Primate Conservation 2017 (31): 83-106

The Taxonomy, Distribution, and Conservation Status of the Slender Loris (Primates, Lorisidae: *Loris*) in Sri Lanka

Saman N. Gamage[1], Colin P. Groves[2]†, Fais M. M. T. Marikar[3], Craig S. Turner[4], Kalinga U. K. G. Padmalal[5] and Sarath W. Kotagama[1]

[1]*Department of Zoology, Faculty of Science, University of Colombo, Colombo, Sri Lanka*
[2]*School of Archaeology and Anthropology, Australian National University, Canberra, Australia*
[3]*Staff Development Centre, Faculty of Medicine, General Sir John Kotelawela Defence University, Ratmalana, Sri Lanka*
[4]*Zoological Society of London, Regent's Park, London, UK*
[5]*Department of Zoology, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka*

Abstract: External body dimensions and proportions, skull morphology, coat coloration, vocalizations, and genetics have contributed to an increase in the number of diagnosable species among nocturnal primates. Two species of slender loris are currently recognized for Sri Lanka: the red slender loris *Loris tardigradus* (Linnaeus, 1758), endemic to the wet zone and montane areas; and the grey slender loris *Loris lydekkerianus* Cabrera, 1908, which is widespread and also occurs in India. The red slender loris has two subspecies, namely the western red slender loris *Loris tardigradus tardigradus* (Linnaeus, 1758) and the Horton Plains slender loris *Loris tardigradus nycticeboides* Hill, 1942. *Loris t. tardigradus* is found in the lowland wet zone and *L. t. nycticeboides* is restricted to the montane region of south-central Sri Lanka. Two subspecies are also ascribed to *Loris lydekkerianus* in Sri Lanka, namely the northern Ceylon slender loris *Loris lydekkerianus nordicus* Hill, 1933, and the highland slender loris *Loris lydekkerianus grandis* Hill and Phillips, 1932. *Loris l. nordicus* is found in the dry zone, and *L. l. grandis* is restricted to the submontane region of Kandy and Matale. Another two subspecies are known from southern India. We examined specimens (live and museum) from all climate/vegetation zones in Sri Lanka, for facial and pelage features, external body morphology, and skull morphology, and concluded that there are at least two species and at least six subspecies, though we suspect that some, or all, of these subspecies may be distinct species. Names are available for four of these taxa, and here we describe two new subspecies.

Key words: taxonomy, *Loris lydekkerianus*, *Loris tardigradus*, morphology, slender loris, Sri Lanka

Introduction

The slender lorises (Suborder Strepsirrhini, Family Lorisidae, *Loris* É. Geoffroy Saint-Hilaire, 1796) are small nocturnal primates found only in India and Sri Lanka (Groves 1998, 2001; Nekaris and Jayawardene 2004). Groves (1998) recognized two species of slender loris for Sri Lanka: the red slender loris *Loris tardigradus* (Linnaeus, 1758) and the grey slender loris *Loris lydekkerianus* Cabrera, 1908. The former is endemic to Sri Lanka, whereas the latter species is also found in southern India.

The oceanic island of Sri Lanka is 65,610 km^2, and is separated from India by the 19-km-wide Palk Strait (Wijesinghe *et al*. 1993). Sri Lanka, along with the Western Ghats of India, is remarkable for its biodiversity, and is one of the world's Biodiversity Hotspots following the analyses and parameters of Mittermeier *et al*. (2004). Our knowledge of its biodiversity is, however, still highly dependent on surveys completed a century or more ago (Pethiyagoda 2005). Recent taxonomic studies are scarce for small mammals and primates (Weerakoon and Goonatilake 2006) and the inventory is evidently far from complete. This is highlighted by the descriptions of a new species of mouse deer *Moschiola kathygre* Groves and Meijaard, 2005, a new species of shrew *Suncus montanus*

†Colin P. Groves 1942-2017

Meegaskumbura and Schneider, 2008, and a new species of Golden palm civet *Paradoxurus stenocephalus* Groves, Rajapaksha and Manemandra-Arachchi, 2009, over the last seven years.

The slender loris was first described as *Lemur tardigradus* Linnaeus, 1758, based on an illustration in Seba (1735), probably depicting a red slender loris from Sri Lanka (Thomas, 1908). Geoffroy Saint-Hilaire (1796), under the impression that Linnaeus had described a slow loris, described the slender loris as a new genus and species, *Loris gracilis*. The generic name was conserved by the International Commission on Zoological Nomenclature (1999). Until the 20th century, Linnaeus's name was taken by almost all authors to be based on a slow loris (genus *Nycticebus*). It was Stone and Rehn (1902) who argued that Linnaeus's name *tardigradus* actually referred to a slender loris, and Thomas (1908) concurred, tightening and extending aspects of their argument. Gentry *et al*. (1998) later designated a lectotype in the Stockholm Museum of Natural History.

Fischer (1804) recognized É. Geoffroy Saint-Hilaire's (1796) *Loris gracilis* as a reddish species ("schlanker Loris"), from Ceylon (Sri Lanka), and in addition described *Loris ceylonicus* ("ceylonischer Loris") as a yellowish-brown species. From the descriptions, it is difficult to determine whether these do or do not refer to the same taxon, and in the absence of type specimens it is impossible to say with certainty. Provisionally both names may be placed as junior synonyms of Linnaeus's name. The measurements given by Fischer (1804: 163−166) are apparently within the range of what is here considered to be *Loris tardigradus tardigradus* (Linnaeus, 1758): *Loris gracilis* has a greatest skull length from the tip of the snout to the convexity of the occiput of 48 mm, while in *Loris ceylonicus* this measurement is 50 mm.

Lesson (1840) renamed the reddish slender loris from "l'île de Ceylan" as *Arachnocebus lori*, but apparently for the first time described one of the blackish forms (likewise from "l'île de Ceylan") under the name *Bradylemur tardigradus* var. c—that is to say, he failed to recognize its affinity to the reddish slender loris and referred it to the genus *Bradylemur*, which he had erected for slow lorises (now *Nycticebus*).

From 1840 to 1905, no new species or subspecies of loris were added to the Sri Lankan loris fauna. Then Lydekker (1905), evidently unaware of Stone and Rehn's (1902) paper, and taking two mounted specimens from Madras (now Chennai) as "typical" for *Loris gracilis*, described "the Ceylon Loris" as *Loris gracilis zeylanicus* on the evidence of another mounted specimen (this is BM 1904.10.12.3, with no precise locality other than "Ceylon", according to Jenkins, 1987). Although not strictly a homonym of Fischer's *Loris ceylonicus*, Recommendation 58A of the *Code* states that "An author should not base a new species-group name on a personal or geographical name if another name derived from the same word or from words of the same meaning (even if differently formed) is in use in the same or an allied or associated genus…" Notwithstanding, the name has not been used for over a century, and so ranks as a *nomen oblitum*.

In 1932, a new subspecies of slender loris, the highland slender loris *Loris tardigradus grandis*, was described by Hill and Phillips (1932) from Gammaduwa in the Knuckles Range, and the following year Hill (1933) described another subspecies from the northern dry zone, the northern Ceylon slender loris *Loris tardigradus nordicus*. In 1937, Mr. A. C. Nolthenius caught a pair of loris on his estate below the Horton Plains (1522−1826 m), and kept them in captivity for several years in Colombo (Nicholls 1939). They were described as a further new subspecies by Hill (1942), the Horton Plains slender loris *Loris tardigradus nycticeboides*. Two further subspecies had meanwhile been described from southern India, the Mysore slender loris *Loris tardigradus lydekkerianus* Cabrera, 1908, from Madras, and the Malabar slender loris *Loris tardigradus malabaricus* Wroughton, 1917, from Kutta, South Coorg (more fully described in Hill 1953).

The classification of slender lorises has been debated for many decades (Hill 1953; Phillips 1980; Groves 1998, 2001; Brandon-Jones *et al*. 2003; Roos 2003; Nekaris and Jayawardene 2004; Nekaris *et al*. 2006), yet we are still essentially using Hill (1953) for the taxonomy, with a slight revision by Groves (1998). According to Hill (1953), there is a single species of slender loris, with six subspecies: four in Sri Lanka and two in India. On the basis of museum specimens, Groves (1998) recognized two distinct species: *Loris tardigradus* (Linnaeus, 1758), monotypic and restricted to the wet zone of southwestern Sri Lanka, and *Loris lydekkerianus* Cabrera, 1908, in the rest of the range of the genus in both Sri Lanka and India. These changes were corroborated by Coultas (2002) and Nekaris and Jayawardene (2004) on the basis of behavioral and morphological evidence from wild populations, and were further supported by phylogenetic analyses and studies of museum specimens by Roos (2003) and Nekaris *et al*. (2006). Groves (1998) placed the taxon *nycticeboides* in *L. lydekkerianus* as a subspecies, but Nekaris and Jayawardene (2004) transferred it to *L. tardigradus*, while Yapa and Ratnavira (2013) suggested that it might be a distinct species.

Valid taxonomy is essential for species conservation. Biodiversity assessment—the taxonomy, biogeography and conservation status of a region's fauna and flora—is vital for investment in and implementation of conservation measures (Mace 2004). Conservation management demands reliable data to verify the distribution boundaries of taxa for their identification as spatial conservation units. To fulfill these concerns, we reviewed the taxonomy of the Sri Lankan slender lorises, following a meeting of experts and interested parties in 2009 that included representatives of the following organizations: The Open University of Sri Lanka, University of Colombo, Ministry of Environment and Natural Resources, Department of Wildlife Conservation, Forest Department, National Science Foundation, National Zoological Garden, University of Peradeniya and IUCN Sri Lanka.

In our study, we examined the following alternative hypotheses regarding the taxonomy of the slender loris: (1) that a two-species classification—*L. tardigradus*, either monotypic or with *nycticeboides* as a subspecies, and *L.*

Table 1. Number of samples represented in seven groups of Sri Lankan lorises (see Table 2).

Sample origin (n = sample size)	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 5**	**Group 6**	**Group 7**
Live lorises captured from wild (n = 82)	10	28	7	2	12	5	18
Live lorises observed from the wild (n = 13)	2	3	2	1	1	1	3
Photograph from the live lorises (n = 9)	1	2	1	1	1	1	2
Fresh specimens (dead specimens) (n = 4)	1	-	-	1	-	-	2
Mounted skins with skulls (n = 20)	4	2		1	5		8
Skin only (n = 5)	-	-	-	1	2	1	1
Skulls only (n = 29)	5	6	-	-	1	13	4
Complete mounted skeleton (n = 1)	1	-	-	-	-	-	-

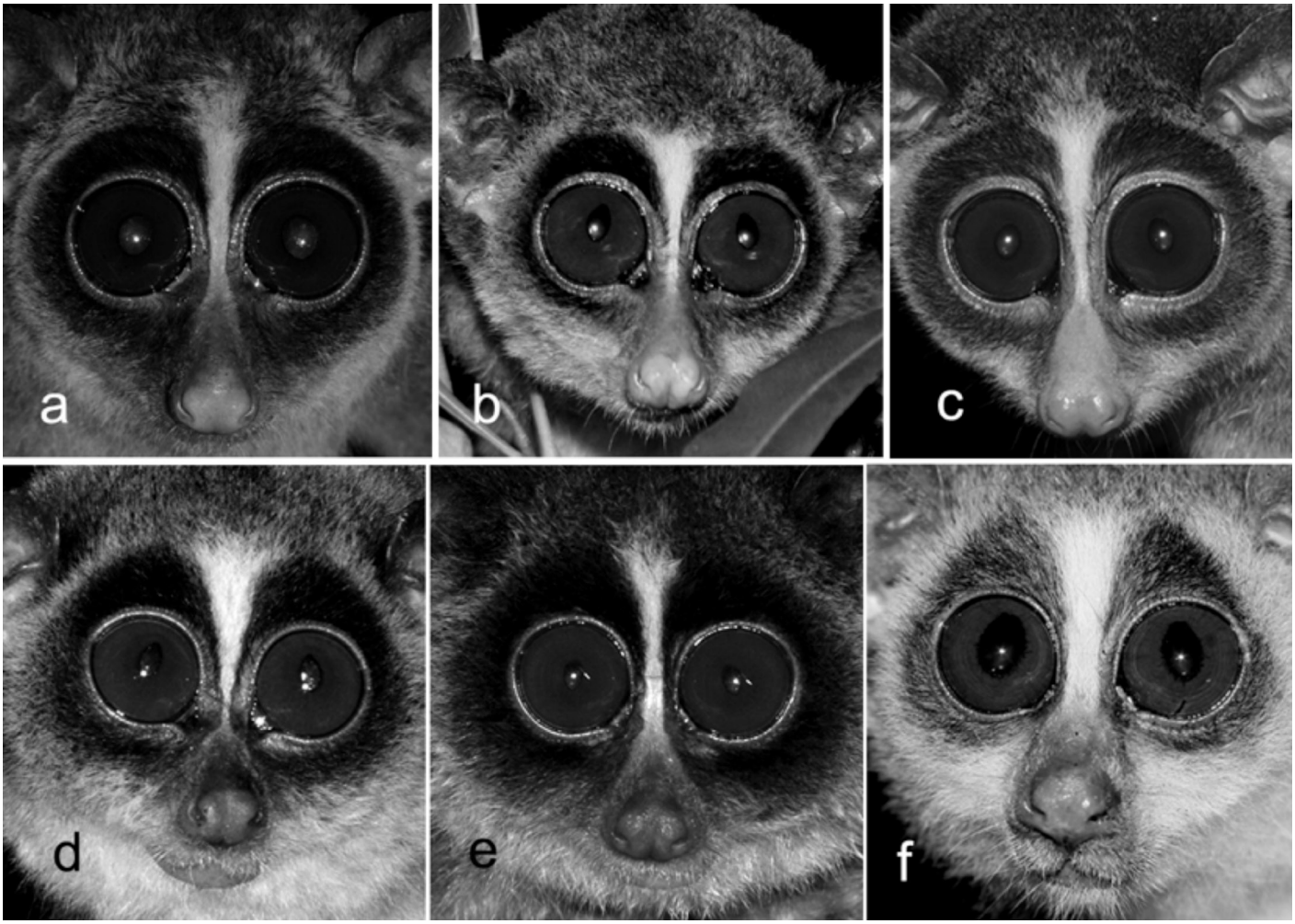

Figure 1. Variation of circumocular patch shapes in different slender loris groups in Sri Lanka: **a.** Northwestern group (marquise -elliptical with pointed ends), **b.** Southwestern group (ovoid/rounded), **c.** Uva group (ovoid/rounded), **d.** Highland grey (pear), **e.** Montane group (broad pear), and **f.** Northern grey group (teardrop).

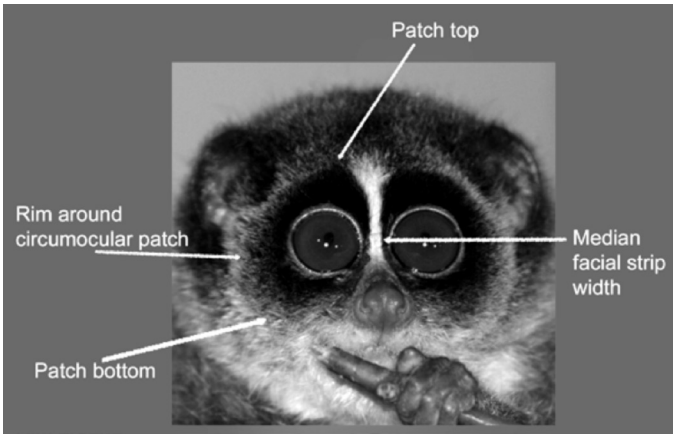

Figure 2. Some facial features used for the analysis.

lydekkerianus, with subspecies *grandis* and *nordicus* and perhaps *nycticeboides*—adequately describes the taxonomy of the slender loris in Sri Lanka; and (2) that a single-species classification, with four subspecies, adequately describes the taxonomy of the slender loris in Sri Lanka.

Methods

Examination of live animals and photographs

Ninety-five live lorises were examined, 82 of which were captured and measured in the wild, and 13 were closely examined in the field, but not captured, by the first author. A further four lorises were received as dead specimens. Clear photographs of nine live slender lorises contributed further information (see Table 1). These samples were from different climatic regions: (1) wet zone (annual rainfall >2500 mm), (2) intermediate zone (annual rainfall, 2500−1900 mm), and (3) dry zone (annual rainfall <1900 mm), at different elevations (1) low elevation (0−400 m asl), (2) mid elevation (400−1200 m asl), and (3) high elevation (>1200 m asl), in Sri Lanka.

Captures were done by hand by trained field researchers; two to four at a time. After taking measurements, the lorises were released where they were captured. The research was carried out under the Department of Wildlife Conservation Sri Lanka permit number WL/3/2/1/9, and guided and supervised by the National Research Committee of the Department of Wildlife Conservation. Measurements taken in the field followed the guidelines of Groves (2003). Facial and pelage features were examined of all of the 82 live animals captured.

There are wet and dry seasons in Sri Lanka. The first author has been studying wild lorises since 2002, and has never observed seasonal variation pelage. Aging is the only factor affecting pelage variation, and only facial and pelage features of mature animals were used for analysis. Facial marks and terms used in the study are shown in Figures 1 and 2 and in the conservation database for lorises (Schulze *et al*. 2003). Nine measurements were taken from each live animal to assess phenetic variation among samples. Measurements were taken to the nearest 0.01 mm using digital calipers. The measurements were: upper arm length (UAL), forearm length (FAL), thigh length (TL), leg length (LL), knee length (KL), maximum head length (MHL), head breadth (HB), maximum breadth over postorbital bars (MBOP) and ear length (EL). Standard measuring points are shown in the conservation database for lorises (Schulze *et al*. 2003).

Examination of museum specimens

Forty-four specimens from natural history museum collections were examined: National Museum of Sri Lanka, Colombo (NHMC) (skin + skull = 4; skin only = 2), University of Colombo Zoology Museum (UOCSL) (skull only = 1; complete mounted skeleton = 1), British Museum (Natural History), London (BMNH) (skin + skull = 6; skin only = 2; skull only = 3), Field Museum of Natural History Chicago (FMNH) (skin + skull = 8; skull only = 1), Royal College of Surgeons of London (RCSL) (skulls only = 15, but two of them belonging to skins in the NHMC), and National Museum of Scotland (NMS) (skin only = 1). We also examined 11 slender lorises captured live that were euthanized (Department of Wildlife Conservation Sri Lanka permit number WL/3/2/1/9), using standard protocols under the supervision of a qualified veterinarian and strictly following the American Society of Primatologists' principles for the ethical treatment of primates and the International Primatological Society's international guidelines for the acquisition, care and breeding of nonhuman primates. Their skins and skulls are preserved as voucher specimens. Three road kills, one electrocuted specimen, and seven skulls were received from various parts of the country during the study period. These and the 11 live specimens that were euthanized will be deposited in the National Museum of Sri Lanka, Colombo (NHMC) under the Slender Loris Conservation Project (SLCP) collection.

Pelage characters and facial mask differences were examined from the 23 skins deposited in the various museums, and from the three road kills, the electrocuted individual and the 11 euthanized specimens. Major fur characters, color marks and terms used in the study are shown in Figures 1 and 2, and in the conservation database for lorises (Schulze *et al.* 2003). The sample included the type specimens for the described subspecies *Loris gracilis zeylanicus*, *Loris tardigradus nycticeboides*, *L. t. nordicus* and *L. t. grandis*.

Eleven cranial and mandibular measurements were taken (standard measuring points are shown in Schulze *et al*. 2003). Measurements were taken to the nearest 0.01 mm with digital calipers, as follows: greatest length of skull (GLS), length of nasal (LON), biorbital breadth (BB), zygomatic breath (ZB), breadth of braincase (BOB), mastoid breadth (MB), palate length (PL), condylobasal length (CBL), condylo-canine length (CCL), alveolar length of maxillary toothrow (ALMT), mandible length (ML).

Analysis – facial and pelage features

Recent studies suggest that vision may play a greater role in the lives of nocturnal primates than was originally supposed (Bearder *et al*. 2006). Lorisiforms have monochromacy resulting from the loss of a functional SWS1 opsin (Tan

et al. 2005); therefore, white and strongly contrasting colours and patterns are easily distinguishable, aiding these animals in identifying potential mates and conspecifics. Variation in the facial mask is especially useful in distinguishing between species (Nekaris and Jaffe 2007; Nekaris and Munds 2010; Munds *et al*. 2013), and such contrasting patterns are seen in the facial masks of slender lorises. Thus live animals and skins were grouped according to facial/pelage features and area of origin. A guide was created for future researchers to replicate or expand upon this study (Figs. 1 and 2).

Twenty-three facial and pelage features were used for this study, as follows: overall shape of the circumocular patch (Fig. 1); shape of the top and bottom of the circumocular patch (patch top is rounded, pointed distinct or pointed diffuse, patch bottom is broad, pointed toward muzzle, narrow rounded or extends toward zygomatic arch); width of the median facial strip, white rim around the circumocular patches (prominent, thin or absent), presence of dorsal frosting, yellow pigmentation on muzzle and ears, and base colour of ventral hair. Facial and pelage features of only mature animals were used for analysis; 106 loris specimens were used (Table 2). Initially, cluster analysis was carried out for all specimens, using 23 features (variables), by the complete linkage method by Euclidean Distance, in Minitab 16. Then the specimens were grouped by area of origin and again the complete linkage method by Euclidean Distance, given in Minitab 16, was used to create a dendrogram. Standardized Canonical Discriminant Function Coefficients for each of the variables (23 facial/pelage variables) was calculated by using General Discriminant Analysis (GDA) as given in STATISTICA 10. Variables with "0.000" values of Standardized Canonical Discriminant Function Coefficients were omitted from the subsequent analysis. Discriminant Function Analysis (DFA) was undertaken with STATISTICA 10 to assess the significance of this clustering pattern. A subsequent Principal Components Analysis was carried out for the groups with small sample size (n<13) using Minitab 16.

Analysis – external body measurements

Nine body measurements were used for each live animal, in order to analyze the morphometric variation among samples. Males and females were combined because limited samples were available from each sex. Most external measurements given by Kar Gupta (2013) of 12 females and 22 males from an Indian site differ little between sexes (with the exception of body weight), and initial inspection of our own metric data did not reveal consistent differences between the sexes. All these measurements have been widely used to analyze morphometric variation in *Loris* (Hill and Phillips 1932; Hill 1942).

Two separate analyses were done to test the two different models, as described above. For the first model, live specimens were grouped based on distribution and the identification characters given by Hill (1953) and Phillips (1980). For the second model, they were grouped based on similarities of facial and pelage features.

Initially, a one-way ANOVA was used to determine any significant differences between the groups for each measurement, using Minitab16. Principal Components Analysis (PCA) and subsequently Discriminant Function Analysis (DFA) were undertaken to assess patterns in the data, where evident, and whether this pattern was significant; and further, these groups were compared using box plots with STATISTICA 10.

Analysis – skull measurements (cranial and mandibular)

Eleven cranial and mandibular measurements were taken (see above). Only adult specimens (based on the degree of fusion of skull sutures, especially the basilar suture) were used in the analyses. All these measurements have been widely used to analyze cranial and mandibular variation in *Loris* (Hill and Phillips 1932; Hill 1942; Groves 1998).

Two separate analyses were again done to test the two different models. For the first model, skulls were grouped based on names given by specimen collectors (when available) or area of origin; for the second model, skulls were grouped based on similarities of facial/pelage features (where an associated skin was available), and skulls without skins were grouped based on area of origin.

Again, a one-way ANOVA was used to determine any significant differences between the groups for each skull measurement and subsequent Principal Components Analysis (PCA) were done using Minitab16. Discriminant Function Analysis (DFA) using STATISTICA 10 was undertaken to assess patterns in the data, where evident, and whether this pattern was significant; and further, these groups were compared using box plots using STATISTICA 10. The sizes of the groups in DFA must be greater than the number of variables on which the analysis is based, to avoid the almost certain risk of a spurious positive separation (Mitteroecker and Bookstein 2011). Accordingly, we reduced the skull measurements for the DFA to 7, and ran a series of analyses on the basis of those groups of size >7 (namely, groups 1, 2, 5, 6 and 7), entering the two smaller groups as ungrouped. To avoid having to visualise plots of more than two dimensions, we ran three different analyses, entering the five basic groups in different batches of three.

Geographical distribution

In all, 154 sites were surveyed in the wet and intermediate zones and part of the dry zone in Sri Lanka, using the occupancy monitoring techniques of Mackenzie *et al*. (2003). Another 38 sites were surveyed opportunistically for lorises using a broad reconnaissance survey technique, which had been employed for a previous island-wide study of slender lorises by Nekaris and Jayawardene (2004); in this method observers followed pre-existing trails and did both repeat and one-off transect surveys (White and Edwards 2000; Nekaris and Jayawardene 2004). GPS locations were recorded for all loris observations, and ArcGIS® and ArcMap™ version 10 was used to create the map.

Conservation status

We followed the 2001 IUCN Red List Categories and Criteria version 3.1 (IUCN 2014) to evaluate the conservation status.

Results – Phenotypic Study

One hundred and sixty-two specimens (live wild-caught lorises = 82; live lorises observed in the wild = 13; photographs of live lorises = 9; fresh dead specimens = 4; mounted skins with skulls = 20; skin only = 5; skulls only = 28; and one complete mounted skeleton) were examined (Table 1).

Test of the current two-species classification – external body measurements

One-way ANOVA showed that the *Loris lydekkerianus* group (n = 34) was significantly larger than the *Loris tardigradus* group (n = 24) for nine body variables—UAL ($F = 11.2$, $p = 0.001$); FAL ($F = 14.6$, $p<0.000$); LL ($F = 8.1$, $p = 0.006$); KL ($F = 19.3$, $p<0.000$); MHL ($F = 13.4$, $p = 0.001$); HB ($F = 7.5$, $p = 0.008$); MBOP ($F = 30.2$, $p<0.000$)] and EL ($F = 39.5$, $p<0.000$). The PC1 vs. PC2 graph also showed a clear separation of these two groups (Fig. 3). The two specimens of Montane slender loris (*Loris tardigradus* / *lydekkerianus nycticeboides*) from Nuwara Eliya and one specimen of

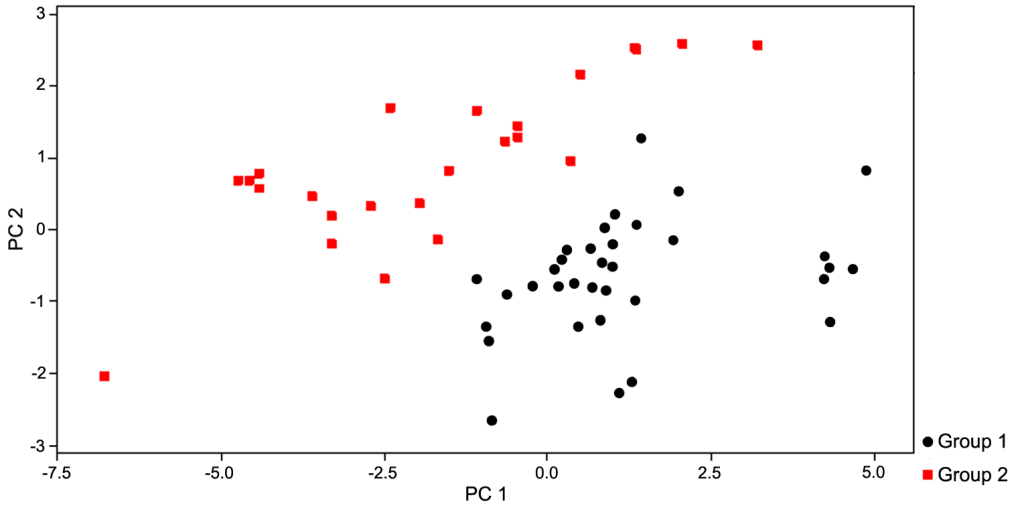

Figure 3. PC1 vs. PC2 factor scores graph for all (*L. tardigradus* = 34, *L. lydekkerianus* = 24) phenotypes captured (adult) during the study (male and female lumped) for nine measured variables (UAL, FAL, TL, LL, KL, MHL, HB, MBOP and EL); PC1 accounts for 62.6 % of the variance, PC2 for 15.1%, and PC3 (not shown) for 6.5%. PC 1 is largely a size factor mainly dependent on KL, LL and FAL, which are negatively weighted. PC 2 mainly dependent on EL, which is positively weighted: group 1 – *Loris lydekkerianus* group and 2 – *Loris tardigradus* group. Specimens were separated based on the area of origin (group 1 – Wet zone lorises and group 2 – dry and intermediate zone lorises). Separation between the two groups is nearly, but not fully, complete.

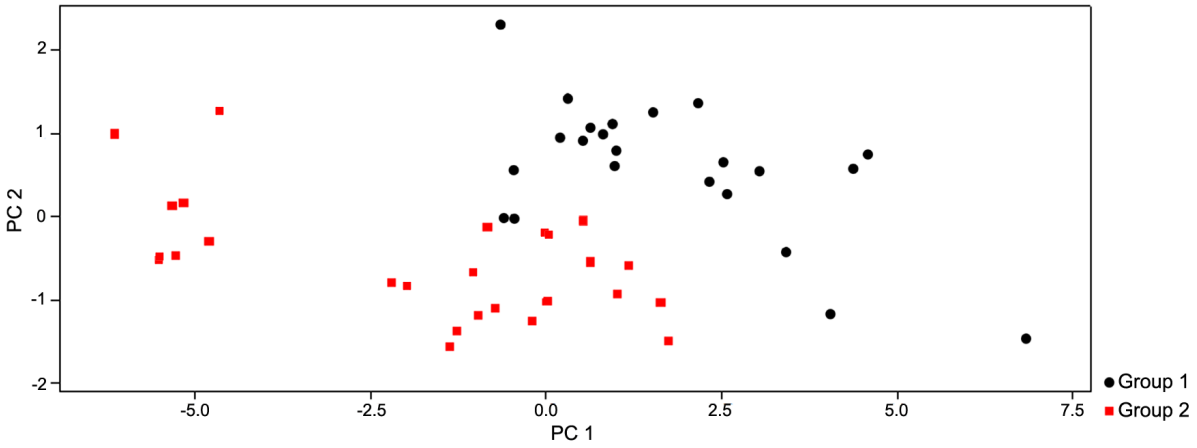

Figure 4. PC1 vs. PC2 factor scores graph (47 loris skulls) for 11 measured variables (GSL, LON, BB, ZB, BOB, MB, PL, CBL, CCL, ALMT and ML); PC1 accounts for 68.0% of the variance, PC2 for 7.6%, and PC3 (not shown) for 4.9%. Skulls were separated into two groups [group 1 - *Loris tardigradus* (n = 23) and group 2 - *Loris lydekkerianus* (n = 34)] based on the name given by the specimen collector (if available) or, if not, according to the area of origin and distribution given by Hill (1953) and Phillips (1980). Note that the separation of the two groups is incomplete.

Highland grey loris (*Loris lydekkerianus* group) from Knuckles were clustered between the two groups.

Test of the current two-species classification – skull measurements

The *Loris lydekkerianus* group was significantly larger than the Loris tardigradus group for 10 skull variables—MHL (F = 7.6, p = 0.008), LON (F = 8.5, p = 0.007), BB (F = 16.2, p<0.000), ZB (F = 30.4, p<0.000), BOB (F = 20.1, p<0.000), MB (F = 25.9, p <0.000), PL (F = 8.9, p =0.005), CBL (F = 9.2, p = 0.004), CCL (F = 13.3, p = 0.001), and ALMT (F = 8.5, p = 0.006). The PC1 vs. PC2 graph showed separation of these two groups, but again the two specimens of montane slender loris (*nycticeboides*) were clustered with the *Loris lydekkerianus* group, while one male specimen from Mirigama fell between the two groups (Fig. 4).

Test of the current four-subspecies classification – external body measurements

One-way ANOVA showed that *L. l. nordicus* was significantly larger than the other three described subspecies (*L. t. tardigradus*, *L. t. nycticeboides* and *L. l. grandis*) and unidentified specimens for nine body variables—UAL (F = 16.52, p<0.001); FAL (F = 18.14, p<0.001); TL (F = 5.35, p = 0.023); LL (F = 7.78, p = 0.007); KL (F = 16.33, p<0.001); MHL (F = 4.59, p = 0.037); HB (F = 4.48, p =0 .038); MBOP (F = 19.57, p<0.001), and EL (F = 33.9, p<0.001). The other groups did not show any significant differences (p>0.05) from each other. The PC1 vs. PC2 graph showed a clear separation of *L. t. tardigradus* and *L. l. nordicus* from other groups; however, a single female specimen of *L. l. grandis* from Knuckles was clustered with the *L. l. nordicus* group (Fig. 5).

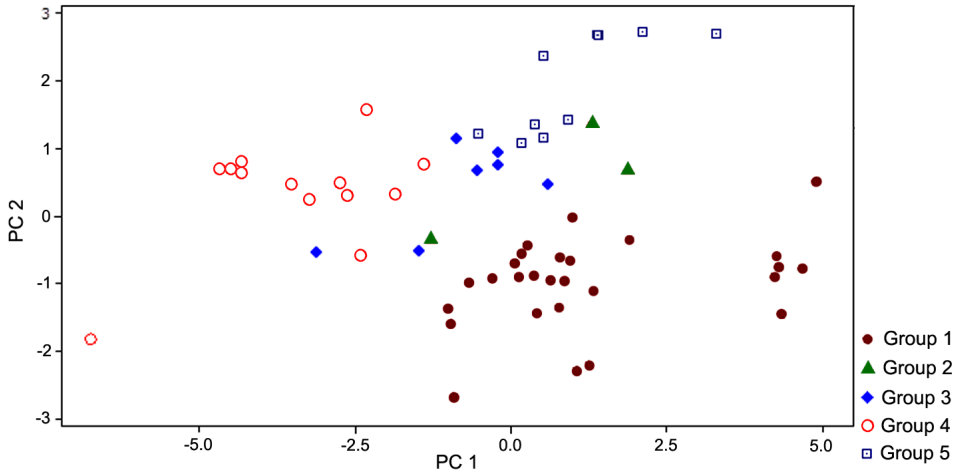

Figure 5. PC1 vs. PC2 factor scores graph for all (n = 58) phenotypes captured (adult) during the study (male and female lumped) for nine measured variables (UAL, FAL, TL, LL, KL, MHL, HB, MBOP and EL); PC1 accounts 61.0 % of the variance, PC2 for 16.7%, and PC3 (not shown) for 6.5%. Specimens were separated based on the area of origin and identification given by Hill (1953) and Phillips (1980). Groups: 1 – *L. t. tardigradus*, 2 – *L. t. nycticeboides*, 3 – *L. l. grandis*, 4 – *L. l. nordicus* and 5 –unidentified specimens. Only Group 1 is fully separated from the other groups.

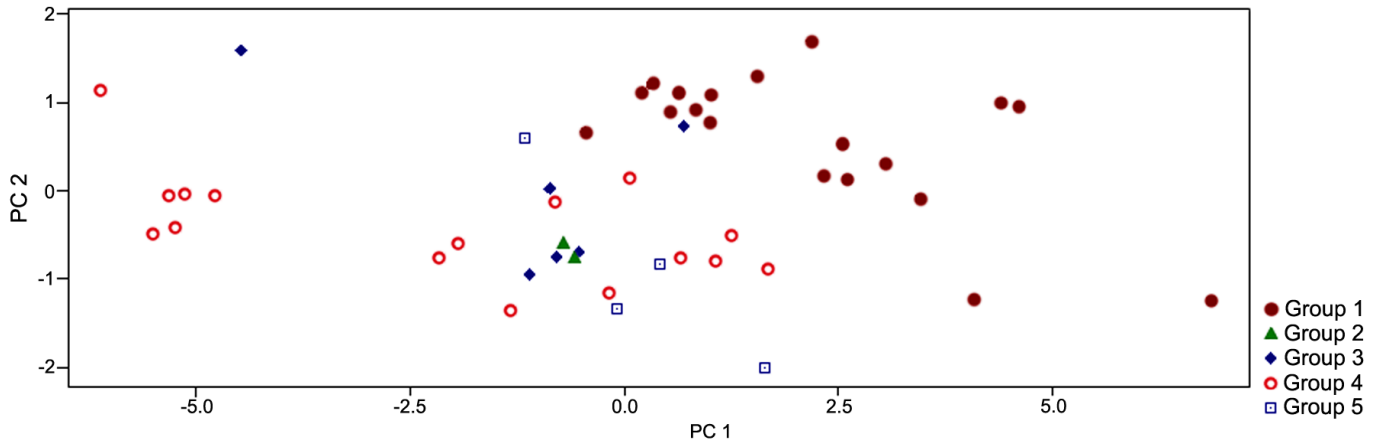

Figure 6. PC1 vs. PC2 factor scores graph (47 loris skulls) for 11 measured variables (GSL, LON, BB, ZB, BOB, MB, PL, CBL, CCL, ALMT and ML); PC1 accounts for 67.6% of the variance, PC2 for 7.0%, and PC3 (not shown) for 5.8%. Skulls were separated into groups based on the name given by the specimen collector (if available) or if not according to the area of origin and distribution given by Hill (1953) and Philips (1980). Groups: 1 – *L. t. tardigradus*, 2 – *L. t. nycticeboides*, 3 – *L. l. grandis*, 4 – *L. l. nordicus*, and 5 – unidentified specimens. The groups are mostly incompletely separated from each other.

Test of the current four-subspecies classification – skull measurements

One-way ANOVA showed that *L. l. nordicus* was significantly larger than the three other lorises (*L. t. tardigradus*, *L. t. nycticeboides* and *L. l. grandis*) for 10 skull variables—MHL ($F = 23.35$, $p<0.001$), LON ($F = 18.7$, $p = 0.003$), BB ($F = 17.87$, $p<0.001$), ZB ($F = 50.91$, $p<0.001$), BOB ($F = 41.78$, $p<0.001$), MB ($F = 61.75$, $p<0.001$), PL ($F = 29.95$, $p<0.001$), CBL ($F = 11.53$, $p = 0.001$), CCL ($F=21.12$, $p<0.001$) and ALMT ($F = 14.55$, $p<0.001$). No significant differences ($p>0.05$) were observed between the other groups. The PC1 vs. PC2 graph did not show any clear separation (Fig. 6).

Proposed classification based on facial and pelage features

We observed several differences in the facial and pelage features (Fig. 1) of live individuals encountered in the field. A cluster analysis using the complete linkage method divided the 106 loris specimens into seven clusters, which are sorted

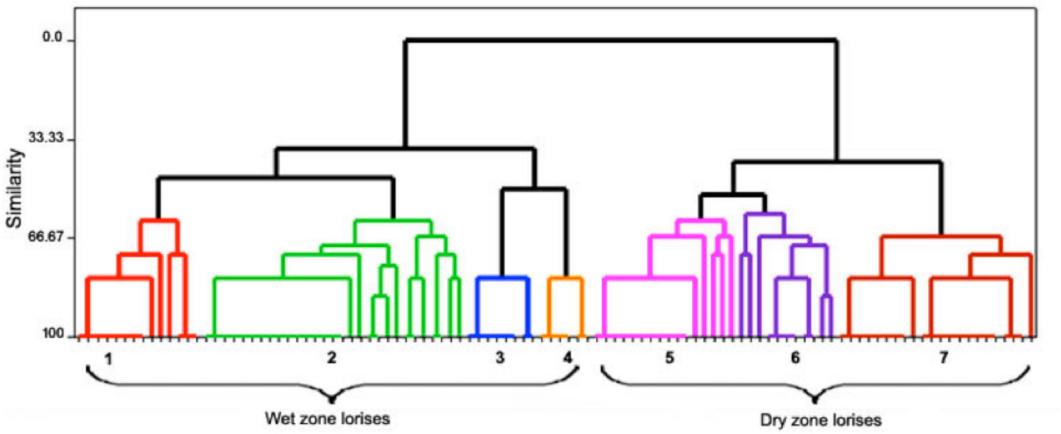

Figure 7. Dendrogram of complete linkage and Euclidean distance for the 23 features (facial and pelage) examined in 97 slender loris specimens, and photographs of nine live slender lorises were clearly seperated into two clusters: the wet zone cluster (*Loris tardigradus*) and dry zone cluster (*Loris lydekkerianus*). Subgroups can be designated as: 1 – Northwestern (Gampaha and Kurunegala); 2 – Southwestern (Colombo, Kalutara, Rathnapura, Kegalla, Galle, and Matara), 3 – Rakwana (Deniyaya-Rakwana mountain range), 4 – Montane (Nuwara Eliya and Badulla), 5 – Highland grey (Matale, Kandy and Kurunegala), 6 – Uva (Badulla, Ratnapura, Monaragala and Ampara) and 7 – Northern grey (Anuradhapura, Polonnaruwa, Puttlum, Mannar, Vauniya and Trincomale). Separation between the groups is complete, although groups 3 and 4 consist of a limited number of specimens (group 3 = 6, and group 4 = 7).

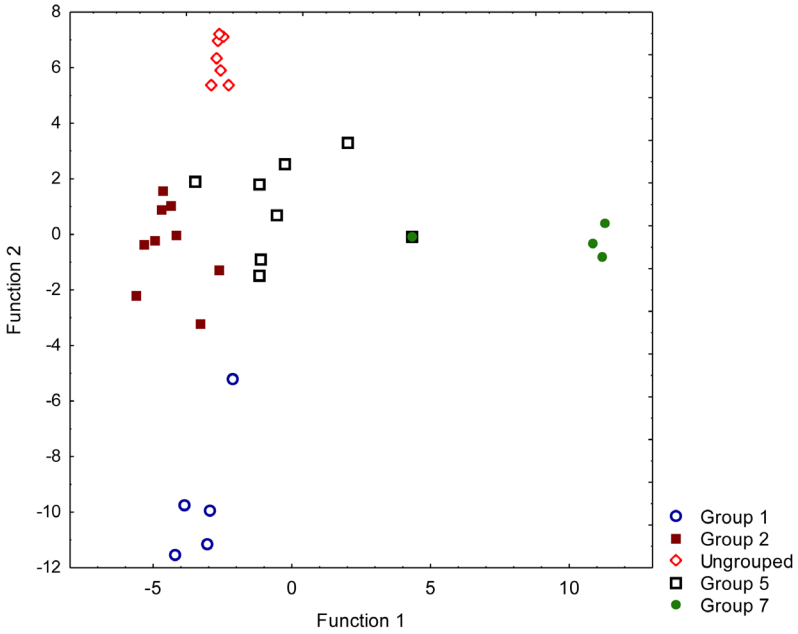

Figure 8: Discriminant Function Analysis, based on 13 facial and pelage features of 106 slender loris specimens (Function 1 vs Function 2 graph); Function 1 accounts 48.2% of the variance and Function 2 for 33.5% of the variance: Group 1 - Northwestern, Group 2 - Southwestern, Group 5 - Highland gray, Group 7 - Northern grey, and ungrouped [combined group 3 (Rakwana) + group 4 (Montane) + group 6 (Uva)]. Groups 1 and 2 are completely separated from each other and from groups 5 and 7, which however overlap slightly with each other.

largely, but not 100%, according to areas of distribution (Fig. 7), as follows:

Group 1: Northwestern (Gampaha, Kurunegala)

Group 2: Southwestern (Colombo, Kalutara, Ratnapura, Kegalla, Galle, Matara)

Group 3: Rakwana (Deniyaya-Rakwana range)

Group 4: Montane (upper montane region of Nuwara Eliya, Badulla)

Group 5: Highland grey (Matale, Kandy, Kurunegala)

Group 6: Uva (Badulla, Ratnapura, Monaragala, Ampara)

Group 7: Northern grey (Anuradhapura, Polonnaruwa, Puttlum, Mannar, Vauniya, Trincomale)

Frequencies of facial and pelage features in the seven groups are given in Table 2. Thus, the classification proposed is based on these facial pelage features and distribution. The members of group 1 (n = 14) clustered with 61% similarity, of group 2 (n = 29) with 61% similarity, group 3 (n = 8) at 80%, group 4 (n = 6) at 80%, group 5 (n = 16) at 61%, group 6 (n = 8) at 69% and group 7 (n = 22) at 66% similarity. All of the wet zone lorises (groups 1, 2, 3 and 4) (n = 57) were clustered at 36% similarity level, and the dry zone and intermediate zone lorises (groups 5, 6 and 7) (n = 49) at 44% similarity. One individual from Dambulla was clustered with group 6 rather than group 7 where it theoretically should belong (58%

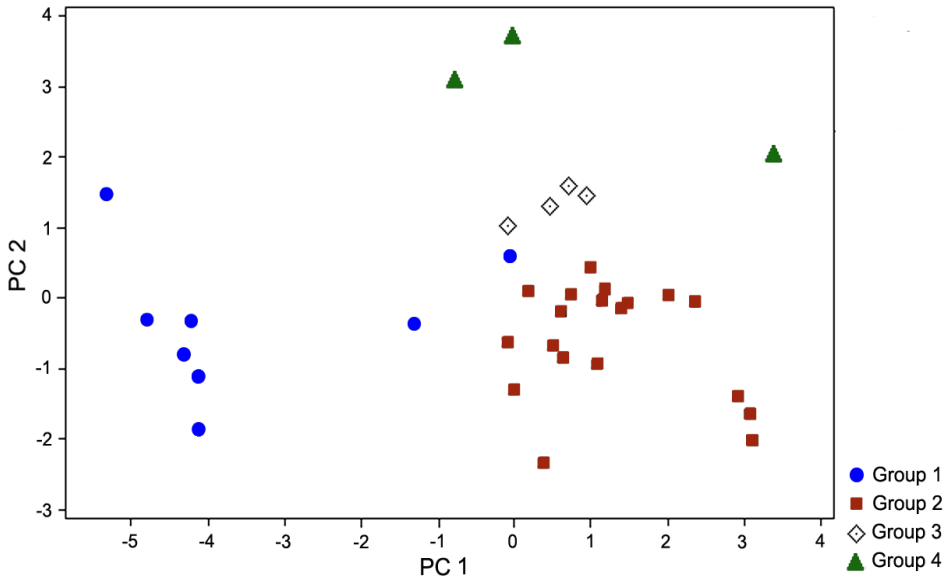

Figure 9: PC1 vs. PC2 factor scores graph for adult wet zone phenotypes (n=34) examined during the study (male and female lumped) for nine measured variables (UAL, FAL, TL, LL, KL, MHL, HB, MBOP and EL); PC1 accounts 56.2 % of the variance, PC2 for 18.6%, and PC3 (not shown) for 7.6%. Groups: 1 - Northwestern, 2 - Southwestern, 3 - Rakwana, and 4 - Montane. The four groups are completely separated from each other, although note that sample sizes of groups 3 and 4 are small.

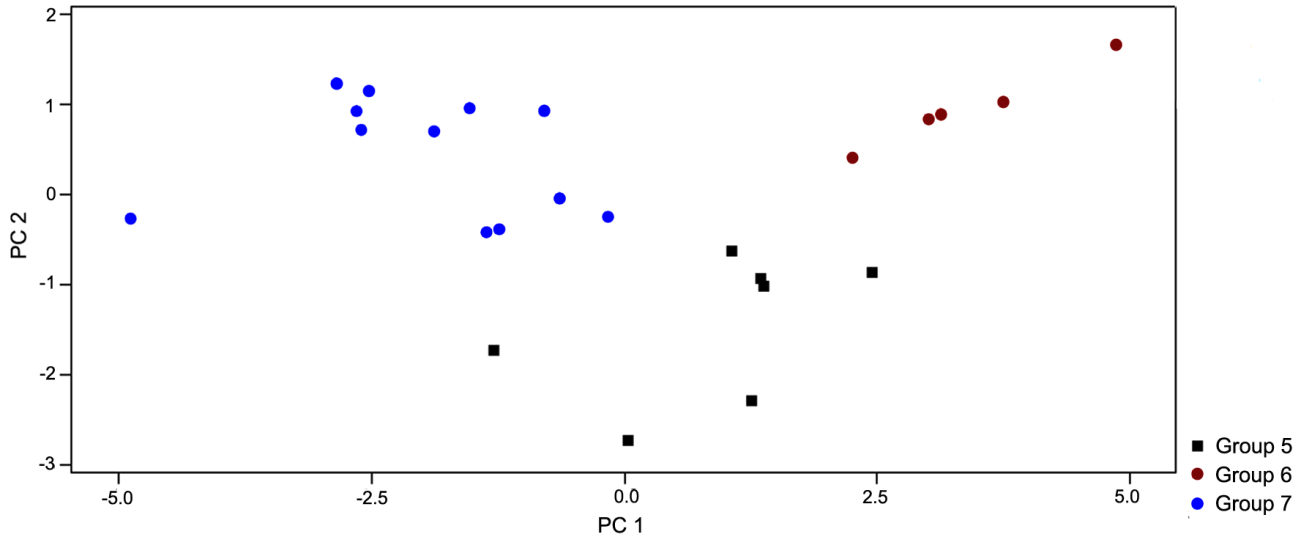

Figure 10. PC1 vs. PC2 factor scores graph for adult dry and intermediate zone phenotypes (n=24) examined during the study (male and female lumped) for nine measured variables (UAL, FAL, TL, LL, KL, MHL, HB, MBOP and EL); PC1 accounts 60.4 % of the variance, PC2 for 13.6%, and PC3 (not shown) for 9.0%. Groups: 5 - Highland grey, 6 - Uva, and 7 - Northern grey. The three groups are completely separated from each other.

Table 2. Frequencies of facial and pelage features in seven groups of Sri Lankan lorises: 1 - Northwestern group; 2 - Southwestern group; 3 - Rakwana group; 4 - Montane group, 5 -Highland grey group; 6 - Uva group; and 7- Northern grey group.

Character	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
a. Circumocular patch **1. Overall shape**							
M = Marquise T = Teardrop O = Ovoid/rounded P = Pear	M = 13 (93%)	M = 0	M = 0	M = 0	M = 0	M = 0	M = 0
	T = 0	T = 0	T = 0	T = 6 (100%)	T = 0	T = 0	T = 22 (96%)
	O = 0	O = 27 (93%)	O = 0	O = 0	O =2 (11%)	O = 8 (100%)	O = 0
	P = 1 (7%)	P = 2 (7%)	P = 8 (100%)	P = 0	P = 16 (89%)	P = 0	P = 1 (4%)
2. Shape on the top							
R = Rounded P = Pointed distinct PD = Pointed diffused	R = 0	R = 24 (83%)	R = 0	R =0	R = 3 (17%)	R = 6 (75%)	R = 0
	P = 13 (93%)	P =3 (10%)	P = 0	P = 6 (100%)	P = 15 (83%)	P = 2 (25%)	P = 19 (83%)
	PD = 1 (7%)	PD = 2 (7%)	PD = 8 (100%)	PD = 0	PD = 0	PD = 0	PD = 4 (17%)
3. Shape on the bottom							
BP = Broad, pointed toward muzzle NR = Narrow, rounded EZ = Extent toward zygomatic arch	BP = 14 (100%)	BP = 1 (3%)	BP = 2 (25%)	BP = 0	BP = 1 (6%)	BP = 0	BP = 0
	NR = 0	NR = 28 (97%)	NR = 6 (75%)	NR = 0	NR = 17 (94%)	NR = 8 (100%)	NR = 10 (43%)
	EZ = 0	EZ = 0	EZ = 0	EZ = 6 (100%)	EZ = 0	EZ = 0	EZ = 13 (57%)
4. Median facial strip width							
N = Narrow M = Moderate B = Broad	N = 4 (26%)	N = 28 (97%)	N = 8 (100%)	N = 0	N = 0	N = 0	N = 0
	M = 10 (74%)	M = 1 (3%)	M = 0	M = 6 (100%)	M = 18 (100%)	M = 8 (100%)	M = 1 (4%)
	B = 0	B = 0	B = 0	B = 0	B = 0	B = 0	B = 22 (96%)
5. White rim around circumocular patch							
P = Prominent white rim T = Thin white rim A = Absent	P = 1 (7%)	P = 5 (17%)	P = 0	P = 6 (100%)	P = 17 (94%)	P = 8 (100%)	P = 23 (100%)
	T = 13 (93%)	T = 24 (83%)	T = 0	T = 0	T = 1 (6%)	T = 0	T = 0
	A = 0	A = 0	A = 8 (100%)	A = 0	A = 0	A = 0	A = 0
b. Frosting on dorsum							
H = Highly frosted L = Lightly frosted N = No frosting	H = 0	H = 0	H = 8 (100%)	H = 0	H = 15 (83%)	H = 8 (100%)	H =23 (100%)
	L = 0	L = 5 (17%)	L = 0	L = 4 (67%)	L = 2 (11%)	L = 0	L = 0
	N = 14 (100%)	N = 24 (83%)	N = 0	N = 2 (33%)	N = 1 (6%)	N = 0	N = 0
c. Yellow pigmentation muzzle and ears							
H = Highly pigmented L = Very low	H = 13 (93%)	H = 29 (100%)	H = 0	H = 0	H = 17 (94%)	H = 6 (75%)	H = 22 (96%)
	L = 1 (7%)	L = 0	L = 8 (100%)	L = 6 (100%)	L = 1 (6%)	L = 2 (25%)	L = 1 (4%)
d. Ventral hair base color							
W = Whitish or light grey G = Dark grey or black	W = 0	W = 0	W = 0	W = 0	W = 2 (11%)	W = 0	W = 23 (100%)
	G = 14 (100%)	G = 29 (100%)	G = 8 (100%)	G = 6 (100%)	G = 16 (89%)	G = 8 (100%)	G = 0

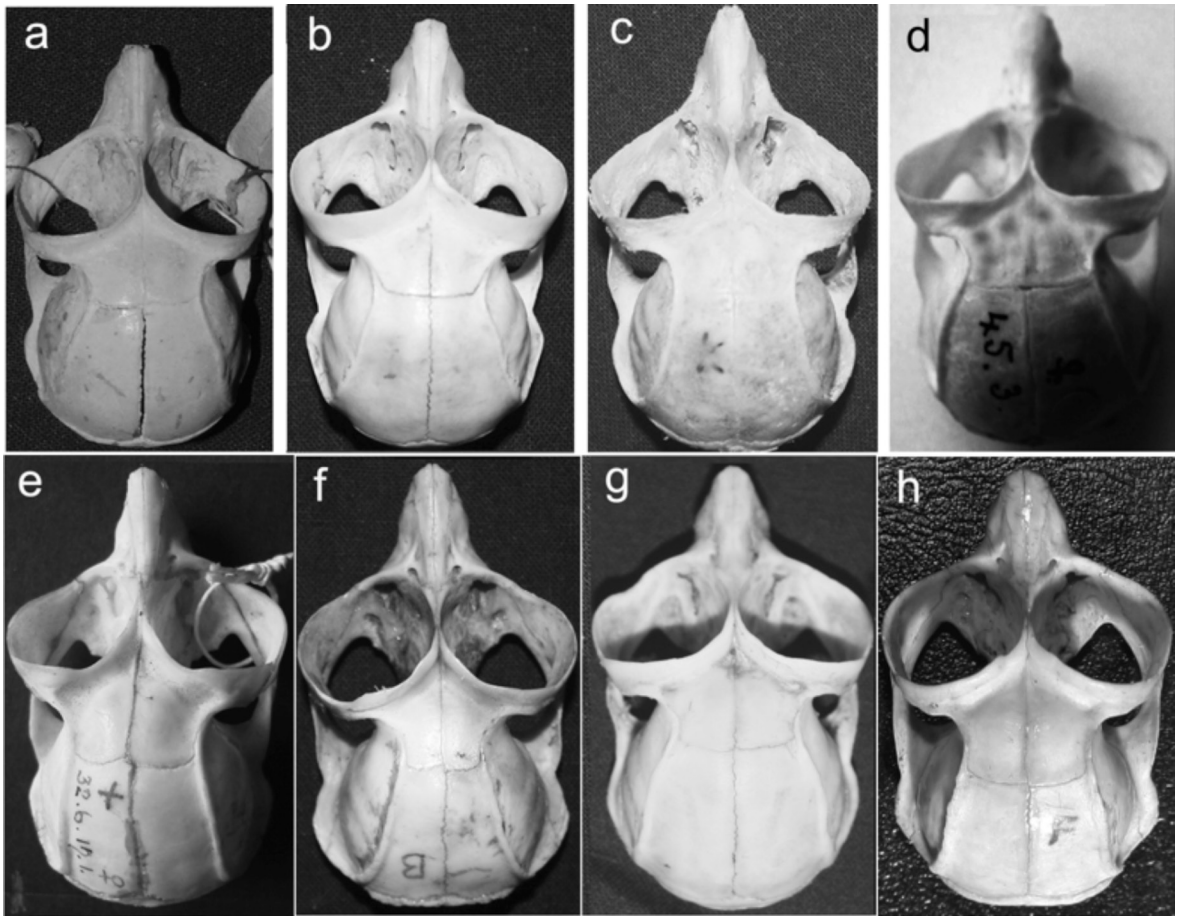

Figure 11. Dorsal views of skulls from the different loris groups: **a.** Northwestern [group 1 - ♂ Henarathgoda-Gampaha (30 m asl)], **b.** Southwestern [group 2 - ♂ Kottawa-Galle (100 m asl)], **c.** Rakwana [group 3 - ♂ Morningside-Singharaja (1100 m asl)], **d.** Montane [group 4 - ♀ below Horton Plains, holotype of *L. t. nycticeboides* (1520–1824 m asl)]; **e.** Highland grey [group 5 - ♀ [Gammaduwa-Knuckles holotype of *L. t. grandis* (850 m asl)], **f.** Highland grey [group 5 - ♀ Redbana-Knuckles (650 m asl)]; **g.** Uva [group 6 - ♂ Nilgala-Monaragala (200 m asl)], and **h**. Northern grey [group 7 - ♀ Talawa-Anuradhapura (100 m asl)].

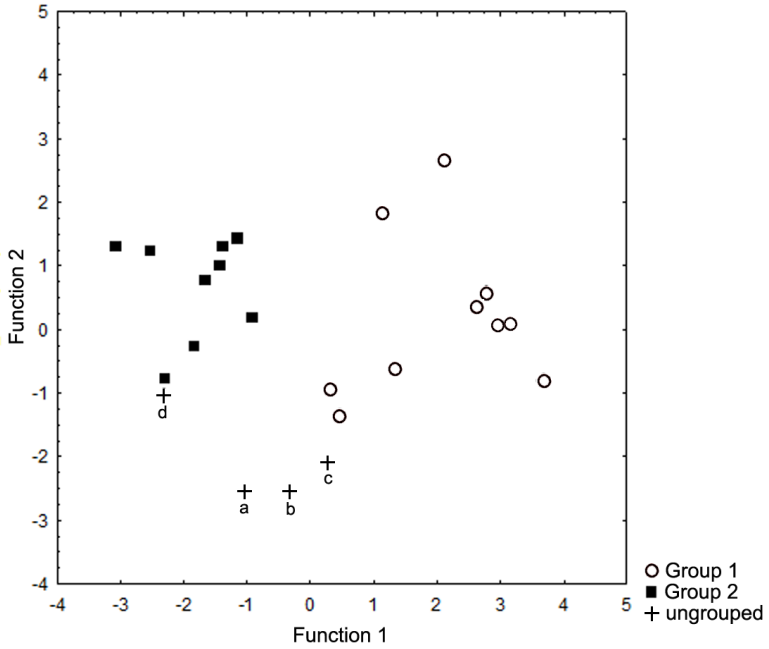

Figure 12. Discriminant Analysis, based on seven skull variables (GLS, LON, BB, MB, CBL, ALMT and ML): group 1 - Northwestern, group 2 - Southwestern and ungrouped [group 3 (Rakwana) + group 4 (Montane)]: a = Montane ♀, b = Montane ♂, c = Rakwana ♀ and d = Rakwana ♂. Function 1 accounts for 77.8% of the variance and mainly contrasts biorbital breadth (BB), and condylobasal length (CBL). Function 2 accounts for 22.2% of the variance and contrasts biorbital breadth (BB), mastoid breadth (MB) and mandible length (ML). Groups 1 and 2 are completely separated from each other.

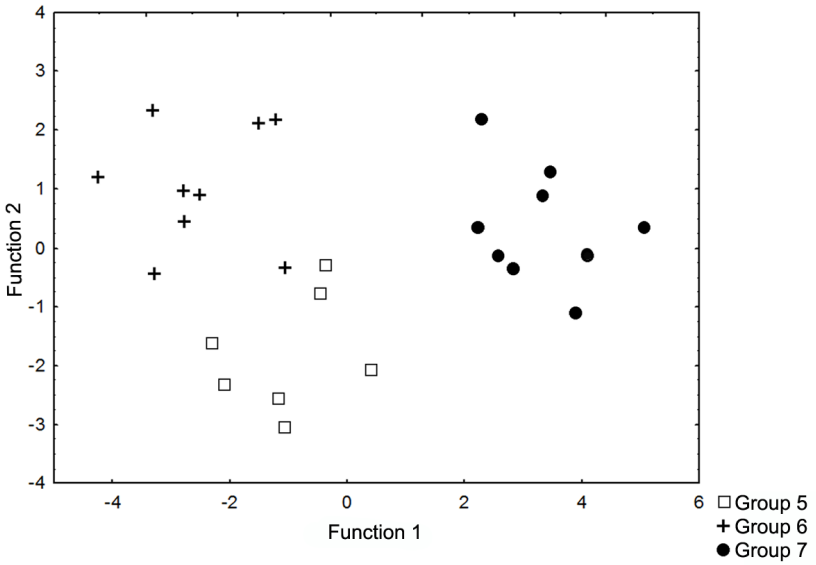

Figure 13. Discriminant Analysis, based on seven skull variables (BB, ZB, BOB, MB, CCL, ALMT and ML): Groups: 5 - Highland grey, 6 - Uva and 7 - Northern grey. Function 1 accounts for 82.8% of the variance and mainly contrasts biorbital breadth (BB), zygomatic breath (ZB), alveolar length of maxillary toothrow (ALMT, breadth of braincase (BOB), condylo-canine length (CCL) and greatest length of skull (GSL); Function 2 accounts for 17.2% of the variance and contrasts mastoid breadth (MB), biorbital breadth (BB) and mandible length (ML). The three groups are completely separated from each other.

similarity), and two individuals from Redbana-Knuckles were clustered with group 6 rather than group 5 at 58% and 66% similarity respectively.

General Discriminant Analysis (GDA) showed that only 17 of 23 variables were supported to create a function, and these variables were used for subsequent Discriminant Analysis. Thirteen variables were selected for the Discriminant Analysis. Only four groups [northwestern (group 1), southwestern (group 2), highland grey (group 5) and northern grey (group 7)] had large enough sample sizes to form the basis for the analyses; thus the other three groups [group 3 (Rakwana), group 4 (montane) and group 6 (Uva)] were entered as ungrouped. The DF1 largely reflects the median facial strip width and overall shape of the circumocular patch; DF2 reflects the median facial strip width, dorsal frosting, white rim around circumocular patch, and overall shape of the circumocular patch. Figure 8 shows DFA plots for 13 facial and pelage features. Separations were complete, except that one specimen of group 7 from Dambulla (Matale) was classed with group 5. The other specimens, entered as ungrouped, classed separately in the basic four groups. Northwestern (group 1), southwestern (group 2), highland grey (group 5) and northern grey (group 7) were all significantly separated from each other. Thus DFA supported the cluster analysis divisions ($P<0.001$). PCA results for the ungrouped specimens showed a clear separation only of group 3 (Rakwana), group 4 (montane) and group 6 (Uva) from each other.

Test of the Proposed Classification Using External Body Measurements

We tested the possibility of the proposed classification based on facial and pelage features, using external body measurements. External body morphology of slender lorises show minor sexual dimorphism (Kar Gupta 2013). but we did not separate sexes in our analyses due to the limited number of samples.

External body measurements of wet zone lorises (*Loris tardigradus*)

The lorises of the Southwestern group (group 2) were significantly larger ($p<0.05$) than those of the Northwestern group (group 1) for eight measured variables—UAL ($F = 23.1$, $p<0.001$); FAL ($F = 60.1$, $p<0.001$); TL ($F = 50.5$, $p<0.001$); LL ($F = 33.3$, $p<0.001$); KL ($F = 38.8$, $p<0.001$); MHL ($F = 39.1$, $p<0.001$); HB ($F = 21.4$, $p<0.001$); MBOP ($F = 11.8$, $p = 0.002$). The PCA results for wet zone lorises showed (Fig. 9) that the three groups [Northwestern (group 1), Southwestern (group 2) and Montane (group 4)] were clearly separate from each other, while the Rakwana (group 3) was clustered between the three. We then performed a Discriminant Analysis on the basis of seven body variables. Only the Northwestern (group 1) and Southwestern (group 2) groups had a large enough sample size to form a basis for the analysis; thus the other two groups [Rakwana (group 3) and Montane (group 4)] were entered as ungrouped. The three groups (Northwestern, Southwestern and ungrouped) were significantly ($p<0.001$) distinct; DF1 accounted for 70.6% of the total variance, and DF2 accounted for 29.4%.

External body measurements of dry and intermediate zone lorises (*Loris lydekkerianus*)

The animals of the Northern grey group (group 7) were significantly larger ($p<0.05$) than any other group found in the dry and intermediate zones for seven measured variables—UAL ($F = 37.6$, $p = 0.003$); FAL ($F = 40.5$, $p<0.001$); TL ($F = 22.5$, $p<0.001$); LL ($F = 12.0$, $p = 0.002$); KL ($F = 11.4$, $p<0.001$); HB ($F = 12.3$, $p = 0.002$); MBOP ($F = 13.3$, $p = 0.002$). The PCA results for the dry and intermediate zone lorises showed that the three groups [Highland grey (group

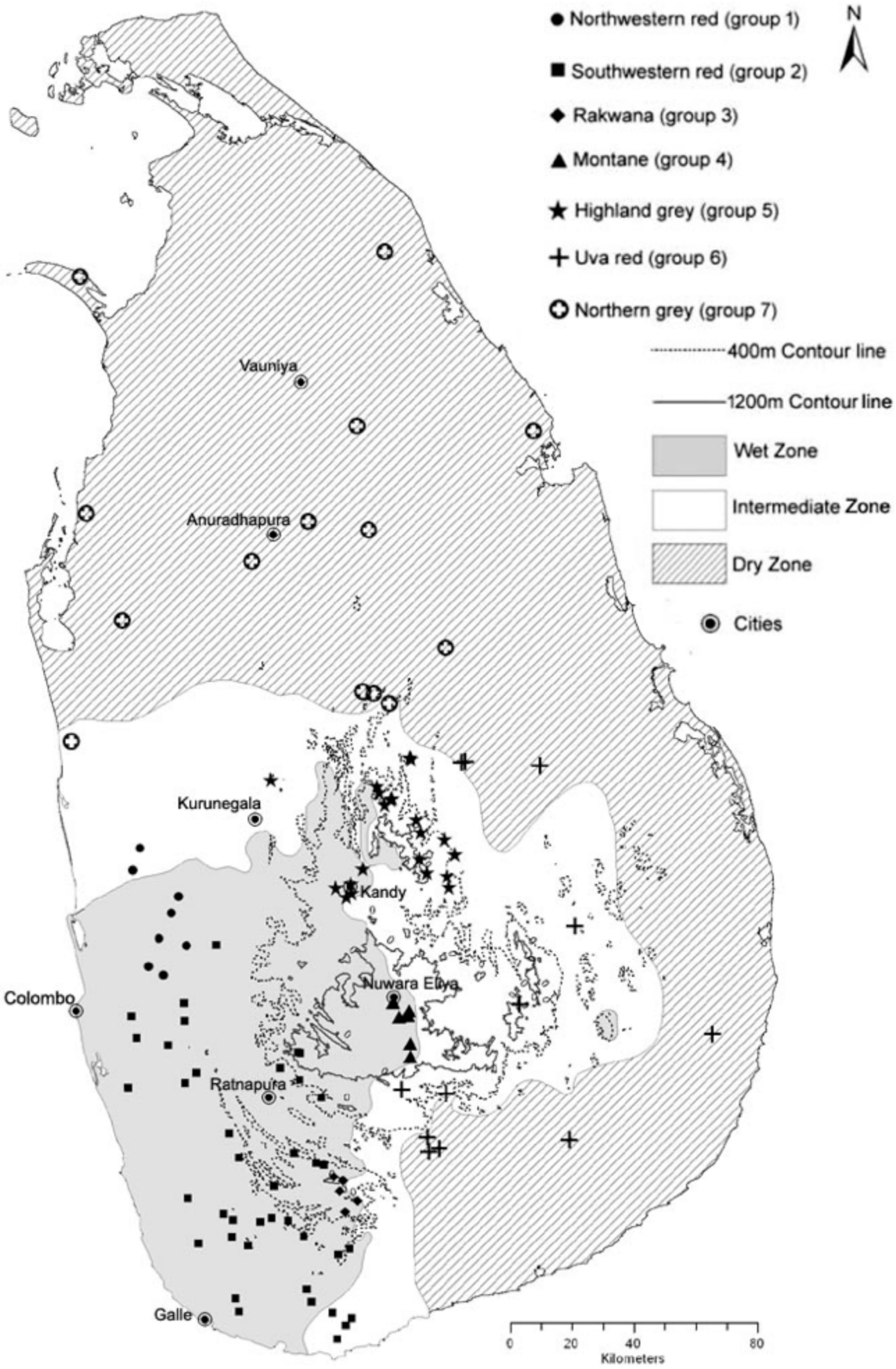

Figure 14. Distributions of the different slender loris groups in Sri Lanka.

Table 3: Summary of the species and subspecies classification.

Group	Species classification	Subspecies classification	Common name	Climatic zone and distribution	Coat color and identification	No. of individuals examined
Group 1	*Loris tardigradus*	*L. tardigradus parvus*	Northwestern red slender loris	Northwestern wet zone and intermediate zone. Gampaha and Kurunegala districts	Dark golden brown. Marquise-shaped, broad circumocular patch	24
Group 2	*Loris tardigradus*	*L. tardigradus tardigradus*	Southwestern red slender loris	Southwestern wet zone. Colombo, Kalutara, Ratnapura, Kegalla, Galle and Matara districts	Varies from yellow brown to dark brown or grayish. Circumocular patches are ovoid in shape and much narrowed at the bottom	41
Group 3	*Loris tardigradus*	*L. tardigradus* ?	Rakwana slender loris	Southwestern wet zone. High altitude (>800 m asl) of Deniyaya-Rakwana mountain range.	Dark grey brown or brownish black with heavily frosted. Circumocular patches are pear shaped and white rim around circumocular patch is absent.	10
Group 4	*Loris tardigradus*	*L. tardigradus nycticeboides*	Montane slender loris	Wet zone, found 1700-1800 m asl of Nuwara Eliya	Dark brown or brownish black. Long, thick, woolly coat. Circumocular patches are pear shaped and white rim around circumocular is prominent.	7
Group 5	*Loris lydekkerianus*	*L. lydekkerianus grandis*	Highland grey slender loris	Wet zone and intermediate zone. Kandy and Matale districts	Grey or grey-brown with heavily frosted. Circumocular patches are broad, pear shaped and white rim around circumocular is prominent.	22
Group 6	*Loris lydekkerianus*	*L. lydekkerianus uva*	Uva red slender loris	Southeastern dry and Intermediate zone. Badulla, Monaragala, Ratnapura and Ampara districts	Yellow brown or reddish brown with heavily frosted. Circumocular patch is relatively narrow and rounded. White rim around circumocular is prominent.	21
Group 7	*Loris lydekkerianus*	*L. lydekkerianus nordicus*	Northern grey slender loris	Northern dry zone. Anuradhapura, Polonnaruwa, Kurunegala, Puttalam, Vouniya, Trincomale and Matale districts	Grey or grey-brown with heavily frosted coat. Broad median facial stripe, and the circumocular patches are elongated with a tear-drop shape.	38

5), Uva (group 6) and Northern grey (group 7)] were clearly separated from each other (Fig. 10).

Test of the Proposed Classification Using Skull Morphology

The dorsal views of skulls from the seven different loris groups are shown in Figure 11. Slender loris skulls are slightly sexual dimorphic (Groves 1998), but the data had to be lumped due to the limited number of specimens.

Skull measurements of wet zone lorises (*Loris tardigradus*)

One-way ANOVA shows the Northwestern group (group 1) was significantly smaller than the Southwestern group (group 2) ($p<0.05$) for seven skull variables—GLS ($F = 8.1$, $p = 0.011$); BB ($F = 15.6$, $p<0.001$); ZB ($F = 6.9$, $p = 0.017$); PL ($F = 12.4$, $p = 0.002$); CBL ($F = 13.2$, $p = 0.002$); CCL ($F = 12.3$, $p = 0.003$); ML ($F = 11.3$, $p = 0.004$). In order to investigate these differences further, and find whether the groups [northwestern (group 1) and southwestern (group 2)] separate absolutely, we ran Discriminant Analyses while entering the two available specimens of group 3 (Rakwana) and the two available of group 4 (montane) as ungrouped. The three groups: northwestern (group 1), southwestern (group 2) and ungrouped were significantly ($p<0.001$) distinct from each other (Fig. 12). DF1 largely reflects condylo-canine length and biorbital breadth; DF2 reflects biorbital breadth, mastoid breadth and mandible length. The two montane specimens (group 4) fall close to each other, well away from any of the wet zone specimens on which the dispersion is based; we take this as strong evidence that this group, for which the name *nycticeboides* is available, constitutes a distinct taxon. On the other hand, the two specimens from Rakwana (group 3) fall far from each other; one is on the edge of group 2 (southwestern) and the other one is on the edge of group 1 (northwestern).

Skull measurements of dry and intermediate zone lorises (*Loris lydekkerianus*)

One-way ANOVA shows the northern grey group (group 7) was significantly larger ($p<0.01$) than Uva (group 6) for 11 skull variables—GLS ($F = 15.5$, $p = 0.001$); LON ($F = 16.6$,

p = 0.001); BB (F = 17.0, p = 0.001); ZB (F = 66.5, p<0.001); BOB (F = 67.6, p<0.001); MB (F = 44.6, p<0.001); PL (F = 22.1, p<0.001); CBL (F = 13.2, p = 0.002); CCL (F = 29.0, p<0.001); ALMT (F = 14.3, p = 0.002); ML (F = 7.6, p = 0.014)], and highland grey (group 5) for six variables [namely, GLS (F = 5.0, p = 0.042); LON (F = 5.2, p = 0.039); ZB (F = 10.7, p = 0.006); BOB (F = 12.9, p = 0.004); MB (F = 20.8, p<0.001); PL (F = 7.0, p<0.019)]. Furthermore, the highland grey (group 5) was larger than Uva (group 6) for five skull variables—BB (F = 6.1, p = 0.027); ZB (F = 4.6, p = 0.002); BOB (F = 8.5, p = 0.011); CBL (F = 5.7, p = 0.032); CCL (F = 13.4, p = 0.003); ALMT (F = 14.3, p = 0.002). The PCA result for dry and intermediate zone lorises showed that the three groups [highland grey (group 5), Uva (group 6) and northern grey (group 7)] were clearly separate from each other. Discriminant Analysis on the basis of seven body variables showed the three groups [highland grey (group 5), Uva (group 6) and northern grey (group 7)] were significantly (p<0.001) distinct from each other (Fig. 13). DF1 largely reflects condylo-canine length and biorbital breadth; DF2 reflects biorbital breadth, mastoid breadth and mandible length.

Discussion

Initial analysis of the external body morphology confirms the existence of two major groups in Sri Lanka, namely, wet zone lorises and dry/intermediate zone lorises. This supports the current two species classification of *Loris tardigradus* (wet zone) and *Loris lydekkerianus* (dry/intermediate zone) of Groves (1998) and Brandon-Jones *et al*. (2003). The position of the taxon *nycticeboides* is equivocal—a subspecies of *L. lydekkerianus* in Groves (1998) but of *L. tardigradus* in Nekaris and Jayewardene (2004)—and it is interesting that in the present study three specimens of the montane slender loris (group 4), potential representatives of *nycticeboides*, were clustered between the two groups. Separate analysis within these two groups (wet zone and dry/intermediate zone) confirmed the existence of several taxa (which we here rank as subspecies) within both of them: in the wet zone groups, northwestern (group 1), southwestern (group 2) and montane (group 4), and in the dry/intermediate zone groups, the highland grey (group 5), the Uva (group 6), and the northern grey (group 7).

Our analysis of the skull morphology also confirms the existence of these two major groups, again tending to support the two species classification; but again the two available skulls of the montane slender loris (*nycticeboides*) were clustered between the two groups. Separate analysis within these two groups also confirmed the existence of several potential taxa (presumed subspecies) within the two major groups. Overall, skull morphology shows that the northwestern (group 1), southwestern (group 2), montane (group 4), highland grey (group 5), Uva (group 6) and northern grey (group 7) lorises are quite distinct from each other, although groups 7 and 5 may interbreed in the vicinity of Kurunegala and Dambulla; while group 3 (Rakwana) is possibly not a homogeneous group craniometrically, in that one specimen falls within group 2, the other within group 6.

Both the cluster analysis based on facial/pelage features and the Discriminant analysis of skull measurements concur in showing that Sri Lankan lorises can be categorized into six groups: 1-northwestern; 2-southwestern; 4-montane; 5-highland grey; 6-Uva; and 7-northern grey. Further, our results of the facial and the pelage analysis of Sri Lankan slender lorises shows some consistency with the previous studies of slow lorises by Nekaris and Jaffe (2007), Nekaris and Munds (2010), and Munds *et al.* (2013).

Analysis of mitochondrial DNA has started, and will be reported in a future publication when further data have been collected. Generally, the members of the northern grey group (group 7) are large and distinctive in both body and skull proportions and facial features. This group is distributed in the northern dry zone up to the Jaffna peninsula; its southwestern boundary is the Deduru Oya, whereas the southeastern boundary is not clear. All specimens of group 7, both museum specimens and living animals, can be readily differentiated from the other 6 groups.

Members of the northwestern group (group 1) are smaller, and have unique facial features and distinctive body and skull proportions when compared to other groups. Based on our field observations, the distribution of this group is concentrated around Gampaha and Kurunegala, with its southern boundary at the Kelani Ganga River; although two specimens (skulls with skins) labeled simply as Colombo (BMNH.1937-7-2.7 and CONHM 7H) are identical with the northwestern group (group 1), our field observations are unable to detect any northwestern (group 1) loris from the Colombo district. The northern and eastern boundaries of the northwestern group are still not clear. The pelage colour of the northwestern (group 1) shows some similarity to that of the southwestern (group 2), but they differ in size, especially FAL and TL, and in the shape of the circumocular patch (marquise shaped, broader at the bottom, and extended toward the muzzle in the northwestern group); and all specimens, both museum specimens and living animals, can be readily differentiated.

The southwestern group (group 2) lorises are medium-sized, with distinctive body proportions when compared to the northwestern (group 1), montane (group 4), highland grey (group 5), Uva (group 6) and northern grey (group 7) groups. Considering the skull variables, the group is well discriminated from most other groups; only the separation from the Rakwana group is not significant, although the discriminant analysis of external body morphology does distinguish them, and similarly in facial/pelage features the southwestern (group 2) and Rakwana (group 3) lorises are significantly (p<0.001) distinct from each other. The coat is hardly frosted in the southwestern (group 2), but dorsally strongly frosted in the Rakwana group (group 3).

In the montane group (group 4), facial/pelage features are noticeably different from all other loris groups, and the external body proportions are strongly different from those of the other wet zone lorises, while their very long, dense fur

is unique to this group and easily distinguishes it from any other loris taxon in Sri Lanka. Furthermore, the two available skulls [the holotype of *L. l. nycticeboides* Hill, 1942, and the specimen from Conical Hill, Nuwara Eliya] are noticeably different from all wet zone groups. The distribution of this group is apparently confined to the upper montane region (>1600 m asl) of the Central Highlands. Initial mitochondrial DNA study (based on cytochrome oxidase I) results shows the montane (group 4) is genetically close to the southwestern (group 2) (Gamage 2015).

The Rakwana group (group 3) is a unique taxon restricted to high altitudes (over 700 m asl) in the Rakwana-Deniyaya mountain range. The facial/pelage features are significantly ($p<0.001$) different from all other loris groups, the notable unique characters being the broad, pear-shaped, dark circumocular patches, which are extended up to the crown, and no white rim is visible around the eyes. The single male skull clearly separates from the skulls of all other groups; yet the skull of a subadult female from Gongala was clustered with the southwestern (group 2). The Rakwana group is parapatric to several other groups. Along its western, southern and northern boundary, it meets the southwestern (group 2), and on its eastern boundary it meets the Uva (group 6) (Fig. 14). This group needs further study with more material.

In its external morphology and facial features the highland grey (group 5) is clearly different from northern grey (group 7), Uva (group 6), northwestern (group 1) and the southwestern (group2), although in its external body morphology the separations from the Rakwana (group 3) and montane (group 4) groups are not quite so clear. The prominent white rim around the circumocular patch is present in both the highland grey (group 5) and montane (group 4) groups, but not in the Rakwana (group 3). It is markedly different in body and skull proportions, especially from the Uva (group 6), with which it shares a high degree of frosting; the circumocular patch is always pear-shaped compared to being rounded in the Uva (group 6). The highland grey (group 5) is restricted to high altitudes (>400 m asl) in the Knuckles Range and the Kandy region (especially the wet part of the central highlands), while its sister group, the Uva (group 6), is widely distributed in the intermediate and dry zone areas at lower elevations (<500 m asl) in the Uva basin (northern and eastern flank of the Central Highlands up to the eastern dry zone) (Fig. 14).

Our examination of type specimens shows that the type of *nycticeboides* belongs to the montane group (group 4), the type of *nordicus* belongs to the northern grey group (group 7), and the highland grey group (group 5) includes the type of *grandis*. The type of *zeylanicus* probably belongs to southwestern group (group 2).

We maintain that there is good evidence for the existence of at least two different species, of which one must at present be regarded as conspecific with the Indian lorises, while the existence of at least three, probably four, further species is probable, but more evidence is needed before they can be fully diagnosed and defined.

Taxonomic Conclusions

Here, we distinguish provisionally two species of slender loris in Sri Lanka with six subspecies (see Table 3). As noted in the introduction, the names *tardigradus*, *gracilis*, *ceylonicus*, *lori* and *zeylanicus* are based on small red lorises, and are likely to represent one of our groups. Although Linnaeus used depictions of specimens in Albertus Seba's (1734) collection for his description of what he called *Lemur tardigradus*, it is hardly possible to tell which group of the red loris [northwestern (group 1), southwestern (group 2) or Uva (group 6)] it actually belongs to; and the type locality was described simply as Ceylon. The type specimen nominated by Gentry *et al*. (1998) does not resolve this question: as illustrated in <http://linnaeus.nrm.se/zool/mamm/images/M532011.jpg>, it is a faded specimen preserved in alcohol and little trace of the original colour or pattern remains.

Lesson's (1840) *Arachnocebus lori* also has Seba as the primary reference, so is an objective synonym of Linnaeus's *tardigradus*. Lesson's other name, *Bradylemur tardigradus*, is a secondary homonym of *tardigradus* Linnaeus, and is in any case a strange mixture of slow and slender lorises, only his Variety *C* being a Sri Lankan slender loris (one of the black ones), but it is hard to tell which to group it might pertain.

Remaining are the two species described by Fischer (1804). His *Loris gracilis* is evidently just a renaming of Linnaeus's *tardigradus*, but his *Loris ceylonicus* is meant to be something different. He described it as "yellowish brown", which could correspond, like Linnaeus's *tardigradus*, to either the northwestern group (group 1), or the southwestern group (group 2) or the Uva group (group 6), but it seems impossible to say what group is actually involved, and as this name has not been used for more than two hundred years and no type specimen is known to be available, here we propose arbitrarily that the name *Loris ceylonicus* is a synonym of *tardigradus*. Hill and Phillips (1932) wrote "Hitherto, however, all the lorises from Ceylon that appear to have been at all thoroughly examined have come from within a radius of 30 or 40 miles of Colombo"(Hill and Phillips 1932, p.109). Two groups described here—the northwestern (group 1) and southwestern (group 2) groups—are found in the western region, within a radius of 30 or 40 miles of Colombo. Of these, the southwestern group (group 2) is widely distributed throughout the wet zone proper, and may thus be considered more likely to represent *tardigradus* Linnaeus, 1758.

Our taxonomic arrangement of the slender lorises of Sri Lanka is as follows.

Loris tardigradus tardigradus (Linnaeus, 1758)
Southwestern group (group 2)

Type: Gentry *et al*. (1998) designated a Swedish Museum of Natural History, Stockholm, specimen (NRM 532011) as

lectotype (see <http://linnaeus.nrm.se/zool/mamm/images/M532011.jpg>).
Type locality: Ceylon.
Diagnosis: *Loris tardigradus* has distinctive facial features: the circumocular patches are ovoid in shape and much narrowed at the bottom and in the middle; the patches are brown, dark brown or chestnut brown. The median facial strip is narrower than in any other Sri Lankan loris group; with strong yellow pigmentation on the muzzle, hands, feet, ears and eyelids in both sexes. Preocular hair varies from brown to dusky white to silvery grey. Coat colour on the body varies from yellowish brown to dark brown or grey brown. The fur is between wavy and curly; and longer than in *Loris tardigradus parvus* n. ssp. (see below). The pelage of the ventral surface is generally yellowish, creamy or dusky whitish. Throat hair is generally superficially yellow/cream, with bases yellowish, light grey, grey or black. A dark dorsal stripe is visible. Skull size is similar to the montane (4), highland grey (5) and Uva (6) groups, and much larger than in the northwestern (1) group. Ridges on the skull are moderately developed, including the temporal ridges and the curved ridge on the occiput. The dorsal surface of the skull is not smooth, with a moderately developed wing-shaped mastoid; skull length ranges from 48.7 mm to 51.1 mm. The body is much larger and more elongated than in the northwestern (1) and Uva (6) groups.
Description: A few specimens from Kalutara have broadly pear-shaped circumocular patches. Animals found in Galle and Matara have a much more brightly coloured belly and the hair bases are dark grey. Those found in Ratnapura, Hiniduma, Akuressa and Deniyaya have a dusky white belly and the hair base colour is black.
Distribution: The distribution is shown in Figure 14. This species is found throughout the wet part of the southwestern region, from Colombo, Kalutara, Ratnapura, Kegalla, Galle, Matara and possibly the wetter part of Hambantota.
Common name: Southwestern red slender loris

The following specimens have been examined:
Skin plus skull: NHMC 7I [adult ♂ Colombo]; FMNH 95027 [adult ♀ Maharagama], SLCP 2015.09 [adult ♀ Madakada-Kaluthara], SLCP 2015.15 [adult ♂ Kottawa-Galle], SLCP 2012.02 [adult ♀ Kudawa-Sinharaja].
Skull only: SLCP 2012.03 [adult sex? Oliyagan-Matara], SLCP 2012.11 [adult sex? Maharagama], SLCP 2012.07 [adult ♂ Kottawa-Galle], SLCP 2012.01 [adult sex? Massmulla]; RCSL. A112.53 [adult ♂ Polgahawela], UOCSL 99.7.31 [adult sex? Kaduwela-Colombo].
Living animals: Madakada-Kalutara [adult ♀ = 1; juveniles = 2], Beraliya-Kalutara [adult ♂ = 1], Yagirala-Kalutara [juvenile ♀ = 1], Kottawa-Galle [adult ♂ = 3, juveniles = 1], Hiyara-Galle [adult ♂ = 1], Massmulla-Matara [adult ♂ = 1, juveniles = 2], Rammale Kanda-Matara [adult ♂ = 1], Diyadawa-Matara [adult ♂ = 2], Velihena-Matara [adult ♀ = 2], Kekanadura-Matara [adult ♀ = 1], Oliyagan-Matara [adult ♂ = 2, ♀ = 2, juvenile = 1], Kondagulankanda-Matara [adult ♀ = 1], Kalubovitiyana-Matara [juvenile = 1], Kanneliya-Galle [sub-adult ♀ = 1], Kudawa-Sinharaja [adult ♂ = 1, ♀ = 1], Madampa-Rathnapura [adult ♂ = 1, ♀ = 1], Delwala-Rathnapura [adult ♀ = 1], Gilimalee-Rathnapura [adult ♂ = 1], Peak Wilderness-Rathnapura [adult ♀ = 1].
Conservation status: Our study confirmed that this subspecies is found only in primary and secondary forest in the southwest wet zone. All of 48 sites where it is known to occur are fragmented. The Extent of Occurrence (EOO) is 4,800 km^2 and the Area of Occupancy (AOO) is 751 km^2. Furthermore, the estimated population is <2,500 mature individuals. Thus, this subspecies is assessed as Endangered [B1b(i, ii and iii), C1].

Loris tardigradus parvus new subspecies
Northwestern group (group 1)

This group has unique facial features, body morphology and skull morphology. Further research on this new subspecies is needed. It seems sharply distinct from the southwestern *Loris t. tardigradus*, and we predict that further work will show that it is a distinct species, but the present sample size is insufficient.
Type: Adult female skin, skull and tissues (in alcohol), SLCP 2015.13, to be deposited in the Natural History Museum of Colombo (NHMC). Collected by the Slender Loris Conservation Project (SLCP), 11 February 2010.
Type locality: Mirigama, Gampaha District, Western Province, Sri Lanka (07°15.813'N, 80°08.405'E).
Diagnosis: This subspecies has a unique marquise-shaped, broad circumocular patch, which is much broader at the bottom compared to *Loris tardigradus tardigradus*, and is extended toward the muzzle. The median facial strip is relatively broad. There is yellow pigmentation on the muzzle, hands, feet, ears, and eyelids, rather slight in males and more marked in females. Pre-ocular hair is light brown in males, creamy or silvery in females. Dark, golden-brown pelage with short fur. Males have yellowish hair on the ventrum, females also have yellowish hair but a little darker; throat hair is superficially creamy, the base colour is yellow; the hind limbs are more strongly coloured, both ventrally and dorsally (see Fig. 15). This is the smallest form of loris; body weight is 123−170 g. Head and body length (<200.5 mm), upper arm length (<55.5 mm) and thigh length (66.6 mm) are much shorter than in any other loris. Temporal ridges are only moderately developed, and the dorsal surface of the skull is smooth and rounded, with a moderately developed mastoid.
Distribution: The distribution is shown in Figure 14. Live animals were observed in Gampaha and Kurunegala districts. Three museum specimens (BMNH 1937.7.2.7, BMNH 10.5.19, and NHMC 7H) labeled “Colombo” (listed below) were classified in this group.
Common name: Northwestern red slender loris

The following specimens have been examined:
Skin plus skull: BMNH 1937.7.2.7 [adult ♀ Colombo], NHMC 7B [adult ♂ Henarthgoda-Gampaha]; 7d [adult ♀

Figure 15. Northwestern red slender loris, *Loris tardigradus parvus*, female holotype from Mirigama, Gampaha District, Sri Lanka (07°15.813'N, 80°08.405'E).

Henarthgoda-Gampaha], 7H [adult ♀ Colombo]; SLCP 2015.06 [adult ♀ Mirigama-Gampaha], 2015.17 [adult ♂ Mirigama-Gampaha].

Skull only: BMNH 10.5.19 [adult sex? Colombo]; FMNH 92861 [adult ♀ Gampaha]; RCSL OH/69 [adult ♀ Ceylon]; SLCP 2015.00 [adult ♂ Mirigama-Gampaha], 2015.20 [adult ♂ Dunagaha-Gampaha].

Living animals: Mirigama [adult ♂ = 2, ♀ = 1, juveniles = 2]; Pilikuththuwa- Gampaha [adult ♂ = 1]; Horagolla-Gampaha [adult ♀ = 1, juvenile ♀ = 1].

Etymology: The species epithet is in reference to its small size. The word *parvus* is Latin for little.

Conservation status: Inhabits the Northwestern part of the wet zone region. Unfortunately, nearly 96% of the natural vegetation has already been destroyed in this region. Available natural vegetation is <9km^2, which is severely fragmented, and deforestation continues apace (Jayasuriya *et al*. 2006). The Extent of Occurrence is 140 km^2 and Area of Occupancy is 9 km^2. Further, the Sri Lanka 2011−2030 National Physical Plan has many of its remaining habitats included in the Western Metro Region (Sri Lanka, Ministry of Construction 2012). The estimated population is <250 mature individuals and no subpopulation is estimated to contain more than 50 mature individuals. Thus, this subspecies is assessed as Critically Endangered [B2a,b(i, ii & iii), C2a(i)].

Loris tardigradus nycticeboides Hill, 1942
Montane group (group 4)

Facial and pelage features, external body morphology and skull morphology are unique to this loris, genetic data (based only on the CO1 region) place it very close to *L. tardigradus* (see Gamage 2015). Yapa and Ratnavira (2013) have argued that it could represent a distinct species, and we have much sympathy with this view, but further research is needed.

Type: Adult female, skin and skull, British Museum (Natural History) BMNH 45.3.Plains. Collected by Mr. A. C. Nolthenius in 1937.

Paratype: Adult male, skin only, National Museum of Scotland NMS 1946.4.

Type locality: Below Horton plains, Sri Lanka.

Diagnosis: A long, thick, woolly coat is a diagnostic character for this species; the colour is brown, dark brown or brownish black; frosting is observed on wild animals. The circumocular patch is pear shaped, black or brownish black in colour, and wider above in both sexes; a whitish rim is visible all around, in both sexes. The median facial strip is wide; yellow pigmentation on the muzzle, hands, feet, ears and eyelids is very reduced; the hands, feet and muzzle are flesh colour. Muscular ridges are moderately developed, including the temporal ridges and the curved ridge on the occipital; dorsal surface of the skull is relatively curved; mastoid is poorly developed.

Description: Body weight ranges from 140−220 g, with head-body length 202−220 mm; maximum head length 52.0−57.0 mm.

Distribution: The distribution is shown in Figure 14. According to field observations, this species is found at elevations of 1700−2100 m asl around Nuwara Eliya. The slender loris found at a similar elevation in the Peak Wilderness is much closer to *Loris tardigradus tardigradus* (group 2).

Common name: Montane slender loris, Horton Plains slender loris

Notes: The first author (SNG) has been conducting a long-term study (10 years) on the ecology of the montane slender loris since 2006, but has yet to hear any vocalizations.

The following specimens have been examined:

Skin plus skull: BMNH 45.3 [adult ♀ below Horton Plains, holotype of nycticeboides Hill, 1942]. SLCP 2015.18 [adult ♂ Conical Hill-Nuwara Eliya]

Skin only: NMS 1946.4 [adult ♂ below Horton Plains, paratype of nycticeboides Hill, 1942].

Live animals: Conical-Nuwara Eliya [adult ♂ = 1, ♀ = 1], Kikiliamana Nuwara Eliya [adult ♂ = 1, ♀ = 1], Horton Plains National Park [♀ = 1], Hakgala-Nuwara Eliya [2].

Conservation status: A recent occupancy modeling study identified *L. t. nycticeboides* as closely associated with elevation, canopy height and canopy connectivity; the best habitat is montane evergreen forest at elevations of 1600 m to 2100 m asl, with a tall canopy (height >4 m) and good canopy connectivity (Gamage *et al*. 2015). Forest dieback, uncontrolled

firewood extraction, and encroachment are causing a continuous reduction of its habitat. The Extent of Occurrence is 76 km^2, and the Area of Occupancy is 28 km^2. The estimated population is <100 mature individuals and no subpopulation is estimated to contain more than 50 mature individuals. Thus, this subspecies is assessed as Critically Endangered [B1b(i, ii and iii), C2a(i)].

Loris lydekkerianus nordicus Hill, 1933
Northern grey group (group 7)

Here, we provisionally retain the northern grey group (7) as a subspecies of *Loris lydekkerianus*, described from the dry country of south-eastern India. We lack morphological and genetic data from Indian slender lorises, and direct comparisons are necessary to test this allocation.
Type: Sub-adult female skin and skull, British Museum (Natural History) BMNH 35.4.1.1.
Type locality: Thalawa, Anuradhapura, Sri Lanka.
Diagnosis: *Loris lydekkerianus nordicus* has a distinctive broad median facial stripe, and the circumocular patches are elongated with a tear-drop shape; the patches are grey or grey brown, and a white rim is visible around them. Grey or grey-brown coat with short, thin wavy fur. The hairs of the ventral surface are white, with hair bases also white or light grey, never becoming dark. The throat hair is white, and the bases are also white. Yellow pigmentation on hands, feet, ears and eyelids present in both sexes. The ears are large, length 23−29 mm. Size averages larger than any other taxon. All muscular ridges of the skull are well developed, especially the temporal ridges and the superior nuchal line (curved ridge on the occiput), which forms a small raised crest or ridge. The occiput is not rounded (nearly flat in dorsal view) and the dorsal surface of the skull is flat with a prominent wing-shaped mastoid process.
Description: Animals in the northwestern region of the range show less yellow pigmentation than elsewhere; especially the muzzle is hardly pigmented. Females are more heavily frosted than males. Well-built body, weight 230−293 g, head body length 214−240 mm, and head length 52.0−58.6 mm . Skull length ranges from 49.0−54.8 mm.
Distribution: The distribution is shown in Figure 14. This species is found throughout the northern dry zone; the south western boundary is Deduru Oya (river) and the southeastern boundary is Maduru Oya National Park. This loris has never been observed in the southeastern dry zone or wet zone areas, although its range appears to overlap with the Highland grey group (5) in Matale and Kurunegala.
Common name: Northern grey slender loris

The following specimens have been examined:
Skin plus skull: BMNH 35.4.1.1 [sub-adult Thalawa-North Central Province, holotype of nordicus Hill, 1933], 1966.3916 [adult ♂ Wilachchia-Anuradhapura], 15.3.1.16 [adult ♀Anuradhapura)]; FMNH 95028 [adult ? Chawakacheri-Jaffna], 95029 [adult ♂ Chawakacheri-Jaffna], and 95030 [adult ? Chawakacheri-Jaffna]; SLCP 2015.16 [adult ♀ near Thalawa-Anuradhapura]; University of Rjarata Sri Lanka, Zoology Museum 2008.04 [adult ♀ Mihintale-Anuradhapura].
Skin only: BMNH 15.3.1.14 [adult ♂Anuradhapura].
Skull only: BMNH 1966.3916 [adult ♂Wilachchia-Anuradhapura], 15.3.1.15 [♂ Anuradhapura]; SLCP 2015.05 [adult ♂ Kebethigollawa-Anuradhapura], SLCP 2015.10 [adult ? Dambulla].
Living animals: Thalawa-Anuradapura [adult ♀ = 1], Mihintalee-Anuradhapura [adult ♀ = 3, adult ♂ = 1, Juveniles = 2], Kebethigollawa-Anuradhapura [♂ adult = 1, sub-adult = 1], Anawilundawa-Puttlum [adult ♂ = 3, ♀ = 2], Dambulla-Matale [adult ♀ = 1], Wilpattu National Park [adult ♀ = 1], Galenbindunuwewa-Anuradapura [adult ♀ = 1], Mannar [♂ adult = 1], Polonnaruwa [adult ♂ = 1, ♀ = 2] and Trincomale [adult ♂ = 1].
Conservation status: This subspecies inhabits the northern dry zone of Sri Lanka. In contrast to the wet zone lorises, this subspecies has a considerable amount of forest left in its range; but these forests are highly fragmented and continually being lost because of deforestation for large-scale agriculture and infrastructure development (Jayasuriya *et al*. 2006). The Extent of Occurrence is 17,400 km^2, and the Area of Occupancy is 3000 km^2. The estimated population is <8500 mature individuals but no subpopulation is estimated to contain more than 1000 mature individuals. Thus, this subspecies is assessed as Vulnerable [B1ab(i, ii and iii), C1,2a(i)].

Loris lydekkerianus grandis Hill and Phillips, 1932
Highland grey group (group 5)

Facial and pelage features, external body morphology and skull morphology is unique and well differentiated from *Loris lydekkerianus nordicus*. This form may turn out to be a distinct species.
Type: Sub-adult female skin and skull, British Museum (Natural History) BMNH 32.6.17.1.
Type locality: Gammaduwa, Knuckles, Sri Lanka.
Diagnosis: This taxon has a distinct, much darker, pear-shaped circumocular patch, and the rim around the patch is white and prominent. The median facial strip is relatively wide. The face and hind limbs are more whitish than *Loris tardigradus tardigradus* (group 2). General character is a grey or grey-brown with thick, relatively long fur; females are more heavily frosted than males, as in the Rakwana group (3). The coat contains a mixture of wavy and woolly hair. The ventrum is superficially white or dusky white in females, and slightly more yellowish brown in males, whereas hair bases are black in both sexes. The throat hair is superficially white and the hair bases are dark grey or black. Both sexes have yellow pigmentation on the muzzle, hands, feet, ears and eyelids. The ears are relatively short and the preocular hair is grey. The body is relatively stout, with muscular ridges moderately developed, including the temporal ridges and the curved ridge on the occiput. The occiput is less rounded in dorsal view and the dorsal surface of the skull is relatively

curved with moderate development of the mastoid; skull length ranges 49.1−51.1 mm.

Description: Those found at higher altitudes are stouter and less frosted than those at lower altitudes. Those from high elevations (>900 m asl) in Knuckles have a very low degree of frosting and relatively stout body and short limbs compared to those found at lower elevations. Some individuals from Kurunegala and Dambulla show intermediate characters between this species and *L. l. nordicus*. Body weight ranges from 176−216 g, head-body length 208−220 mm, and maximum head length 53.9−55.3 mm.

Distribution: The distribution is shown in Figure 14. This species is found in the Knuckles Range and wet and intermediate parts of Kandy and Matale districts (200−1300 m asl). If this taxon really does overlap with *L. l .nordicus* in Matale and Kurunegala, as noted above under the heading of that taxon, then of course the two cannot be regarded as conspecific under any species concept; but this needs to be verified.

Common name: Highland grey slender loris

Notes: The skin from Opalgala, NHMC 7xA, is more brownish-toned than other specimens seen, and so bears a superficial resemblance to *Loris tardigradus nycticeboides*.

The following specimens have been seen:

Skin plus skull: BMNH 32.6.17.1 [sub-adult ♀ Gammaduwa-Knuckles, type of grandis Hill and Phillips, 1932]; FMNH 99479 [adult ♂ Digana-Kandy], 95204 [adult ♂ Pindeniya-Central Province], 95025 [adult ♂ Peradeniya-Central Province], 95026 [adult ♂ Peradeniya -Central Province]; SLCP 2015.16 [adult ♀ Pitawala-Knuckles], SLCP 2015.19 [adult ♀ Redbana-Knuckles].

Skull only: RCSL L2/OH 68 [Adult ♂ Opalgalla-Knuckles].

Skin only: NHMC 7xB [adult ♂ Mausakanda, Gammaduwa-Knuckles], 7xA [adult ♂ Opalgalla Gammaduwa-Knuckles; skin of RCSL L2/OH 68].

Living animals: Mausakanda-Knuckles [juvenile ♀], Pitawala-Knuckles [adult ♂ = 1, ♀ = 1], Mahalakotuwa-Knuckles [Juvenile ♂ = 1], Narangamuwa-Knuckles [adult ♀ = 1], Thangappuwa-Knuckles [adult ♂ = 1], Redbana-Knuckles [Adult ♀ = 2], Udwattakele-Kandy [adult ♂ = 1], Elahera-Matale [adult ♀ = 1], Dagawila-Kandy [sub-adult ♀ = 1], Wattegama-Kandy [adult ♀ = 1].

Conservation status: This subspecies inhabits lowland wet evergreen forest and mid-elevation evergreen forests in the Kandy and Matale districts. These forests are highly fragmented and continuously being lost due to encroachment, firewood extraction and expansion of plantation industry (Jayasuriya *et al*. 2006). In the Knuckles range, cardamom cultivation degrades its habitat (S. N. Gamage pers. obs.). The Extent of Occurrence is 1,750 km2, and the Area of Occupancy is 520 km2. The estimated population is <1,200 mature individuals. Thus, this subspecies is assessed as Endangered [B1ab(i, ii and iii), C1].

Loris lydekkerianus uva new subspecies
Uva group (group 6)

Facial/pelage features, external body morphology and skull morphology, all based on limited material, show apparently significant differences between the Uva group and other Sri Lankan lorises. The genetic data (based only on the CO1 region) place it very close to *L. lydekkerianus grandis* (see Gamage 2015). The Uva group can be treated provisionally as a subspecies of *Loris lydekkerianus*, but it may turn out to be specifically distinct.

Type: Adult male skin, skull and tissues (in alcohol), SLCP 2015.12, to be deposited in the Natural History Museum of Colombo (NHMC). Collected by the Slender Loris Conservation Project on 1 May 2012.

Type locality: Nilgala, Monaragala District, Uva Province, Sri Lanka (07°10.727'N, 81°17.477'E).

Diagnosis: The circumocular patch is relatively narrow, rounded and light brownish. The pelage is yellow brown/reddish brown with a little grey tone; golden frosting is present. The ventrum is more whitish than in *Loris t. tardigradus* or *L. t. parvus* n. ssp.; hair-base color of the belly is grey, never becoming black. The throat hair is creamy on both the shaft and base. White frosting is present on the hind limbs. The median facial stripe is wider than in *Loris t. tardigradus* or *L. t. parvus* n. ssp. There is much yellow pigmentation on the muzzle, hands, feet, ears and eyelids (see Fig. 16). Muscular ridges of the skull are moderately developed; the occiput is more rounded in dorsal view; and the dorsal surface of the skull is rounded; a moderately developed mastoid. Relatively short body and limbs; head-body length is 208.25±7.14 mm and upper arm length is 54.30±1.25 mm.

Distribution: The distribution is shown in Figure 14. It is found mainly in the Uva Basin (southeastern dry and intermediate zones); Badulla, Monaragala and Ampara districts.

Common name: Uva red slender loris.

Figure 16. Uva red slender loris *Loris lydekkerianus uva*, male holotype male from Nilgala, Monaragala District, Sri Lanka (07°10.727'N, 81°17.477'E).

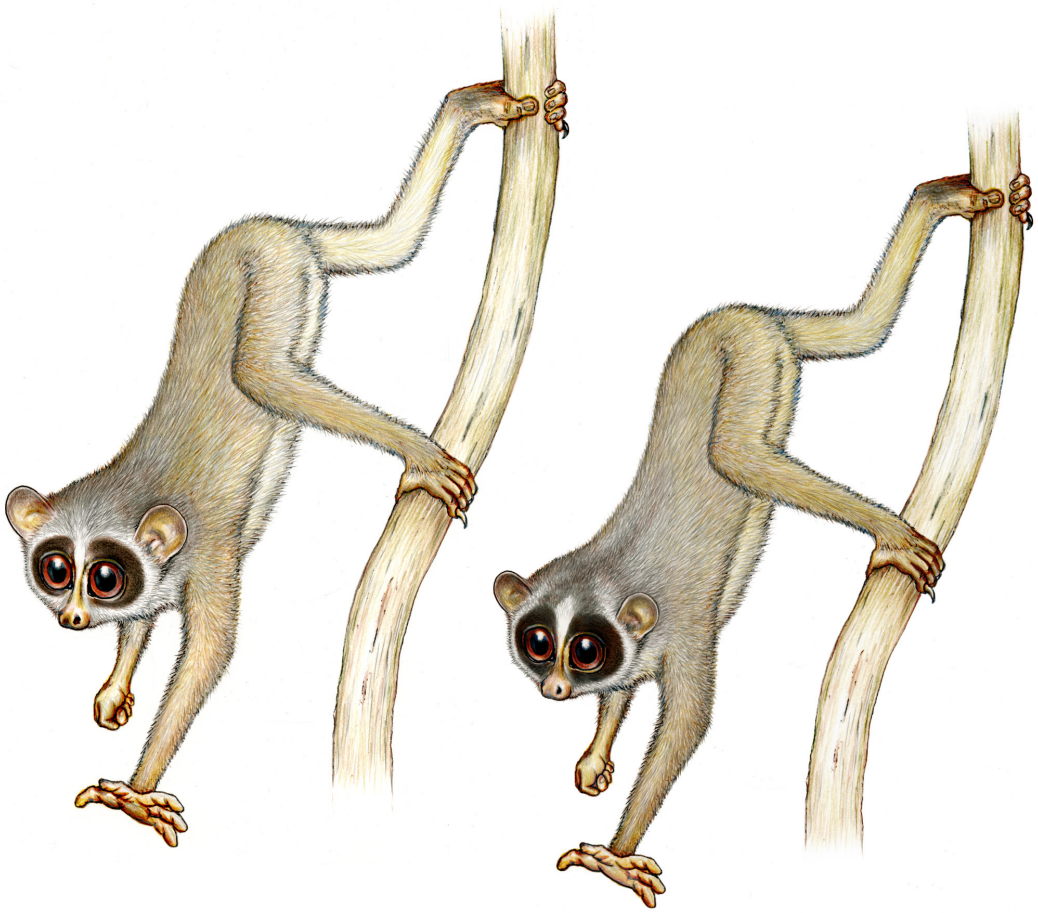

Figure 17. The Uva red slender loris *Loris lydekkerianus uva*, left, and the Northwestern red slender loris, *Loris tardigradus parvus*, right. Illustrations by Stephen D. Nash**.**

The following specimens have been examined:
Skin plus skull: SLCP 2012.12 [adult ♂ Nilgala-Monaragala].
Skin only: BMNH 54.349 [♂ Namunukula-Badulla].
Skull only: RCSL - A112.528 [adult ♀ Monaragala-Uva], A112.523 [adult ♂ Monaragala-Uva], A112.5292 [adult ♀ Monaragala-Uva], A112.522 [adult ♂ Monaragala-Uva], A112.524 [adult ♂ Monaragala-Uva], A112.525 [juvenile ♂ Monaragala-Uva], A112.526 [adult ♂ Monaragala-Uva], A112.529 [adult ♀ Monaragala-Uva], A112.5294 [adult ♀ Monaragala-Uva], A112.5296 [adult ♀ Monaragala-Uva], A112.5291 [adult ♀ Monaragala-Uva], A112.5298 [adult ♀ Monaragala-Uva], SLCP 2015.21 [adult Velioya -Balangoda]**Living animals:** Lahugala-Ampara [adult ♂ = 1], Nilgala-Monaragala [adult ♂ = 1], Rawana Ella-Badulla [adult ♂ = 1], Veelioya-Monaragala [adult ♂ = 1], Passara-Badulla [adult ♂ = 1], Belihuloya-Balangoda [adult ♂ = 1; adult ♀ = 1].
Etymology: The species epithet is in reference to its distributional range in the Uva Basin; Uva is a historical name for the south eastern dry and intermediate zone of Sri Lanka.
Conservation status: The Extent of Occurrence is 7,520 km^2, and the area of occupancy is 2,600 km^2. This subspecies is very rare, being most common in undisturbed moist mixed evergreen forests. These forests are highly fragmented and continually being lost because of deforestation for large-scale agriculture and infrastructure development (Jayasuriya *et al*., 2006). We assess the subspecies as Vulnerable [B1ab(i, ii and iii)].

Rakwana group (group 3)

Facial and pelage features, external body morphology and skull morphology show some differences between the Rakwana group (3) and *Loris tardigradus* but our sample size is not enough for any meaningful analysis. Until further evidence becomes available, it is impossible to consider proposing this as a further subspecies at this stage. We note, however, that "a very rich, rusty-coloured loris has been seen near Morningside near the Sinharadja Forest Reserve… a new subspecies or species?" (Yapa and Ratnavira 2013: 151).
Description: The limited material indicates a dark grey brown or brownish black coat with long dense fur. Both sexes show frosting, but females are more heavily frosted. Pelage of the ventrum is cream or dusky-white with hair bases black. The throat hair is white and bases are black. Dorsally very dark, hence dorsal stripe is not visible. Circumocular patches are pear shaped with black or brownish black color; wider above in both sexes and extended up to crown; no rim is visible

around the circumocular patch. Both sexes have very little yellow pigmentation on the muzzle, hands, feet, ears and eyelids. Pre-ocular hair is dark-brown or nearly black. Muscular ridges are poorly developed, especially temporal ridges; the dorsal surface of the skull is smooth and rounded. The superior nuchal lines are not detectable or poorly developed; the occiput is rounded in dorsal view; poorly developed mastoid in female (sub-adult), moderately developed in male. **Distribution:** Distribution is shown in Figure 14. This form is found at high elevations (800−1300 m asl) of Rakwana-Deniyaya mountain range. Its western, northern and southern boundary meets group 2 (*Loris tardigradus tardigradus*) and its eastern boundary meets group 6 (*Loris lydekkerianus uva* new subspecies).

The following specimens have been examined:
Skin plus skull: SLCP 2015.04 [sub-adult ♀ Gongala-Rathnapura], 2015.14 [adult ♂ Morningside-Sinharaja].
Living animals: Gongala-Rathnapura [adult ♀ = 1], Morningside-Sinharaja [adult ♂ = 1, ♀ = 1, Juveniles = 1], Ensalwatta-Estate Sinharaja division [adult ♂ = 1, Juvenile ♀ = 1], Handapanella-Rathnapura [adult = 1], Deniyaya [adult ♂ = 1, sub-adult ♀ = 1].

Future studies

We have retained the division of Sri Lankan slender lorises into two species. Further surveys and DNA samples will help to fully clarify the affinities of the Sri Lankan loris taxa to each other and to the Indian lorises. The latter have recently been briefly surveyed by Kumara *et al*. (2013). In Sri Lanka, the affinities o*f L.* cf. *tardigradus nycticeboides* are unclear; we have provisionally placed it in *L. tardigradus*, following Nekaris and Jayewardene (2004). Groves (1998, 2001) placed it in *L. lydekkerianus*, while Yapa and Ratnavira (2013) have suggested that it may be specifically distinct. The latter authors have also claimed they found "a totally isolated subpopulation of *L. lydekkerianus* […] deep within *tardigradus* territory, in the Deniyaya area" (Yapa 2013: 146). We intend to follow up on some of these questions in a future publication.

Acknowledgments

We thank the Director General of the Department of Wildlife Conservation (DWC), its Research Committee, the Deputy Director of Research, and DWC staff for their support and providing necessary permission for the collection of voucher specimens (permit no: WL/3/2/1/9). We extend our thanks to the Conservator General of Forest and the Conservator of Forests (Research and Education), and the Forest Department staff for their support and providing necessary permission. Thanks are also due to the Secretary to the Ministry of Environment, and members of the Loris Steering Committee for their advice on this work. Special thanks to Helga Schulze for providing valuable literature and comments. We also thank C. P. Rathnayaka for his contribution to the statistical analysis, C. J. Hettiarachchi for his contribution to GIS work, and A. Wadugodapitiya for his contribution to measuring the skulls at RCSL. We thank W. K. D. D. Liyanage for valuable comments on the manuscript. We give special acknowledgment to the dedicated and professional Slender Loris Conservation Project field team: C. A. Mahanayakage, G. D. C. Pushpa-Kumara, V. Sumanasekara, G. Rathnayake, D. R. Vidan¬apathirana, S. Ariyarathna, V. Rathnayake, D. Samarasingha, D. De Silva, T. Senevirathna, R. Peries, U. Wickramasingha, N. Goonasekara, L. Rathnayake, S. Jayalath, P. Yahanpath and M. A. C. Maheshani. The authors are grateful to Mendis Wickramasinghe and Anura Edirisinghe for providing some site information. We also wish to thank Ravindra Wickramasingha (National Museum, Colombo) for preserving and mounting some voucher specimens.

We are greatly indebted to the curators and staff of the National Museum of Sri Lanka, Colombo; University of Colombo Zoology Museum; Natural History Museum of London; Field Museum of Natural History, Chicago; Royal College of Surgeons, London; and the National Museum of Scotland for their support. The programme is funded through the EDGE of Existence Programme of the Zoological Society of London and the Synchronicity Foundation—we are extremely grateful for their support. Furthermore, the first author (SNG) gratefully acknowledges the Conservation Leadership Programme (CLP) and the People's Trust for Endangered Species (PTES), UK, for providing equipment. The authors also acknowledge the staff of the University of Colombo, the Open University of Sri Lanka, and the Field Ornithology Group of Sri Lanka for their kind support during the study. All work carried out falls under permits and ethics approvals issued to and held by Dr. U. K. G. K. Padmalal and the Open University of Sri Lanka by the Department of Wildlife Conservation. We followed the American Society of Primatologists' principles for the ethical treatment of primates and the International Primatological Society (IPS) international guidelines for the acquisition, care and breeding of nonhuman primates. We extend our gratitude to anonymous reviewers and the editor, who graciously reviewed this manuscript and provided helpful suggestions for its improvement.

Photo Credits: C. A. Mahanayakage, D. R. Vidanapathirana, S. N. Gamage, G. D. C. Pushpa-Kumara, R. Peries, and A. Wadugodapitiya.

Literature Cited

Bearder, S. K, K. A. I. Nekaris and D. J. Curtis. 2006. A re-evaluation of the role of vision in the activity and communication of nocturnal primates. *Folia Primatol.* 77: 50–71.

Brandon-Jones, D., A. A. Eudey, T. Geissmann, C. P. Groves, D.J. Melnick, J. C. Morales, M. Shekelle and C.-B.

Stewart. 2003. Asian primates classification. *Int. J. Primatol.* 25: 97–164.

Cabrera, A. 1908. Sobre los loris, y en especial sobre la forma filipina. *Bol. R. Soc. Esp. Hist. Nat*. 8: 135–139.

Coultas, D. S. 2002. Bioacoustic Analysis of the Loud Call of Two Species of Slender Loris (*Loris tardigradus* and *Loris lydekkerianus nordicus*) from Sri Lanka. Master's thesis, Oxford Brookes University, Oxford

Fischer, G. 1804. *Anatomie der Maki. Andreäischen Buchhandlung*, Frankfurt.

Gamage, S. N. 2015. Revision of Taxonomy, Distribution, Abundance and Habitat Preference of Slender Loris (Primates, Lorisidae: *Loris*) in Sri Lanka. PhD thesis, University of Colombo, Colombo, Sri Lanka.

Gamage, S. N., C. J. Hettiarachchi, C. A. Mahanayakage, U. K. G. K. Padmalal and S. W. Kotagama. 2015. Factors influencing site occupancy of montane slender loris (*Loris tardigradus nycticeboides*) in Sri Lanka. *Wildlanka* 3(2): 67−73.

Gentry, A., C. P. Groves and P. D. Jenkins, 1998. Comment on the proposed conservation of the name *Loris* E. Geoffroy Saint-Hilaire, 1796 (Mammalia, Primates). *Bull. Zool. Nomencl.* 55: 118–119.

Geoffroy Saint-Hilaire, É. 1796. Mémoire sur les rapports naturels des Makis Lemur, L. et description d'une espèce nouvelle de mammifère. *Magasin Encyclopédique*, An. 2, 1: 20–50.

Groves, C. P. 1998. Systematics of tarsiers and Lorises. *Primates* 39: 13–27.

Groves, C. P. 2001. *Primate Taxonomy*. Smithsonian Institution Press, Washington, DC.

Groves, C. P. 2003. Morphology, morphometrics and taxonomy. In: *Field and Laboratory Methods in Primatology: A Practical Guide*, J. M. Setchell and D. J. Curtis (eds.), pp.140–157. Cambridge University Press, Cambridge, UK.

Groves, C. P. and P. Grubb. 2011. *Ungulate Taxonomy*. Johns Hopkins University Press, Baltimore, MD.

Groves, C. P. and E. Meijaard. 2005. Interspecific variation in Moschiola, the Indian chevrotain. *Raffles Bull. Zool. Suppl.* (12): 413–421.

Groves, C. P., C. Rajapaksha and K. Manamendra-Arachchi. 2009. The taxonomy of the endemic golden palm civet of Sri Lanka. *Zool. J. Linn. Soc.* 155: 238–251.

Hill, W. C. O. 1933. A monograph on the genus *Loris* with an account of the external, cranial and dental characters of the genus; a revision of the known forms; and the description of a new form from Northern Ceylon. *Ceylon J. Sci. (Spolia Zeylanica)* XVIII(2): 89–132.

Hill, W. C. O. 1942. The slender loris of the Horton Plains, Ceylon, *Loris tardigradus nycticeboides* subsp. nov. *J. Bombay Nat. Hist. Soc*. 43: 73–78.

Hill. W. C. O. 1953. *Primates. Comparative Anatomy and Taxonomy. I. Strepsirrhini.* Edinburgh University Press, Edinburgh.

Hill, W. C. O. and W. W. A. Phillips. 1932. A new race of slender loris from the highlands of Ceylon. *Ceylon J. Sci. (Spolia Zeylanica)* XVII(2): 109–122.

International Commission on Zoological Nomenclature. 1999. Opinion 1922: *Loris* É. Geoffroy Saint-Hilaire, 1796 (Mammalia, Primates): conserved, and correction made to the entry for *Choloepus* Illiger, 1811 (Xenarthra) on the Official List. *Bull. Zool. Nomencl.* 56: 101–103.

IUCN. (2013) IUCN Red List of Threatened Species. Version 2013.1. Available: http://www.iucnredlist.org (Date of access on 22 June 2013).

Jayasuriya, A. H. M., D. Kitchener and C. Biradar. 2006. *Portfolio of Strategic Conservation Sites / Protected Area Gap Analysis in Sri Lanka*. Ministry of Environment and Natural Resource, Sri Lanka. 284 pp.

Jenkins, P. D. 1987. *Catalogue of Primates in the British Museum (Natural History) and elsewhere in the British Isles. Part IV: Suborder Strepsirrhini, including the Subfossil Madagascar Lemurs and Family Tarsiidae*. British Museum (Natural History). London.

Kar Gupta, K. 2013. Slender Loris. In: *Mammals of South Asia.*, A. J. T. Johnsingh and N. Manjrekar (eds.), pp.94–105. Universities Press, Hyderabad.

Kumara, H. N., M. Singh, M. Irfan-Ullah and S. Kumar. 2013. Status, distribution, and conservation of slender lorises in India. In: *Leaping Ahead: Advances in Prosimian Biology*, J. Masters, M. Gamba and F. Génin, (eds.), pp. 343–352. Springer, New York.

Lesson, R. P. 1840. *Species des Mammifères bimanes et quadrumanes; suivi d'un mémoire sur les Oryctéropes*. J-B. Baillière, Paris.

Linnaeus, C. 1758. *Systema Naturae.* 10th edition. L. Salvius, Stockholm.

Lydekker, R. 1905. On two lorises. *Proc. Zool. Soc. Lond. (1904)*: 345–346.

Mace, G. M. 2004. The role of taxonomy in species conservation. *Phil. Trans. Roy. Soc. B* 359: 711–719.

MacKenzie, D. I. 2003. Assessing site occupancy modelling as a tool for monitoring Mahoenui giant weta populations. DOC Science Internal Series 145. Department of Conservation, Wellington, New Zealand.

Meegaskumbura, S. and C. J. Schneider. 2008. A taxonomic evaluation of the shrew *Suncus montanus* (Soricidae: Crocidurinae) of Sri Lanka and India. *Ceylon J. Sci. (Biol. Sci.)* 37(2): 129–136.

Mittermeier, R. A., P. Robles Gil, M. Hoffmann, J. Pilgrim, T. Brooks, C. G. Mittermeier, J. Lamoreux and G. A. B. da Fonseca (eds.). 2004. *Hotspots Revisited: Earth's Biologically Richest and Most Threatened Terrestrial Ecoregions*. CEMEX, Mexico City.

Mitteroecker, P. and F. Bookstein. 2011. Linear discrimination, ordination, and the visualisation of selection gradients in modern morphometrics. *Evol. Biol.* 38: 100–114.

Munds, R. A., K. A. I. Nekaris and S. M. Ford. 2013. Taxonomy of the Bornean slow loris, with new species

Nycticebus kayan (Primates, Lorisidae). *Am. J. Primatol.* 75: 46–56. DOI:10.1002/ajp.22071.

Nekaris, K. A. I. and S. Jaffe. 2007. Unexpected diversity of slow lorises (*Nycticebus* spp.) within the Javan pet trade: implications for slow loris taxonomy. *Contrib. Zool*. 76(3):187−196.

Nekaris, K. A. I. and R. A. Munds. 2010. Using facial markings to unmask diversity: the slow lorises (Primates: Lorisidae: *Nycticebus*) of Indonesia. In: *The Primates of Indonesia*, S. Gursky and J. Supriatna (eds.), pp.383−396. Springer, New York.

Nekaris, K. A. I. and J. Jayawardene. 2004. Survey of slender loris (Primates, Lorisidae Grey, 1821: *Loris tardigradus* Linnaeus, 1758 and *Loris lydekkerianus* Cabrera, 1908) in Sri Lanka. *J. Zool., Lond.* 262: 327–338.

Nekaris, K. A. I., C. Roos, E. R. Pimley and H. Schulze. 2006. Diversity slowly coming to light: reconsidering the taxonomy of pottos and lorises. *Int. J. Primatol*. 27 (suppl. 1): 441. [Abstract]

Nicholls, L. 1939. Period of gestation in *Loris*. *Nature* 143: 246.

Pethiyagoda, R. 2005. Exploring Sri Lanka's biodiversity. *Raffles Bull. Zool. Supplement* 12: 1–4.

Phillips, W. W. A. 1980. *Manual of the Mammals of Sri Lanka*. 3 Volumes. 2nd edition. Wildlife and Nature Protection Society (WNPS) of Sri Lanka, Colombo.

Roos, C. 2003. Molekulare Phylogenie der Halbaffen, Schlankaffen, und Gibbons. PhD thesis, Fakultät Wissenschaftszentrum Weihenstephan für Ernährung, Landnutzung, Umwelt der Technischen Universität München, München.

Seba, A. 1735. *Locupletissimi rerum naturalium accurata descriptio et iconibus artificiosissimis expressio per universam physices historiam*. Jansson-Waesberg, Amsterdam.

Schultze, H., H. Preuschoft, C. P. Groves *et al.* 2003. Conservation database for lorises (*Loris*, *Nycticebus*) and pottos (*Arctocebus*, *Perodicticus*), prosimian primates. Standardized body measurement and description of lorises and pottos for taxonomic purposes. Website: <http://www.loris-conservation.org/database/population_database/measure_index.html>. Accessed: 12 May 2017.

Sri Lanka, Ministry of Construction. 2012. Sri Lanka 2011–2030 National Physical Plan and Project Proposals. National Physical Planning Department, Ministry of Construction, Engineering Services, Housing and Common Amenities, Sethsiripaya, Battaramulla. 3 March 2012. URL:<http://www.acesl.org/download/conference/tp_Lakshman%20Jayasekera%20and%20Veranjan%20Kurukulasuriya.pdf>. Accessed 20 May 2017.

Stone, W. and J. A. G. Rehn. 1902. A collection of mammals from Sumatra, with a review of the genera *Nycticebus* and *Tragulus*. *Proc. Acad. Nat. Sci. Philadelphia* 54: 127–142.

Surridge, A. K., D. Osorio and N. I. Mundy. 2003. Evolution and selection of trichromatic vision in primates. *Trends Ecol. Evol.* 18: 198–205.

Tan, Y., A. D. Yoder, N. Yamashita and W. Le. 2005. Evidence from opsin genes rejects nocturnality in ancestral primates. *Proc. Natl. Acad. Sci. USA* 102:14712–14716.

Thomas, O. 1908. The nomenclature of certain lorises. *Ann. Mag. Nat. Hist.*, ser. 8, 1: 467−469.

Wadugodapitiya, A. 2011. Morphometric Variation in Slender Lorises (Genus: *Loris*). MSc dissertation, Royal Veterinary College, University of London, UK.

Weerakoon, D. K. and W. L. D. P. T. S. D. A. Goonatilake. 2006. *Taxonomic Status of the Mammals of Sri Lanka. The Fauna of Sri Lanka: Status of Taxonomy, Research and Conservation*. Edited by C. N. B. Bambaradeniya. IUCN, Sri Lanka and Government of Sri Lanka.

White, L. and A. Edwards. 2000. Methods for assessing the status of animal populations. In: *Conservation Research in the African Rainforests: A Technical Handbook*, L. White and A. Edwards (eds.), pp.191–201. Wildlife Conservation Society, New York.

Wijesinghe, L. C. A. D. S., I. A. U. N. Gunatilieke, S. D. G. Jayawardena, S. W. Kotagama and C. V. S. Gunatilleke. 1993. *Biological Conservation in Sri Lanka: A National Status Report. IUCN Sri Lanka*. 100pp.

Wroughton, R. C. 1917. The slender loris of Malabar. *J. Bombay Nat. Hist. Soc.* 25: 45.

Yapa, A. and G. Ratnavira. 2013. Sri Lanka's terrestrial and marine mammals. In: *The Mammals of Sri Lanka*, A.Yapu and G. Ratnavira, pp.126-−151. Field Ornithology Group of Sri Lanka, Colombo.

Authors' addresses:

Saman N. Gamage, Department of Zoology, Faculty of Science, University of Colombo, Colombo 3, Sri Lanka, and Land Owners Restore Rainforests in Sri Lanka, A30, Maddumagewatta, Gangodawila, Nugegoda, Sri Lanka; **Colin P. Groves**, School of Archaeology and Anthropology, Australian National University, Canberra, Australia; **Fais M. M. T. Marikar**, Staff Development Centre, Faculty of Medicine, General Sir John Kotelawela Defence University, Ratmalana, Sri Lanka; **Craig S. Turner**, Zoological Society of London, Regent's Park, London, NW1 4RY, UK; **Kalinga U. K. G. Padmalal**, Department of Zoology, The Open University of Sri Lanka, Nawala, Nugegoda, Sri Lanka; and **Sarath W. Kotagama**, Department of Zoology, Faculty of Science, University of Colombo, Colombo 3, Sri Lanka. E-mail of first author: <samangam2004@yahoo.com>.

Received for publication:14 December 2016
Revised: 12 May 2017
Printed: 28 December 2017