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First Physical Examination of the Horton Plains Slender Loris, *Loris tardigradus nycticeboides*, in 72 Years

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Abstract: We report here the first close examination in 70 years of the Horton Plains slender loris, *Loris tardigradus (lydekkerianus) nycticeboides*, previously known only from two collected specimens and a number of sightings from eye-shine. Photographic and morphometric data presented here enable a preliminary assessment of the possible distinctive endomorphic features of this loris in comparison to its sister species and subspecies. This loris clearly demonstrates adaptations to montane forest, as previously suggested from the preserved skins of the holotype and paratype. Confirmation of the continued existence of this loris raises familiar concerns over its taxonomic distinctiveness, its apparent low abundance in a highly fragmented and diminishing habitat, and the actions necessary to eliminate the threats to its survival.

Key words: *Loris tardigradus nycticeboides*, Horton Plains slender loris, Sri Lanka, montane forest, conservation, fragmentation, Sri Lanka.

Introduction

Here we report on the first clear observation, examination and photographs of the Horton Plains slender loris, *Loris tardigradus nycticeboides* since its discovery (Hill 1942). This loris had previously been recorded from just two specimens collected in 1937 after extensive searching by Tutein-Nolthenius in the Horton Plains region (Hill 1942), and a later sighting from eye-shine in 2002 (Nekaris 2003; Nekaris and Jayewardene 2003), totalling four recorded sightings in 72 years. The animals located in 1937 produced two offspring in captivity (Nicholls 1939), and one of these individuals is the holotype specimen held in the British Museum of Natural History, London. The considerable efforts of primatologists and fieldworkers over the past decade in search of this nocturnal primate indicate an extremely low detection probability, which may be a reflection of extreme rarity, patchy occurrence, and cryptic behaviour. The subspecies was noted as seriously threatened following an international review of the world's most threatened primates by the IUCN/SSC Primate Specialist Group in 2004 (Nekaris 2006; see also Nekaris and Perera 2007).

Location and Habitat

An individual was sighted in dwarf montane forest at an elevation of 1,940 m in the Conical Hill proposed forest reserve; a mountain rising to 2,165 m above sea level in the vicinity of Nuwara Eliya (06°91'086"N, 80°78'248"E). This altitude is consistent with that recorded for the site of capture of the holotype of *L. t. nycticeboides* held in the British Museum (Natural History) labelled "Below Horton Plains, 06°48'N, 80° 48'E, 6,000 ft. [1,828 m], May 1938". The sighting reported here was made in montane evergreen rainforest characterized by low canopy heights of approximately 5–15 m. Precipitation is high in this ecotype resulting in a less drought prone ecosystem than elsewhere on the island (Werner 1984). Temperatures there are also the lowest in Sri Lanka; frosts are not uncommon, the annual average temperature is 15.4°C, and the minimum recorded temperature is –4°C (Werner 1984). As recent sightings are limited to two confirmed reports it is not yet possible to judge habitat preferences or bias in occupancy but, assuming *L. t. nycticeboides* moves and sleeps in a similar manner to *L. t. tardigradus*, climbable vegetation complexity and dense foliage for day-time roosting are abundant in the vicinity of these sightings.

Morphology and Adaptation

The most striking feature of *L. t. nycticeboides* is the apparent endomorphy characterized by short limbs and long, dense pelage (Figs. 1 and 2). This is in contrast to the long, slender limbs and short ruddy-brown pelage of *L. t. tardigradus* (Fig. 3). Both fore- and hind limbs appear shorter and sturdier than the limbs of any of the other loris taxa found in Sri Lanka or southern India.

Morphometric measurements taken in the field were obtained quickly from the captured individuals, following the guidelines of Groves (2003). While being measured, the lorises were allowed to hold on to a small branch thus ensuring that they remained relatively still and composed. The animal reported here is an adult male, which recorded a head-body length (HBL) of 202 mm. The brachium (upper arm) length measured 56 mm and the anti-brachium (fore-arm) length was 64.8 mm. The thigh (upper leg) length measured 62.6 mm and cnemis (lower leg) length 66.7 mm.

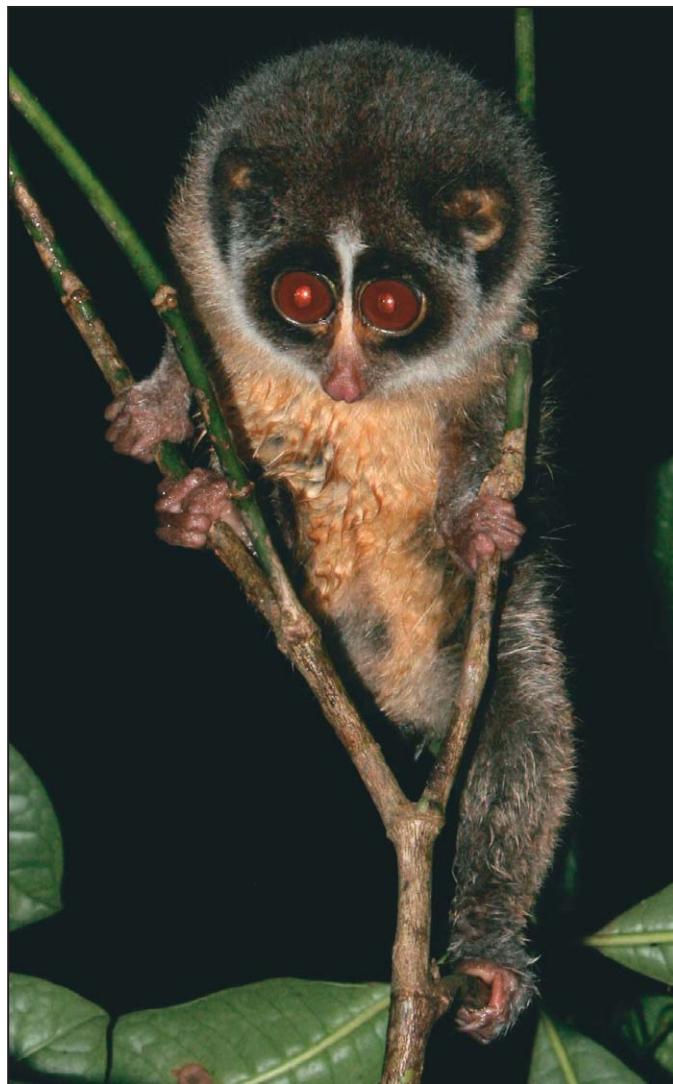


Figure 1. *Loris tardigradus nycticeboides*, Newara Eliya, Sri Lanka. The animal was photographed after being pursued by observers through understory vegetation. Photograph by C. Mahanayakage.

Body weight was 220 grams. To date, we have collected only limited morphometric data for other loris taxa, as the field program is still continuing, and we have as yet insufficient data to allow an adequate comparison of HBL between the subspecies. Three adult male *L. t. tardigradus* that we have measured had an average HBL of 208 mm (7.2 SE, $n=3$), the brachium averaged 58.1 mm (0.4 SE, $n=3$), the antibrachium 70 mm (0.5 SE, $n=3$), the thigh 70.3 mm (1.7 SE, $n=3$) and the cnemis 69.6 mm (0.6 SE, $n=3$). Body weight mean for three adult male *L. t. tardigradus* was 175.3 grams (8.8 SE, $n=3$). These data indicate that *L. t. nycticeboides* is shorter limbed than *L. t. tardigradus* and, considering similar HBL, also heavier in this instance.

The pelage of *L. t. nycticeboides* is striking in being longer and thicker than in other lorises, as described by Nekaris (2003). Circumocular patches are deep chestnut, with pre-auricular hairs tipped white but turning into a bold white, vertical interocular stripe. The dorsal fur is greyish brown with white frosting and a darker fine-haired undercoat. The fur is thick and considerably longer than in other Sri Lankan lorises. The ventral fur is notably long and a pale sandy orange. There is limited cutaneous pigmentation on the ear rims, and in the individuals we observed eyelid margins do not appear as deeply pigmented as reported by Hill (1942). Nose and digits are pinkish. The specimen recorded conforms to the phenotypic distinctiveness described by Groves (1998) and commented on by Nekaris (2003).

Ecology, Conservation, and Threats

We found this loris only after more than 200 hrs of nocturnal transect surveys in the known habitat, on a 2-km transect which we had walked repeatedly (18 hours over a 9-day period). The Horton Plains slender loris is evidently extremely rare. Our surveys were part of an on-going Wet Zone-wide occupancy study of lorises for conservation management planning (Gamage, Reardon and Padmalal unpubl.; Mackenzie *et al.* 2003). Our methods involve teams of two field biologists systematically searching the forest habitat visible from the predetermined transect track. They walk at a slow pace of about 1 km per hour, looking for eye shine with dimmed, wide-beam and heavily red-filtered head torches (LED lenser™ H7). It is not helpful to compare frequency of encounter data with previous studies because of differences in data collection methods. Also, because our surveys covered a number of different forest types, the encounter frequency may be a poor metric to measure anything other than within site changes in loris detection.

Loris tardigradus is listed as Endangered on the IUCN Red List of Threatened Species (EN, C2a(i); Nekaris 2008). The rarity of *L. t. nycticeboides* resulted in it being listed as one of the world's 25 most endangered primates for the periods 2006–2004 and 2004–2006 (Nekaris 2004; Nekaris and Perera 2007). Nekaris and Perera indicated that the geographical range of *L. t. nycticeboides* was less than 40,000 ha (Nekaris 2003). We are continuing to survey sites across this



Figure 2. *Loris tardigradus nycticeboides*, lateral view, Newara Eliya, Sri Lanka. Photograph by C. Mahanayakage.

area in the hope of determining the full extent of the subspecies' range. Continued fragmentation due to agricultural development, die-back of forest believed to be due to climate change (Werner 1984) and, more insidiously, the degradation of montane forest due to firewood collection and cardamom production, may put the area of available suitable habitat at a significantly lower figure. The anthropogenic pressures on the environment in Sri Lanka, which is among the top three biodiversity hotspots threatened by population pressure (Richard *et al.* 2000), suggest that any organism requiring extensive, non-degraded natural habitat is likely to be threatened with extinction. Regarding the threats to *L. t. nycticeboides*, Molur *et al.* (2003) wrote "Local and commercial trade for eyes and meat by tea plantation workers. Possible village level trade for folk medicine" (p.87). We found no evidence, however, of such exploitation of lorises in Sri Lanka. Electrocutation, a common cause of death of lorises in the dryer regions of central northern Sri Lanka, is also largely absent in the montane habitat of *L. t. nycticeboides* due to the lack of power lines.

Currently, habitat fragmentation and degradation outweigh all other threats to this subspecies. Being an apparent montane specialist, climate change effects on high altitude forest ecology can only exacerbate this threat. Forest fragmentation may be of special concern to the movement and dispersal of *L. t. nycticeboides* as denseness of its montane forest habitat to which it is adapted may make this subspecies less inclined than other lorises to traverse simplified vegetation such as heavily disturbed or early succession forest (Williams *et al.* 2002). The regeneration of forest in the montane zone is also inhibited by a number of climatic factors, and montane forests in Sri Lanka are more susceptible to long-term damage due to fragmentation than sub-montane and lowland



Figure 3. *Loris tardigradus tardigradus*, for comparison. Kanneliya, Sri Lanka. Photograph by J. T. Reardon.

rain forest systems, where regeneration can be relatively rapid (Wade 1984; Wikramanayake *et al.* 2001).

Further morphometric, molecular and behavioral data will be gathered to enable a review of the systematics of the subspecies of *L. tardigradus*. An on-going research, conservation, and management programme will incorporate the findings to ensure that adequate effort is focused to describe the extent of occupancy of *L. t. nycticeboides* so that necessary recommendations for threat-reducing management may be delivered to the resource management agencies. Key questions that must now be addressed besides determining the true extent of this subspecies' montane forest occupancy include assessing the abundance of *L. t. nycticeboides* where present to enable rudimentary assessment of population viability and an investigation of the extent to which it is able to disperse through and use degraded or regenerating forest.

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