

A Conservation Action Plan for the Mentawai Primates

Author: Whittaker, Danielle J.

Source: Primate Conservation, 2006(20) : 95-105

Published By: Conservation International

URL: <https://doi.org/10.1896/0898-6207.20.1.95>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

A Conservation Action Plan for the Mentawai Primates

Danielle J. Whittaker

Department of Anthropology, Queens College, Flushing, New York, USA

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 cercopithecin. 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 Men-

tawai 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.

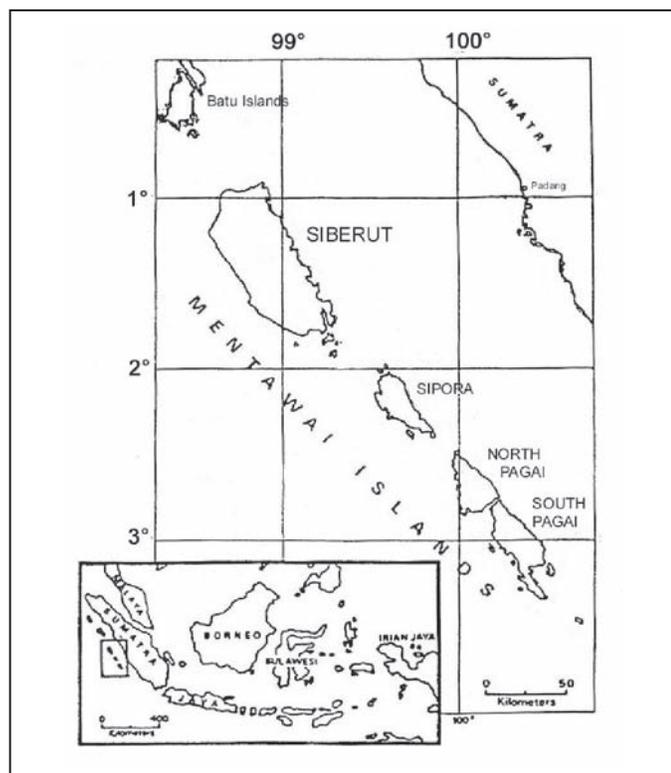


Figure 1. Map of the Mentawai Islands.

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 cercopithecin 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 congeners, 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).

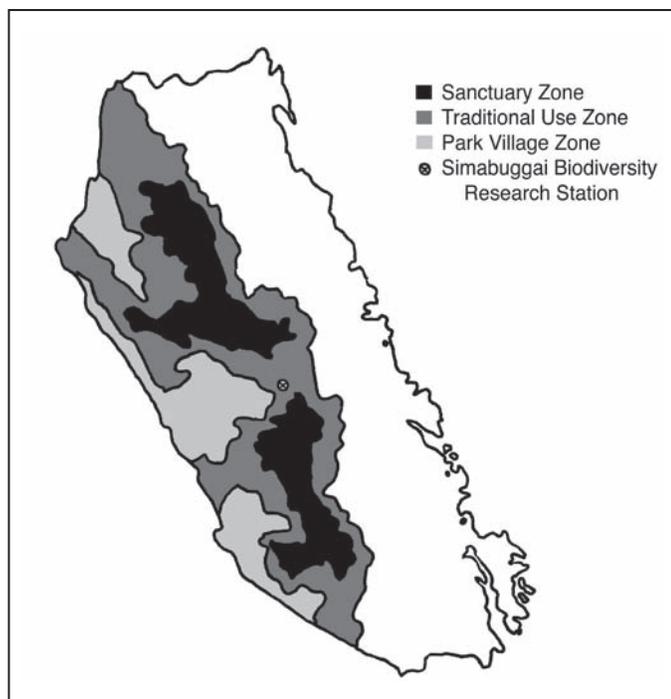


Figure 2. Map of Siberut National Park showing management zones.

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 Sikabalan. 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 gibbon in the Pagai Islands, and specifically for *S. c. concolor*, *P. p. potenzianni* and *M. pagen-sis* 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 des-

ignated 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 km ²	3,500 km ²	2,400 km ²
Sipora	845 km ²	400 km ²	100 km ²
North and South Pagai	1,675 km ²	900 km ²	200 km ²
Total	6,550 km ²	4,800 km ²	2,700 km ²

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 $\geq 20\%$ 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 $\geq 20\%$ 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 $\geq 50\%$ 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 $\geq 50\%$ 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.

Island	<i>Hylobates klossii</i>		<i>Simias concolor</i>		<i>Presbytis potenziani</i>		<i>Macaca pagensis</i>	
	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 habi-

tat 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 $\geq 30\%$ 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.

Acknowledgments

I thank John F. Oates, Noviar Andayani, Amsir Bakar, Koen Meyers, Christophe Abegg, Lisa Paciulli, Sasimar Sangchantr, Kathleen Donovan, Firman, Rizaldi, and Nathan Burroughs for their assistance. This project was funded by the National Science Foundation (BCS-0335949), the Lindbergh Foundation, Primate Conservation, Inc., and Conservation International. Thanks to the Republic of Indonesia, LIPI, and PT Minas Pagai Lumber Corporation for permission and assistance with this project.

Literature Cited

- Abegg, C. 2004. Siberut Conservation Project. Website: <http://www.siberut-island.org/website.php>. Accessed 24 March 2005.
- Anonymous. 2000. Loggers rush to strip Siberut. *Down to Earth Newsletter* Number 44. Website: <http://dte.gn.apc.org/44sib.htm>. Accessed 31 August 2005.
- Anonymous. 2003. Warga Madobak Mengadu ke Bupati. *Puailiggoubat*, Padang, 1–14 October: 3.
- Anonymous. 2005. Regent revokes logging permits. *The Jakarta Post*, Jakarta, Indonesia, 19 April 2005.
- Bachyul Jb, S. 2005. Mentawai gets no income from forestry sector. *The Jakarta Post*, Jakarta, 24 March 2005.
- Batchelor, B. C. 1979. Discontinuously rising late Cenozoic eustatic sea-levels, with special reference to Sundaland, Southeast Asia. *Geologie en Mijnbouw* 58: 1–20.
- Bonaparte, P. C. L. 1856. Excursions dans les divers musées d’Allemagne, de Hollande et de Belgique, et tableaux

- paralléliques de l'ordre des échassiers. C. r. hebd. Séanc. Acad. Sci., Paris 43: 410–421.
- Brandon-Jones, D. 1993. The taxonomic affinities of the Mentawai Island sureli, *Presbytis potenziani* (Bonaparte 1856) (Mammalia: Primata: Cercopithecidae). *Raffles Bull Zool.* 41: 331–357.
- Brandon-Jones, D., A. A. Eudey, T. Geissmann, C. P. Groves, D. J. Melnick, J. C. Morales, M. Shekelle and C.-B. Stewart. 2004. Asian primate classification. *Int. J. Primatol.* 25: 97–164.
- Brockelman, W. Y. and R. Ali. 1987. Methods of surveying and sampling forest primate populations. In: *Primate Conservation in the Tropical Rain Forest*, C. W. Marsh and R. A. Mittermeier (eds.), pp.23–62. Alan R. Liss, New York.
- Chasen, F. N. 1940. A handlist of Malayan mammals. *Bull. Raffles Mus. Singapore* 15: 1–209.
- Chasen, F. N. and C. B. Kloss. 1927. Spolia Mentawiensia —Mammals. *Proc. Zool. Soc. Lond.* 53: 797–840.
- Chatterjee, H. 2001. Phylogeny and biogeography of gibbons, genus *Hylobates*. PhD thesis, University of London, London.
- Chivers, D. J. 1977. The lesser apes. In: *Primate Conservation*, H. S. H. Prince Rainier III of Monaco and G. H. Bourne (eds.), pp.539–598. Academic Press, New York.
- Creel, N. and H. Preuschoft. 1984. Systematics of the lesser apes: A quantitative taxonomic analysis of craniometric and other variables. In: *The Lesser Apes: Evolutionary and Behavioral Biology*, H. Preuschoft, D. J. Chivers, W. Y. Brockelman and N. Creel (eds.), pp.562–613. Edinburgh University Press, Edinburgh.
- Delson, E. 1975. Evolutionary history of the Cercopithecidae. *Contrib. Primatol.* 5: 167–217.
- Dring, J. C. M., C. J. McCarthy and A. J. Whitten. 1990. The terrestrial herpetofauna of the Mentawai Islands, Indonesia. *Indo-Malayan Zool.* 6: 119–132.
- Eudey, A. A. 1987. *Action Plan for Asian Primate Conservation: 1987–91*. IUCN/SSC Primate Specialist Group, Gland, Switzerland.
- Fooden, J. 1975. Taxonomy and evolution of liontail and pig-tail macaques (Primates: Cercopithecidae). *Fieldiana Zool., New Series* (67): 1–169.
- Fuentes, A. 1994. The socioecology of the Mentawai Island langur (*Presbytis potenziani*). PhD thesis, University of California, Berkeley.
- Fuentes, A. 1996/1997. Current status and future viability for the Mentawai primates. *Primate Conserv.* (17): 111–116.
- Fuentes, A. 2002. Monkeys, humans and politics in the Mentawai Islands: No simple solutions in a complex world. In: *Primates Face to Face: Conservation Implications of Human-Nonhuman Primate Interactions*, A. Fuentes and L. D. Wolfe (eds.), pp.187–207. Cambridge University Press, Cambridge, UK.
- Fuentes, A. and M. Olson. 1995. Preliminary observations and status of the Pagai macaque. *Asian Primates* 4: 1–4.
- Garza, J. C. and D. S. Woodruff. 1992. A phylogenetic study of the gibbons (*Hylobates*) using DNA obtained noninvasively from hair. *Molec. Phylogenet. Evol.* 1: 202–210.
- Geissmann, T. 1993. Evolution of communication in gibbons (Hylobatidae). PhD thesis, University of Zürich, Zürich.
- Groves, C. P. 1970. The forgotten leaf-eaters and the phylogeny of Colobinae. In: *Old World Monkeys*, J. R. Napier and P. H. Napier (eds.). Academic Press, New York.
- Groves, C. P. 2001. *Primate Taxonomy*. Smithsonian Institution Press, Washington, DC.
- Groves, C. P. 2005. Order Primates. In: *Mammal Species of the World: A Taxonomic and Geographic Reference*, 3rd Edition, Volume 1, D. E. Wilson and D. M. Reeder (eds.), pp.111–184. Johns Hopkins University Press, Baltimore.
- Haimoff, E. H., D. J. Chivers, S. P. Gittins and T. Whitten. 1982. A phylogeny of gibbons (*Hylobates* spp.) based on morphological and behavioural characters. *Folia Primatol.* 39: 213–237.
- Harvey, P. H., R. D. Martin and T. H. Clutton-Brock. 1987. Life histories in a comparative perspective. In: *Primate Societies*, B. B. Smuts, D. L. Cheney, R. M. Seyfarth, R. W. Wrangham and T. T. Struhsaker (eds.), pp. 181–196. The University of Chicago Press, Chicago.
- IUCN 2004. *2004 IUCN Red List of Threatened Species*. Website: www.redlist.org. Accessed 24 January 2005.
- Karig, D. E., G. F. Moore, J. R. Curray and M. B. Lawrence. 1980. Morphology and shallow structure of the lower trench slope off Nias Island, Sunda Arc. In: *The Tectonic and Geologic Evolution of Southeast Asian Seas and Islands*, D. E. Hayes (ed.), pp.179–208. American Geophysical Union, Washington, DC.
- Kobold, S., T. Ziegler and R. Maennel. 2003. The primates of Mentawai and the Siberut Conservation Project. *ZGAP Mitteilungen* 19: 7–9.
- Loeb, E. M. 1929. Mentawai religious cult. *Univ. Calif. Publ. Am. Archaeol. Ethnol.* (25): 185–247.
- Marshall, J. and J. Sugardjito. 1986. Gibbon systematics. In: *Comparative Primate Biology. Volume I. Systematics, Evolution, and Anatomy*, D. R. Swindler and J. Erwin (eds.), pp.137–185. Alan R. Liss, New York.
- Miller, G. S. 1903. Seventy new Malayan mammals. *Smithson. Misc. Coll.* (45): 1–73.
- Miller, G. S. 1933. The classification of the gibbons. *J. Mammal.* 14: 158–159.
- Mitchell, A. H. and R. L. Tilson. 1986. Restoring the balance: traditional hunting and primate conservation in the Mentawai Islands, Indonesia. In: *Primate Ecology and Conservation*, J. G. Else and P. C. Lee (eds.), pp.249–260. Cambridge University Press, Cambridge, UK.
- Moore, G. F., J. R. Curray, D. G. Moore and D. E. Karig. 1980. Variations in geologic structure along the Sunda fore arc, northeastern Indian Ocean. In: *The Tectonic and Geologic Evolution of Southeast Asian Seas and Islands*, D. E. Hayes (ed.), pp.145–160. American Geophysical Union, Washington, DC.
- Nooy-Palm, H. 1968. The culture of the Pagai Islands and Sipora, Mentawai. *Tropical Man* 1: 153–241.

- Paciulli, L. M. 2004. The effects of logging, hunting, and vegetation on the densities of the Pagai, Mentawai Islands primates. PhD thesis, State University of New York, Stony Brook.
- Peterson, D. and K. Amman. 2003. *Eating Apes*. University of California Press, Berkeley.
- PHPA. 1995. *Siberut National Park Integrated Conservation and Development Management Plan (1995–2020). Volume I: Current Conditions and Evaluation; Volume II: Action Plan for Conservation and Development; Volume III: Appendices*. Chemonics International in association with PT. Indeco Duta Utama and PT. Nadya Karsa Amerta, for Ditjen Perlindungan Hutan dan Pelestarian Alam, Departemen Kehutanan, Republik Indonesia, Jakarta.
- PT Minas Pagai Lumber Corporation. 1996. *Rencana Karya Pengusahaan Hutan yang Meliputi Seluruh Jangka Waktu Pengusahaan Hutan*. Padang, Indonesia.
- Ricklefs, M. C. 1993. *A History of Modern Indonesia Since c.1300*. Stanford University Press, Stanford, California.
- Roos, C., T. Ziegler, J. K. Hodges, H. Zischler and C. Abegg. 2003. Molecular phylogeny of Mentawai macaques: Taxonomic and biogeographic implications. *Molec. Phylogenet. Evol.* 29: 139–150.
- Sangchantr, S. 2004. Social organization and ecology of Mentawai leaf monkeys. PhD thesis, Columbia University, New York.
- Stibig, H.-J., R. Beuchle and P. Janvier. 2002. Forest cover map of insular Southeast Asia at 1:5,500,000. European Commission, European Union, Luxembourg.
- Takacs, Z., J. C. Morales, T. Geissmann and D. J. Melnick. 2005. A complete species-level phylogeny of the Hylobatidae based on mitochondrial ND3-4 gene sequences. *Molec. Phylogenet. Evol.* 36: 456–467.
- Tenaza, R. 1987. The status of primates and their habitats in the Pagai Islands, Indonesia. *Primate Conserv.* (8): 104–110.
- Tenaza, R. 1988. Status of primates in the Pagai Islands, Indonesia: A progress report. *Primate Conserv.* (9): 146–149.
- Tenaza, R. R. 1974. I. Monogamy, territory and song among Kloss' gibbons (*Hylobates klossii*) in Siberut Island, Indonesia. II. Kloss' gibbon sleeping trees relative to human predation: Implications for the socio-ecology of forest-dwelling primates. PhD thesis, University of California, Davis.
- Tenaza, R. R. and A. Fuentes. 1995. Monandrous social organization of pigtailed langurs (*Simias concolor*) in the Pagai Islands, Indonesia. *Int. J. Primatol.* 16: 295–310.
- Tenaza, R. R. and W. J. Hamilton III. 1971. Preliminary observations of the Mentawai Islands gibbon, *Hylobates klossii*. *Folia Primatol.* 15: 201–211.
- Tilson, R. L. 1980. Monogamous mating systems of gibbons and langurs in the Mentawai Islands, Indonesia. PhD thesis, University of California, Davis.
- Ting, N., D. J. Whittaker and D. J. Melnick. 2005. The phylogenetic position of the simakobu monkey (*Simias concolor*) based on mitochondrial sequence data. *Am. J. Phys. Anthropol. Suppl.* 40: 206. (Abstract)
- UNESCO 2005. UNESCO Man and the Biosphere Programme. Website: <http://www.unesco.org/mab/index.htm>. Accessed 25 April 2005.
- Washburn, S. L. 1944. The genera of Malaysian langurs. *J. Mammal.* 25: 289–294.
- Watanabe, K. 1981. Variations in group composition and population density of the two sympatric Mentawaiian leaf-monkeys. *Primates* 22: 145–160.
- Whittaker, D. J. 2005a. Evolutionary genetics of the Kloss's Gibbon (*Hylobates klossii*): Systematics, phylogeography, and conservation. PhD thesis, City University of New York, New York.
- Whittaker, D. J. 2005b. New population estimates for the endemic Kloss's gibbon *Hylobates klossii* on the Mentawai Islands, Indonesia. *Oryx* 39(4): 458–461.
- Whittaker, D. J., J. C. Morales and D. J. Melnick. 2005. Molecular systematics of the lar group of gibbons (*Hylobates*). *Am. J. Phys. Anthropol. Suppl.* 40: 222. (Abstract)
- Whittaker, D. J., N. Ting and D. J. Melnick. In press. Molecular phylogenetic affinities of the simakobu monkey (*Simias concolor*). *Molec. Phylogenet. Evol.*
- Whitten, A. J. 1982a. The ecology of singing in Kloss gibbons (*Hylobates klossii*) on Siberut Island, Indonesia. *Int. J. Primatol.* 3(1): 33–51.
- Whitten, A. J. 1982b. Diet and feeding behaviour of Kloss gibbons on Siberut Island, Indonesia. *Folia Primatol.* 37: 177–208.
- Whitten, A. J. 1982c. *The Gibbons of Siberut*. J. M. Dent & Sons Ltd., London.
- Whitten, A. J. and J. E. J. Whitten. 1982. Preliminary observations of the Mentawai macaque on Siberut Island, Indonesia. *Int. J. Primatol.* 3: 445–459.
- Whitten, A. J., J. Whitten and A. House. 1979. Solution for Siberut? *Oryx* 15: 166–169.
- Whitten, J. E. J. 1980. Ecological separation of three diurnal squirrels in tropical rainforest on Siberut Island, Indonesia. *J. Zool., Lond.* 193: 405–420.
- Whitten, T., S. J. Damanik, J. Anwar and N. Hisyam. 2000. *The Ecology of Sumatra*. Periplus, Singapore.
- Wilson, C. C. and W. L. Wilson. 1976. Behavioral and morphological variation among primate populations in Sumatra. *Yearb. Phys. Anthropol.* 20: 207–233.
- World Wildlife Fund. 1980. *Saving Siberut: A Conservation Master Plan*. WWF Indonesia Programme, Bogor.
- Zehr, S. M. 1999. A nuclear and mitochondrial phylogeny of the lesser apes (Primates, genus *Hylobates*). PhD thesis, Harvard University, Cambridge, Massachusetts.

Author's address:

Danielle J. Whittaker, Department of Anthropology, Queens College, 65-30 Kissena Blvd., Flushing, NY 11367, USA. E-mail: <djwhittaker@mindspring.com>.

Received for publication: September 2005

Revised: April 2006