (d) actual or potential levels of exploitation."

Simias concolor

The snub-nosed pig-tailed langur, or simakobu monkey, is currently listed on the IUCN Red List as "Endangered," on the basis of criteria A1cd+2c. This means the species is judged to be at a "very high risk of extinction" due to "(A1) a reduction in population size of ≥50% over the last ten years or three generations due to […] (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat, and (d) actual or potential levels of exploitation"; as well as "(2) a projected decline over the next ten years or three generations based on […] (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat." *Simias concolor* has been listed as "Endangered" since it was first evaluated in 1986 (IUCN 2004).

The most recent survey of *Simias* density was conducted in the Pagai Islands, where densities ranged from 5 individuals/km² in unlogged forest to 2.5 individuals/km² in forest patches logged 20 years ago (Paciulli 2004). If about 2,700 km² of primate habitat remains in the Mentawai Islands, then there are 6,700–17,300 simakobu monkeys today, representing a decline of 33–75% from the 1980 estimate of 19,000 simakobu monkeys in Siberut (26,000

Table 2. Population estimates. See text for details.

	Hylobates klossii		***Simias concolor***		***Presbytis potenziani***		***Macaca pagensis***	
Island	**1980**	**2005**	**1980**	**2005**	**1980**	**2005**	**1980**	**2005**
Siberut	36,000	18,000–21,000	19,000	6,000–15,500	46,000	1,600–9,500	39,000	17,000–30,000
Sipora	4,000	800	2,000	200–600	5,000	100–400	4,500	700–1200
N and S Pagai	9,000	1,700–1,900	5,000	500–1,200	12,000	200–800	10,000	1400–2500
Total	49,000	20,000–25,000	26,000	6,700–17,300	63,000	1,900–11,000	53,500	19,000–33,700
Decline	49–59%		33–75%		83–97%		37–65%	
Adjustments			63,000 in 1994: 73–90% decline		36,000 in 2005: 43% decline			
Recommended status	Endangered		Critically Endangered		Endangered		Vulnerable	

in all four Mentawai Islands). The loss may have been even greater than this estimate: more recently, the mean population density for *Simias* throughout the Mentawais, based on home range sizes, was estimated as 21 individuals/km² (Tenaza and Fuentes 1995). Based on this density and a very conservative estimate of 3,000 km² of forest, there were 63,000 simakobus in 1994, indicating a possible loss of 73–90% of the population in 10 years.

The loss is likely greater in the Pagai Islands, where logging has been more of a problem and hunting has been facilitated by logging roads, than in Siberut. The primary threat to *Simias* is hunting, as it is the preferred game of most Mentawai hunters (Mitchell and Tilson 1986; Fuentes 2002; Paciulli 2004). In 1990, Tenaza and Fuentes (1995) found no simakobu monkeys in a site in Siberut that had an unusually high density (~220 individuals/km²) when surveyed by Watanabe (1981) in 1974–1978. The site had been logged, and after logging had ceased, local people reported that hunting the simakobus was easier because there were fewer places for them to hide (Tenaza and Fuentes 1995). This evidence of heavy hunting suggests the higher estimate of decline may be more correct.

I recommend that the status of *S. concolor* should be upgraded to "Critically Endangered," which means that the species faces an "extremely high risk of extinction" based on criteria A2cd: "(A) An observed, estimated, inferred or suspected population reduction (2) of ≥80% over the last 10 years or three generations […] based on (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat and (d) actual or potential levels of exploitation."

Presbytis potenziani

The IUCN Red List currently categorizes the Mentawai langur as "Vulnerable," based on criteria A1c+2c and B1+2ac. Under the 1994 version of Categories and Criteria, this means that the species faces "a high risk of extinction" because of a reduction in population size of ≥20% based on "a decline in area of occupancy, extent of occurrence, and/or quality of habitat," as well as a predicted reduction in population size of ≥ 20% over the next 10 years or three generations. Additionally, to meet these criteria, taxa should have an extent of occurrence that is less than 20,000 km², or an area of occupancy less than 2,000 km², with populations that are severely fragmented and suffer from an observed, inferred, or projected continuing decline of extent of occurrence and area, extent, and/or quality of habitat. In 1986, *P. potenziani* was listed as "Indeterminate," and then evaluated as "Endangered" in 1988. Its status was downgraded to "Vulnerable" in 1996 (IUCN 2004).

The most recent estimate of *P. potenziani* density is about 1–4 individuals/km² in the Pagai Islands (Paciulli 2004). Mentawai langurs appear to reach their highest densities in forest logged about 20 years ago, and their lowest densities in forest logged 10 years ago. This density estimate suggests that there are only 1,900–11,000 Mentawai langurs on all four islands, or 1,600–9,500 individuals in Siberut alone. In 1980, the Siberut population of *P. potenziani* was estimated (based on home range size) as 46,000 individuals: the most abundant species in Siberut. A later study suggested a population density of 13.5 individuals/km² at a site in Siberut, which suggests a similar population size of about 47,000 of langurs in Siberut (Watanabe 1981). If these estimates are correct, then the *P. potenziani* population may have suffered an 83–97% loss.

However, behavioral studies of *P. potenziani* have found that this species is very difficult to habituate, possibly as an adaptation to human hunting, and may employ cryptic anti-predator behavior (Fuentes 1994; Sangchantr 2004). Such behavior would make Mentawai langurs difficult to observe on line transect surveys, and the densities presented in Paciulli (2004) may be an underestimate. Sangchantr (2004) observed four groups within a 50-ha study site in North Pagai, and Fuentes (1994) encountered 10 groups within 1.36 km², also in North Pagai, suggesting a much higher density than that observed by Paciulli (2004). If the Mentawai langur has maintained a similar population density as that observed in 1981 (13.5 individuals/km²), then today there would be about 36,000 langurs remaining, representing a decline of 43%.

Simias concolor is the preferred prey item of Mentawai hunters, but *P. potenziani* is also a popular food and the second-most hunted Mentawai primate (Fuentes 1994, 2002). *P. potenziani* also appears to be very sensitive to habitat disturbance (Paciulli 2004). There has likely been a decline due to hunting and logging, but I believe the estimate of an 80–95% decline for the entire species is probably too high, and that the actual decline is closer to 50%.

I recommend that the status of *P. potenziani* should be upgraded to "Endangered," under criteria A2cd, which state that the species is facing a very high risk of extinction in the wild due to "(A) a reduction in population size based on […] (2) an observed, estimated, inferred, or suspected population size reduction of ≥50% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on […] (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat and (d) actual or potential levels of exploitation."

Macaca pagensis

The Mentawai macaque is currently listed as "Critically Endangered," under criteria A1cd+2c. These criteria state that the species is at "extremely high risk of extinction" due to "(A1) A reduction in population size of ≥80% over the last ten years or three generations […] due to (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat, and (d) actual or potential levels of exploitation," as well as "(2) a projected decline of at least 80% over the next ten years or three generations […] based on (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat." In 1986, *M. pagensis* was listed as "Indeterminate." The species was evaluated as "Endangered" in 1988, and upgraded to "Critically Endangered" in 1996 (IUCN 2004).

The most recent estimates of *M. pagensis* density suggest densities of 7–12 individuals/km² in suitable habitat in the Pagai Islands (Paciulli 2004), giving a total of about 19,000–33,700 macaques throughout the Mentawais, or 17,000–30,000 on Siberut alone. The range of variation in density estimates is related to habitat quality: macaques live at much higher densities in logged than unlogged forest, and their highest density is in forest logged 20 years ago. In 1980, it was roughly estimated that there were 39,000 macaques on Siberut (or 53,500 if this figure is extrapolated to the entire Mentawai Islands); this estimate was based on widely varying home range sizes and group sizes (World Wildlife Fund 1980). The decline since 1980 is thus 37–65% throughout the Mentawai Islands. Because Mentawai macaques are found in higher densities in disturbed forest, and very little of the Mentawai forest is undisturbed, I suggest that the larger population estimate is more accurate.

While macaques are not a preferred food item because their meat is considered unpalatable, they still suffer from hunting because they are considered pests (Fuentes 2002; Paciulli 2004). While habitat disturbance appears to affect population sizes positively, macaques are found in lower densities near human settlements (Paciulli 2004).

I recommend that the status of *M. pagensis* should be downgraded to "Vulnerable," under criteria A2cd, which state that the species is facing a "high risk of extinction in the wild" due to "(A) reduction in population size based on […] (2) an observed, estimated, inferred or suspected population size reduction of ≥30% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on […] (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat and (d) actual or potential levels of exploitation."

Recommended Conservation Action

In this section I will first review the progress made on recommendations from the 1987 Action Plan for Asian Primates, and then list new recommendations for conservation in the Mentawai Islands.

Review of recommendations from 1987–91 Asian Primate Action Plan

Four recommendations were made that specifically addressed the Mentawai Islands (Eudey 1987).

1. *Development of the Biosphere Reserve on Siberut Island*: This objective was fully accomplished with the 1995 ICDP plan. However, local enforcement is weak, and hunting of all four primates and forest product extraction occurs in all management zones.

2. *Creation of a primate reserve on South Pagai Island and offshore islands*: Despite several attempts to establish such a reserve, this has not been accomplished. Areas suggested for conservation have been logged.

3. *Survey of primates on Sipora Island*: While a survey of Kloss's gibbon density was conducted on Sipora (Whittaker 2005b), no survey has been conducted of the macaques or colobines.

4. *Captive breeding program to recover the endemic subspecies of Mentawai primates on the southern islands, Sipora and Pagais*: This expensive recommendation has not been included in any other plans for conservation in the Mentawai Islands, and no progress has been made. Few Mentawai primates are found in zoos anywhere in the world.

New recommended conservation action

I have two general recommendations: first, to increase existing protection by enforcing the laws governing the integrity and management of the existing national park, extending formal protected area status to the Peleonan forest, and working with existing "Conservation Areas" set aside by PT Minas Pagai Lumber Corporation in the Pagais; and second, to begin a campaign of education and law enforcement against hunting of endangered primates throughout the Mentawais.

Increased protection of Siberut National Park. Siberut National Park already encompasses nearly half of the island of Siberut, and is home to the largest populations of all four primate species. This area has the potential to adequately protect the Mentawai wildlife, but unfortunately the laws are not enforced. Hunting beyond that allowed by the land-use regulations occurs throughout the park, and logging companies outside the park boundaries frequently encroach upon park forest. The park has few employees, and funds from park headquarters in Padang infrequently reach Siberut (a problem for workers throughout the Mentawais, including government employees and teachers), giving employees little motivation to perform their jobs with zeal and competence. The park needs funding to hire more park guards, and improved administration to ensure that guards receive their pay in a timely manner. A system of penalties for breaking park regulations should be developed and implemented.

Formal protection of the Peleonan forest. While the national park has big enough to provide for conservation of the Mentawai primates, it is very inaccessible. About 2,000 tourists visit Siberut each year to observe the traditional lifestyle of the local people, but none of them ever enter the remote national park. Similarly, few researchers work within the park boundaries. Formally protecting the 40-km² Peleonan forest in North Siberut will provide opportunities for Siberut to generate income from ecotourism and research, as well as increase awareness about the Mentawai Island forests and primates.

Protected areas in the Pagai Islands. Although there is no apparent subspecific differentiation between Kloss's gibbon populations on Pagai and Siberut, this is evidently the case for the other three species. Protection of the primate populations on the Pagai Islands is essential to conserve these differentiated populations. Because attempts to conserve undisturbed areas in the Pagais have not been successful, and because PT Minas Pagai Lumber Corporation has established its own "conservation areas" within its concession, I propose that a conservation program collaborate with this corporation to conserve these endemic subspecies. The corporation has been very open to allowing researchers to study primates in the concession, and has even provided accommodation, transportation, and field assistants. The administrative heads of the company have expressed great interest in the results of recent studies by Paciulli (2004) and Whittaker (2005a). Furthermore, most employees of this corporation appear to have an understanding of the concepts of sustainable use and conservation, an attitude that is rare in the Mentawais. I recommend working closely with the logging company, requesting the continued conservation of those areas, perhaps in exchange for benefits for the company or its employees, which would include a "green" certification for the company's lumber, or educational programs for the employees (many Mentawai people have expressed a desire for training in economics, for example).

A collaboration between conservationists and a logging company has been attempted at least once — between the Wildlife Conservation Society (WCS) and the Congolaise Industrielle des Bois (CIB) in the Republic of Congo (Peterson and Amman 2003). As described by Dale Peterson and Karl Ammann (2003), this partnership evidently had unfortunate consequences, allowing the logging company to advertise its relationship with WCS while failing to enforce hunting laws as agreed. A collaboration with PT Minas could have very different results, for several reasons: 1) PT Minas is a small Indonesian company, controlling 833 km², while CIB is a German-owned corporation with a 12,000 km² concession; 2) PT Minas already implements selective logging and regeneration techniques, and has carefully managed the same small area for over 30 years by rotating plots on a 20-year cycle; 3) the forested area within PT Minas is relatively very small, and would require few people (and not much money) to manage and monitor the area; and 4) the corporation has already welcomed researchers, as noted above.

Conservation education, especially regarding hunting. An educational campaign throughout the Mentawais, but especially in the Pagais, is essential to the survival of the Mentawai primates. New technologies for forest product extraction and hunting, as well as a cash-based economy (making the prospect of selling land to companies very attractive), are relatively new to the Mentawai people. As is evident in their attitude toward hunting primates, a full understanding of the concept of sustainability has not really arrived. While no data are available to quantify how much hunting is sustainable, a reduction in hunting is crucial even though cessation is unrealistic. A conservation education campaign should begin with the schools and perhaps the churches. In addition, educating the hundreds of people who work with PT Minas to reduce hunting could be very effective, as they already express an understanding of sustainability with regard to the trees.

Alternative economic development. Major educational campaigns are underway in Siberut through UNESCO and Siberut National Park to inform local people about land rights, economics, and alternative, sustainable livelihoods, such as the planting and harvesting of cinnamon. These efforts should be supported and continued, as well as expanded to the Pagais. More personnel are needed for these efforts. I recommend that local Mentawai people be trained as educators and compensated for their work.

Conclusion

The Mentawai primate populations have declined dramatically in the last 25 years, and recent data necessitate updating the conservation status of each of the four endemic species. Action must be taken to conserve populations of these species; while much of the infrastructure for conservation (for example, in Siberut National Park) is already in place, further involvement is necessary to ensure the success of these measures. The long-term success of conservation in the Mentawai Islands will depend on the involvement of the local people, which in turn will depend on changes in the current attitudes about sustainability.

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Conservation of Threatened Primates of Northeast India

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Abstract: The northeastern region of India also, referred to as a “biogeographical gateway,” is the transition zone between Indian, Indo-Malayan and Indo-Chinese biogeographical regions. Primates are an important component of this region’s biodiversity. The objectives of our study were to map the distribution and status of the different primate species to record habitat fragmentation, and to assess present forest status and human population pressures in Northeast India. Between 1994 and 2001, we surveyed several protected, reserved, and unclassified forests (about 650,000 ha) using a modified line-transect method to cover all representative areas in a randomly stratified manner to estimate density and distribution of primate species. Four species of macaque (rhesus, Assamese, northern pig-tailed, and stump-tailed) and three species of langur (capped, golden, and Phayre’s), the hoolock gibbon, and the Bengal slow loris were sighted. The species recorded occur in very low densities with low numbers of immatures, and are threatened due to habitat loss and hunting. Recommendations were made to upgrade the status of many reserved forests, to make improvements to the country’s wildlife laws, to increase the number of protected areas in the region, for public education and community participation programs, and political action to implement effective conservation strategies.

Key Words: Primates, Northeast India, conservation, golden langur, hoolock gibbon

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Introduction

Extensive deforestation and habitat fragmentation continue at alarming rates throughout the world, and the survival of innumerable forest species, mainly in the tropics, is in jeopardy (Marsh and Mittermeier 1987). Officially only 3.7% of the world’s total land area is protected as national parks or forest reserves (McNeely *et al*. 1990) and most of it is under tremendous pressure of human population growth. Based on estimated numbers of endemic species and degree of threat, Myers *et al*. (2000) recognized 25 ‘hotspots’ worldwide, and as more data became available their number has been recently increased to 34 (Conservation International 2006). These hotspots cover 2.3% of the land surface, yet harbor 50% of all plant species and 42% of all vertebrate species, and in some less than 12 percent of the original natural habitat remains (Myers *et al*. 2000). Of the three biodiversity hotspots in India, the Indo-Burma Hotspot (includes northeastern India) is in greater danger than the Western Ghats and the Eastern Himalayas (India, Forest Survey of India 1999). Sandwiched between the Himalayas and the Bay of Bengal, the narrow strip of land known as Northeast India serves as a corridor connecting the people, fauna and flora of the Indian subcontinent to tropical Southeast Asia and the more temperate northern Asian climes. Periodically covered by glaciers during the Pleistocene, this area today is rich in ethnic and biological diversity (Srivastava 1999). It is the western limit for some south Asian species and the eastern limit for some Indian species. In spite of the variety of taxa found in this region, only recently have concerted efforts have been made to explore and study its biodiversity.

Northeastern India is made up of seven political states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura) with a total area of 255,083 km², of which 164,043 km² is forested and only 13,555 km² (5.3%) is protected. These forests are composed of evergreen rain forest, semi-evergreen, and moist deciduous forests. About one third of this area (34%) is protected as reserved forests and (9.2%) as strictly protected wildlife sanctuaries and national parks. Over half (56.8%) remain unclassified. According to the National Remote Sensing Agency, actual forest cover is now declining and is being degraded, mainly due to illegal felling and encroachment (India, Forest Survey of India 1999). The human population in Northeast India has grown exponentially from about 4 million people in 1901 to 14.5 million by 1961 and 38.5 million by 2001 (India, Census of India 2001).

The population pressure on natural habitats, combined with hunting, and live capture, has driven numerous species to the brink of extinction. It is therefore important to identify the species most susceptible to extinction in isolated fragments and the habitats that are most likely to support them. Such generalizations will allow for predictions to be made for areas for which data are as yet unavailable.

Primates are valuable subjects for such studies for several reasons (for review, see Marsh and Mittermeier 1987). In order to prevent the extinction of a significant percentage of primates, empirical information about these species and their habitats was required. In 1994, therefore, we set up an integrated, collaborative Indo-U.S. Primate Project to conduct systematic status surveys, record fragmentation of primate habitats, and develop eco-ethological profiles of individual species to provide a basis for the conservation and management of primate habitats and species living therein.

Between 1994 and 1999, our research team surveyed over 650,000 ha of protected, unprotected, and unclassified forests using the line transect method, modified to cover all representative areas in a randomly stratified sample (Burnham *et al.* 1980; NRC 1981; Kent and Coker 1994, Srivastava *et al.* 2001a, 2000b). Many long-term studies on ecology and behavior of particular species were also conducted to understand plasticity in behavior, responses to habitat change, and the long-term consequences of these changes on the future of primate populations. The detailed analysis of these results is beyond the scope of this paper and reported elsewhere. Here I provide a brief summary of the status, distribution and conservation of the primates in Northeast India, with special reference to golden langurs and hoolock gibbons, both of which are confined to this region in the Indian portions of their ranges.

Results

Nine species of primates were found: hoolock gibbon (*Hoolock hoolock*) (formerly in the genus *Hylobates*, and briefly in the genus *Bunopithecus*; see Mootnick and Groves 2005), golden langur (*Trachypithecus geei*), capped langur (*Trachypithecus pileatus*), Phayre's leaf monkey (*Trachypithecus phayrei*), stump-tailed macaque (*Macaca arctoides*), Assamese macaque (*Macaca assamensis*), northern pig-tailed macaque (*Macaca leonina*), rhesus macaque (*Macaca mulatta*), and Bengal slow loris (*Nycticebus bengalensis*). There have been reports of silvered leaf monkey (*T. cristatus*), Tibetan macaque (*M. thibetana*), and golden snub-nosed monkey (*Rhinopithecus roxellanae*) in the past (Roonwal and Mohnot 1977; Choudhury 1998) but our detailed survey indicated that these reports were either based on indirect observations or misidentification. Several forms are represented by distinct subspecies, as in the case of Assamese macaque, where the western and eastern subspecies are as genetically distinct as the different species of macaques (Hoelzer and Melnick 1996). Though recorded earlier, Hanuman langurs (*Semnopithecus entellus*) were not encountered in the areas surveyed.

Distribution and conservation status

A number of primates were evidently restricted to the south of the Brahmaputra River: Stump-tailed macaque, pigtailed macaque, hoolock gibbon and Phayre's leaf monkey. Rhesus macaques were encountered more often in areas adjacent to forest rather than in the forest proper. Capped langurs, the most widely distributed of the species, with five distinct subspecies, were encountered frequently, even though occurring in very low densities. Phayre's leaf monkey was observed thriving well in degraded habitats and bamboo forests. Hoolock gibbons were encountered with low densities in primary, secondary and regenerating forests. Table 1 contains the data on primate sightings in different forest types and sympatry with other primate species.

The number of groups for each species, total forest area surveyed, number of individuals, the male-female sex ratio, and percent availability of immatures are given in Table 2. These results indicate that all the primates in Northeast India occur in very low densities: low encounter rates were very low as were the numbers of immatures in the populations—suggestive of population decline, but census figures before 1994 are not available for comparison.

Although nonhuman primates do survive in the forests of Northeast India, their habitats are under severe pressure. Most of the reserved forests which had once been a rich primate habitat have been degraded, and populations are small, barely able to subsist, and in rapid decline. These surveys revealed that most of the species in Northeast India are threatened and their legal status is inadequately addressed by the various conservation agencies (Table 3).

Habitat loss is the principal threat to wild primate populations in Northeast India. Table 4 shows the loss of forest by state between 1997–1999 and 2001–2003 (India, Forest Survey of India 1999, 2003) and the remaining primate habitat. Habitat loss results from clear cutting for settlements and agriculture, and forests are also selectively logged for fuelwood and construction material and exploited for natural products. In many areas the damage is substantial and locally threatening to the survival of the primates.

Table 1. Primate sightings in different forests types and sympatric species.

Species	Forest Types	Sympatric Species
1. *Macaca arctoides*	MF, SEG, MD	2,3,4,6,7,8,9
2. *Macaca assamensis*	EG, SEG, DD, MD	1,3,4,5,6,7,8,9
3. *Macaca mulatta*	DD, MD, BF, SG, HH	1,2,4,5,6,7,8,9
4. *Macaca leonina*	SEG, EG, SG, MF	1,2,3,6,7,8,9
5. *Trachypithecus geei*	MD, EG, SEG	2,3
6. *Trachypithecus phayrei*	EG, BF, MD	1,2,3,4,7,8,9
7. *Trachypithecus pileatus*	EG, BF, MD	1,2,3,4,6,8,9
8. *Hoolock hoolock*	EG, SEG	1,2,3,4,6,7,9
9. *Nycticebus bengalensis*	EG, SEG, SG	1,2,3,4,6,7,8

[1] M = Mixed forests; EG = Evergreen; SEG = Semi evergreen; MD = Moist deciduous; DD = Dry deciduous; BF = Bamboo forests; SG = Secondary growth; HH = Human habitation.

Table 2. Demographic profile of primates of Northeast India.

Species	Forest surveyed (km²)	No. troops sighted	No. individuals	Sex ratio (M:F)	% of immatures
Nycticebus bengalensis[1]	–	–	7	–	–
Macaca arctoides	1,732	14	133	1:1.9	68
Macaca assamensis	13,998	68	449	1:2.6	45
Macaca mulatta	5,913	141	1,804	1:2.5	39
Macaca leonina	993	11	71	1:1.5	31
Trachypithecus geei	1,547	131	1,035	1:2.5	24
Trachypithecus phayrei	1,060	21	145	1:1.5	47
Trachypithecus pileatus	43,509	152	844	1:2.5	40
Hoolock hoolock	3,055	76	244	1:1	26

[1] Night surveys were not conducted; individuals confiscated from various locations.

Table 3. Status of primates of Northeastern India as per different agencies.

Species	Status (WPA 2002)[1]	IUCN Red List 2004	Current status[2]
Nycticebus bengalensis	Schedule – I	Data Deficient	Data Deficient
Macaca arctoides	Schedule – II	Vulnerable	Critically Endangered
Macaca assamensis	Schedule – II	Endangered	Endangered
Macaca mulatta	Schedule – II	Least Concern	Forest populations dwindling
Macaca leonina	Schedule – II	Vulnerable	Critically Endangered / Endangered[3]
Trachypithecus geei	Schedule – I	Endangered	Critically Endangered / Endangered[4]
Trachypithecus phayrei	Schedule – I	Not Evaluated	Critically Endangered / Endangered[5]
Trachypithecus pileatus	Schedule – I	Endangered	Endangered
Hoolock hoolock	Schedule – I	Endangered	Endangered

[1] Wildlife (Protection) Amendment Act 2002

[2] Based on Indo-U.S. Primate Project Survey and Molur *et al.* (2003)

[3] Molur *et al*. (2003) assessed the species as Endangered

[4] Molur *et al*. (2003) assessed the species as Endangered

[5] Molur *et al*. (2003) refer to Phayre's langur as *T. obscurus phayrei* and assessed it as Endangered

Table 4. State wise forest cover loss and remaining primate habitats in Northeast India.

States	Total area (km²)	Dense forest cover loss 1997–1999[1] (km²)	Dense forest cover loss 2000–2003[1] (km²)	Remaining dense forest (more than 40% crown density)[1]
Arunachal Pradesh	83,743	798	2,671	51,261
Assam	78,438	1,328	3,547	12,283
Manipur	22,327	218	2,116	3,594
Meghalaya	22,429	28	1,767	3,913
Mizoram	21,087	1,106	5,155	3,781
Nagaland	16,579	4	1,910	3,483
Tripura	10,477	206	684	2,779

[1] India, Forest Survey of India, 1999; 2003 (Source: IRS- 1B LISS II; IRS-1C & 1D LISS III)

The hunting of primates in Northeast India takes place for a number of reasons, but by far the most important is for food. Although hunting is prohibited by the Wildlife (Protection) Act of India of 1972 (amended 2002), its enforcement is usually nonexistent in the remote areas. In areas where the hunting of primates for food is common, it can represent a threat even more severe than forest destruction. In Arunachal Pradesh, Mizoram and Nagaland, for example, there are large tracts of primary forest remaining where primate populations have been either exterminated or pushed to the brink of local extinction by excessive hunting.

Primates may also be killed when they raid and damage crops; this is especially true for the rhesus macaque in most of Northeast India. Other macaques are also reported crop-raiding in a number of areas: pig-tailed macaques in Meghalaya, stump-tailed macaques in Nagaland, and Assamese macaques in Arunachal Pradesh are hunted as agricultural pests (Srivastava 1999). Golden langurs are reported to damage cardamom crops and capped langurs maize fields in Northeast India. In general it appears that the more locally abundant species are the more they raid crops, and the persecution of crop-raiding species is not, it would appear, a cause of endangerment to the species in any particular area (Srivastava and Mohnot 2001c). This issue is important, however, and, being poorly understood, certainly needs further investigation.

Status of golden langurs

The golden langur (*Trachypithecus geei*) is found only in a small portion of western Assam, India and neighboring regions of Bhutan. Its distribution lies north of the Brahmaputra River and is bounded on the east by the Manas River and in the west by the Sankosh River (Srivastava 1999). Surveys carried out over 733 km of transects indicated that 93% of the total population inhabits just three reserved forests and the western part of Manas National Park. The seven percent of the remaining population encountered in other reserved forests of various sizes are often isolated and sometimes in areas under very heavy human population pressures (Srivastava *et al*. 2001a). Ethnic violence that broke out in 1989 in the range of the golden langur resulted in considerable loss of their forests. As such they were victims of the "tragedy of the commons," and one-third of the original golden langur habitat has been lost over the last ten years (Data IRS-1B LISS II images taken in 1989 and 1999). A total of 1,035 individuals were counted, and the estimate was that about 1,500 animals were surviving in India. A much larger population may exist in Bhutan. The percent of immature individuals was 24%. Our survey suggested that less than 500 km² of suitable habitat is available in the northeast and that the golden langur should be placed in the category of Critically Endangered in India.

Status of hoolock gibbons

The hoolock gibbon (*Hoolock hoolock*), India's only ape, is confined to small forest patches of the northeast, to the south of the Brahmaputra River. Surveys have indicated that the free-ranging populations of gibbons are the most seriously threatened of the primates, even where habitat destruction is minimal. We monitored the hoolock population at Borajan Reserved Forest (5 km²) for more than four years, between 1995 and 1999, during which time there was a population decline of 68% (Srivastava *et al*. 2001b) (Table 5). Eleven groups, 34 individuals in all, were found in the reserve in the 1995 survey, but by 1999 only five groups remained, with a total of 11 individuals—all in an isolated stand of trees that required they go to the ground to reach additional food trees. The number of immature animals was only 20% of the population. A total of 3,055 km² of forests with different degrees of protection were surveyed, and a population of 244 individuals living in 76 family groups was recorded (Srivastava and Mohnot 2001c). The total population in India may not exceed 5,000 individuals. The adult male to female ratio was 1:1, and 26% of the langurs counted were immature. The survey estimated 18,669 km² of available suitable habitat in Northeast India, and recommended the species should be placed in the Endangered category in India. Choudhury (2006) reported similar trends for the status of gibbons based on cross-sectional surveys carried out between 1987 and 2005 covering the states of Meghalaya, Manipur, Mizoram and Nagaland of northeast India.

Discussion

Primate conservation in India requires that three main issues be addressed—forest conservation, hunting pressure and legal status.

Since, forest loss is the principal threat to primates, habitat protection should be given highest conservation priority. The most valuable direct means of assessing species conservation is the establishment and management of strictly protected areas as well as community-based conservation areas. Over 60% of the closed forests (canopy cover of 40% or more) in Northeast India remain without any kind of legal or community protection, and it is imperative to prepare a conservation plan which would bring these areas into the protected area network; be they managed by local communities or by administrative authorities with local participation. Joint forest management programs have been adopted by a number of states elsewhere in the country and have shown some remarkable results. They could well be applied in the northeast; with modifications to account for the regional and local culture and traditions. The National Forest Commission recently submitted a report that gave the following recommendations: 1) to bring one-third of the landmass of the country under tree cover into protected area categories; 2) to revise and update the Indian Forest Act of 1927; and 3) to carry out periodic revisions of the Wildlife (Protection) Amendment Act (India, National Forest Commission 2006). Conservation education can be very effective and many people understand the value of wildlife and natural habitats. There is already a basic and, in many areas deep-seated, respect for living creatures and pride in the nation's natural heritage. Conservation education and conservation action projects should involve NGOs, and the local communities that live in and around forested areas.

Primates in Northeast India are hunted for a variety of reasons, but by far the most important is for food. Although hunting is prohibited by the Indian Wildlife (Protection) Act of 1972 (amended in 1993), its enforcement is often very difficult in remote areas and even local communities are unaware of the regulations. Hunting is a threat even more severe than forest destruction in some of the more remote areas. Efforts

Table 5. Hoolock gibbon population change between 1995 and 1999 in the Borajan Reserved Forest.

Transects	1995	1995	1997	1997	1998	1998	1999	1999
	Groups	Total	Groups	Total	Groups	Total	Groups	Total
T-1	2	4	1	3	1	4	2	6
T-2	3	11	0	0	0	0	0	0
T-3	4	11	3	6	3	5	2	3
T-	2	8	3	8	1	2	1	2
Total	11	34	7	17	5	11	5	11

Photo 1. Rhesus macaques, *Macaca mulatta,* are captured young and trained to perform at roadside shows by charmers. Photograph by Arun Srivastava.

Photo 2. Golden langur habitat near Ultapani (Chirrang Reserved Forest) cleared for cultivation. Photograph by Arun Srivastava.

Photo 3. The capped langur, *Trachypithecus pileatus*, is an endangered colobine widely distributed in northeast India. Photograph by Arun Srivastava.

Photo 4. The slow loris, *Nycticebus bengalensis*, is being hunted for wildlife trade throughout its range in Asia. Photograph by Prabal Sarkar.

should be made to raise awareness among communities living in these fringe areas.

India's Wildlife (Protection) Amendment Act of 2002 needs revision. A number of species included in Schedule-II should now be listed in Schedule-I, which would prohibit their persecution, hunting and capture for any reason. Although the *2004 IUCN Red List of Threatened Species* is comprehensive and identifies a significant number of primates of Northeast India as threatened, this too needs revision; especially taking into account the careful assessments carried out during the South Asian Primate Conservation Assessment and Management Plan (CAMP) Workshop, organized by the Conservation Breeding Specialist Group – South Asia in 2002 (Molur *et al*. 2003) (Table 3). Molur *et al*. (2003) provide specific recommendations for conservation action and research to better assess the status of these Northeast Indian primates, particularly necessary for several macaque species, which are thought to be evenly distributed across south and southeast Asia. All the distinct threatened populations must be given proper consideration (for example, the eastern and western subspecies of Assamese macaques and the five subspecies of capped langurs).

The surveys of US-Indo Primate Project have helped us to identify the "focal areas" for the survival and for long-term conservation and management of the primates in Northeast India. They have also given us the opportunity to identify the threats and suggest specific measures. The next step is to identify the underlying causes of habitat loss and change affecting the primate populations; how different species are responding to each of threats; the demographic aspects which affect future generations; and to obtain some degree of understanding as to the fate of these monkeys in their natural habitats and how we can save them from extinction. The next phase of our conservation efforts, therefore, will aim to initiate species-specific long-term studies on behavior and ecology to provide information vital for establishing reserves and delineating their necessary size and boundaries; to understand the specific ecological and sociological requirements of each species; and allow us to predict trend in population change. Based on this, it is possible to set up a comprehensive conservation action plan for the species.

Conclusions

1. Revision of *2004 IUCN Red List of Threatened Species* is urgently required.
2. The Indian Wildlife (Protection) Amendment Act of 2002 also needs revision. Several species included in Schedule-II, should now be put in Schedule-I.
3. In Arunachal Pradesh, Meghalaya, Mizoram and Nagaland there are large tracts of primate habitat remaining, but primate populations have effectively been either exterminated or pushed to the brink of local extinction by excessive hunting.
4. Hunting of primates as agricultural pests is a major problem. The rhesus macaques can become significant crop-raiders in certain areas and are persecuted as such. The northern pig-tailed, stump-tailed and Assamese macaques are also hunted as pests.
5. It is important to note that the primates in northeastern India have been forced into crop raiding because of loss of natural habitat. In some cases, they have clearly learned to co-exist with humans by raiding crops. Conflicts of this kind are likely to increase in the future as the human population continues to grow exponentially in northeastern India, and encroachment on primate habitats continues.
6. Habitat destruction is the most significant threat to the survival of primates in Northeast India. It is evident, however, that certain species can survive in disturbed habitats, but the long-term consequences on reproduction and survival are unknown.
7. With the current rate of habitat loss it is estimated that some Critically Endangered species such as golden langurs could go extinct in the next quarter century.
8. Gibbons are confined to isolated forest fragments and are worst affected even with minimal levels of habitat destruction.
9. Differences in population density, demography, and social structure can be related to habitat quality at different reserve forests with varying degree of disturbance.
10. Detailed studies that combine field surveys and phylogenetic studies are needed to determine relatedness among newly recognized taxa, especially subspecies of the *Trachypithecus pileatus* group and the Hanuman langurs (*Semnopithecus entellus*) to implement effective conservation and management strategies.

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Back cover: Golden langur (*Trachypithecus geei*). Adult female with an infant in Chirrang Reserved Forest. A Critically Endangered species of northeast India, which has lost one-third of its habitat to encroachment and clear cutting in recent years. Photograph by Arun Srivastava.

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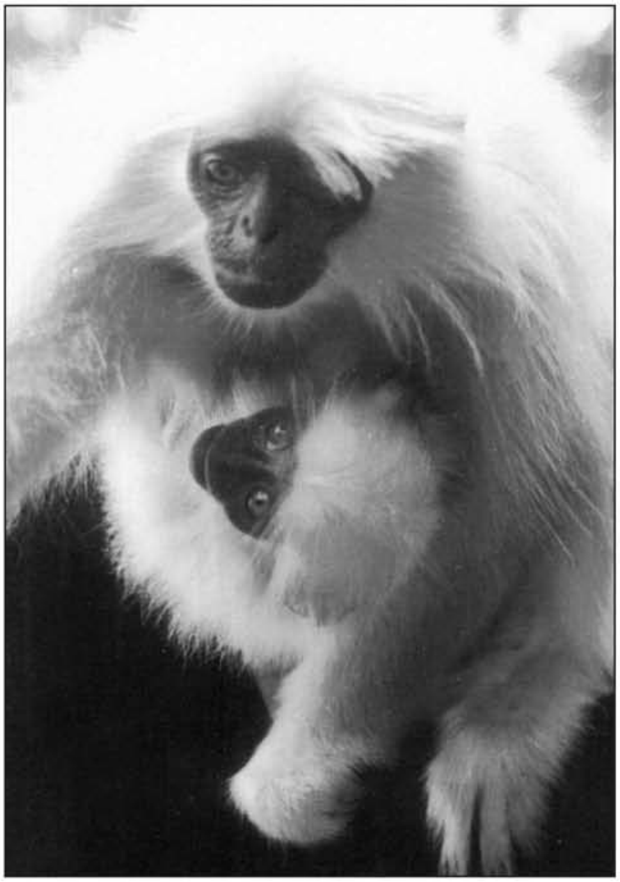

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