

## Madagascar

### Greater Bamboo Lemur

*Prolemur simus* (Gray, 1871)

Madagascar

(2002, 2004, 2006, 2008)

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The greater bamboo lemur (*Prolemur simus*) is the largest of Madagascar's bamboo-eating lemurs (Albrecht *et al.* 1990) and the most critically endangered lemur in Madagascar (Ganzhorn *et al.* 1996, 1997; Konstant *et al.* 2006; Mittermeier *et al.* 2006; Ganzhorn and Johnson 2007; Wright *et al.* 2008). Although its placement in *Prolemur* has been questioned (for example, Tattersall 2007), it now represents a monospecific genus, based on a suite of distinctive dental and chromosomal characteristics (Vuillaume-Randriamanantena *et al.* 1985; Macedonia and Stanger 1994) that support its separation from the genus *Hapalemur* (cf. Groves 2001). Genetic studies further 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; Fausser *et al.*, 2002). *Prolemur simus* also differs from other bamboo lemurs in behavioral and ecological variation.

Greater bamboo lemurs are cathemeral and gregarious, with observed group sizes ranging up to 28 individuals (Santini-Palka 1994; Tan 1999, 2000). Their extensive vocal repertoire of at least seven distinct calls is thought to be linked to their relatively large group size (Bergey and Patel 2008). It is the only male-dominant lemur species known (Tan 1999, 2000). Home ranges are large (60–97 ha; Sterling and Ramaroson 1996; Tan 1999, 2000; Dolch *et al.* 2008) and are primarily influenced by the distribution of bamboo and the availability of drinking water during the dry season (Wright *et al.* 2008). The species' stark reliance on giant bamboo makes it ecologically unique among primates. Throughout its range, *P. simus* has diets consisting almost exclusively of just one species of bamboo; *Cathariostachys madagascariensis* in the north (Tan 1999, 2000; Dolch *et al.* 2008) and a lowland species in the south (Wright *et al.* 2008). *Prolemur simus* is able to manipulate live bamboo culm with specializations in its teeth and jaws (Jernvall *et al.* 2008) that allow it to strip the outside of the live stalk and consume the pith, which is especially crucial for subsistence in drier



months, while it relies on its shoots and leaves at other times of the year. *Prolemur simus* supplements its diet with fruits, flowers, soil and fungi (Meier and Rumpler 1987; Tan 1999, 2000; Wright *et al.* 2008; R. Dolch, J. L. Fiely, J. Rafalimandimby, E. E. Louis Jr. unpubl. data).

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; Simons 1997; Godfrey *et al.* 1999, 2004). Today, *P. simus* occupies as little as 1–4% of its former range, and remaining populations are very patchily distributed. It has only been confirmed to occur at 12 sites; all of them in the eastern rainforests. Most of them are restricted to SE Madagascar, including those in the national parks of Ranomafana (Miaranony, Talatakely, and Ambatolahy Dimy) and Andringitra (Manambolo, possibly Korokoto, and Camp 2). Five sites are located in unprotected and often degraded forests at Kianjavato, Morafeno, Karianga (near Vondrozo), Mahasoia, and Evendra (near Ivato) (Meier and Rumpler 1987; Wright *et al.* 1987; Sterling and Ramaroson 1996; Goodman *et al.* 2001; Irwin *et al.* 2005; Ratelolahy *et al.* 2006; Wright *et al.* 2008). Recent surveys have confirmed the species' presence in the forests of Torotorofotsy in the region of Andasibe-Mantadia (Dolch *et al.* 2004, 2008).

Wild populations occur in genetically isolated ranges with critically low numbers. Based on available

data, the total wild population of *P. simus* is estimated not to exceed 100-160 individuals (Wright *et al.* 2008; R. Dolch unpubl. data). The largest populations are thought to occur in Torotorofotsy (R. Dolch, J. L. Fiely, J. Rafalimandimby, E. E. Louis Jr. unpubl. data) with up to 60 individuals, and in Ranomafana with up to 50 individuals. As of 2007, only 22 individuals of *P. simus* were held in captivity (Wright *et al.* 2008; D. Rouillet pers. comm.).

The greater bamboo lemur is threatened by slash-and-burn agriculture, mining, illegal logging, the cutting of bamboo, and hunting with slingshots (Meier 1987; Meier and Rumpler 1987; Arrigo-Nelson and Wright 2004; Dolch *et al.* 2008). Presumed causes of its decline are its extreme dietary specialization and dependency on giant bamboo. Reduced availability of drinking water due to climatic change has also been cited as a limiting factor for the species' distribution (Wright *et al.* 2008).

*Prolemur simus* occurs mainly outside protected areas. It has been found in two national parks, Ranomafana and Andringitra. Suitable microhabitat within these protected areas is limited, and stochastically elevated mortality has contributed to the recent decline of these groups (Wright *et al.* 2008). The recent discovery of new groups raises hopes for the survival of the species. Yet, declines in known groups have raised new concern. Efforts are underway to declare important *Prolemur* sites as protected areas, and there are plans also for Torotorofotsy, Mahaso, and Kianjavato. Conservation research projects have been initiated to study additional populations to provide behavioral, ecological, and genetic data necessary to implement an immediate large-scale conservation management plan. Moreover, microhabitat preferences of *P. simus* at known localities should be used to identify suitable habitats within the eastern rainforest, within which it is presumed other greater bamboo lemur populations could be found.

**Ranomafana region.** The population in and around Ranomafana National Park (RNP) is 26 individuals, with a maximum estimate of 50 individuals, a number of which live outside the park boundaries. Madagascar National Parks (former *Association Nationale pour la Gestion des Aires Protégées – ANGAP*) and Centre ValBio/Institute for the Conservation of Tropical Environments (ICTE) at Stony Brook University have achieved long-term behavioral data on the group in Talatakely. Further research initiatives are being conducted to monitor, protect and collect data on the two subpopulations just outside the park, in addition to conducting further surveys throughout the park. The major threats to the RNP population are its small size, genetic isolation, ranging into unprotected areas and opportunistic hunting. Participating institutions active in conservation efforts in this region are

Centre ValBio, Madagascar National Parks, and the *Madagascar Institut pour la Conservations des Ecosystèmes Tropicaux* (MICET).

**Torotorofotsy region.** One of the most recently discovered, this site has one of the largest known contiguous populations with at least 4-5 groups and up to 60 individuals. Its discovery (Dolch *et al.* 2004, 2008) extended the known range of *P. simus* 400 km north of any known populations. The Torotorofotsy groups live almost entirely outside both Torotorofotsy Ramsar site and Andasibe-Mantadia National Park, and are squeezed in between mining concessions. Only one of the known groups occurs entirely within the boundaries of the Torotorofotsy Ramsar site. Mineral exploitation (nickel, cobalt and graphite) is the most prominent threat to the Torotorofotsy population, while it also remains a discrete population, genetically isolated from other known localities by a vast distance. The Torotorofotsy population was discovered by and has since been studied by members of Association Mitsinjo, a local NGO that has subsequently grown to an organization responsible for the management and research-based conservation of the Torotorofotsy Ramsar site. The Torotorofotsy population has been continuously tracked and monitored on a daily basis since July 2007. Data collection on ranging and behavioral ecology and efforts for the formal protection of the unprotected groups are ongoing by members of Association Mitsinjo, with the support of Omaha's Henry Doorly Zoo Madagascar Biodiversity and Biogeography Project (MBP-HDZ). Association Mitsinjo leads efforts to extend the Torotorofotsy Ramsar site to include all *P. simus* groups and to make it a new protected area in its own right.

**Ivato and Karianga region.** This population occurs in the southeastern part of the species' range in an extremely fragmented landscape that is completely unprotected and severely threatened by habitat disturbance. ICTE and MICET have begun working in Ivato commune, concentrating on one group of *P. simus* in Mahaso agricultural plantation, just near the village of Ivato. Thus far, this subpopulation consists of one group of 27 individuals that is restricted to a 150-ha forest fragment. While an individual was sighted on a trail between Ivato and Evendra, additional groups between Mahaosa and the corridor remain unknown, but additional surveys are underway. The project is working to protect, monitor and collect behavioral, ecological and genetic data on the known group. This area is threatened mainly by slash-and-burn agriculture and fragmentation. Conservation efforts include working with the local community on more sustainable agricultural practices, and an endemic reforestation program to connect current forest fragments to the corridor *c.*10 km to the west, where other subpopulations have been sighted. ICTE

and MICET are trying to implement formal protection of the area extending from Karianga/Morafeno to the corridor. Virtually no forest persists near these sites, with a landscape consisting largely of agricultural land and anthropogenic grasslands, interspersed with small, isolated bamboo patches. Current initiatives will be expanded to Karianga commune, which contains a group of at least three individuals in Morafeno agricultural plantation. Mining concessions and hunting also threaten this population, which subsists in extremely small numbers and in genetically isolated forest fragments that are being actively degraded. Participating institutions in conservation efforts in this region include ICTE, MICET and Stony Brook University.

**Kianjavato.** Since 1986, individuals have been observed in bamboo patches at the edge of Kianjavato coffee plantation, isolated from the eastern forest escarpment by about 50 km. This area contains at least three groups, with at least 7 individuals each, and an estimated population size of 30 individuals. The MBP-HDZ is researching the behavioral ecology and genetic composition of this population.

**Corridor.** Surveys within the Vondrozo corridor have been ongoing to try and find additional individuals between Ranomafana (north) and the Manapatrana River (south). Although a recent survey found two individuals between Ivato commune and Andringitra National Park (K. Delmore, unpubl.), further surveys are needed. Meanwhile, Conservation International has been working to protect the biodiversity within the remaining habitat in the corridor. Protection of this tract of intact forest will be crucial to provide a natural link between the remnant populations in south and central-eastern Madagascar. Participating institutions in the surveys in the corridor include ICTE and Centre ValBio.

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