

OBSERVATIONS ON THE BENGAL SLOW LORIS *Nycticebus bengalensis* in PAKKE TIGER RESERVE, ARUNACHAL PRADESH, INDIA

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INTRODUCTION

The Bengal or Northern Slow Loris, *Nycticebus bengalensis* (Lacépède), ranges widely from northeast India to east Bangladesh, south China, Myanmar, north and central Vietnam, Laos, Cambodia, Thailand, and possibly north of peninsular Malaysia (Roos et al., 2014). Currently, nine species of slow lorises are recognized, with most living allopatrically (Nijman & Nekaris, 2010). Previously, the Bengal Slow Loris was considered a subspecies of the Greater Slow Loris *N. coucang* (Boddaert), but later taxonomic studies (Groves, 1998) and molecular work (Roos, 2003) demonstrated it to be a distinct species. An understanding of the extent of its range and abundance is essential for conservation, especially considering the possibility of further taxonomic revision in the future.

For many years the Bengal Slow Loris was listed on the IUCN Red List as Data Deficient, but it was updated to Vulnerable in 2008 (Nekaris et al., 2008; Streicher et al., 2008). A Red List re-assessment in December 2015 elevated the threat status to Endangered (K.A.I. Nekaris, unpublished data). The increasing number of slow lorises in illegal international wildlife trade led to all species of *Nycticebus* being transferred from Appendix II to Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2007 (Nekaris & Nijman, 2007). Slow lorises are well protected by legislation in all range countries, categorized under Schedule I of the Wildlife Protection Act 1972 in India (amended in 2006), which prohibits domestic trade of slow lorises and their products (Nekaris & Starr, 2015). Yet slow lorises remain among the most commonly observed primates for sale in markets across their distribution range (Nekaris & Nijman, 2007). They are most often sold for use as pets as well as for the production of

traditional medicines. This over-exploitation for illegal trade combined with rampant habitat loss are the main threats to *Nycticebus* spp. (Nekaris & Nijman, 2007; Thorn et al., 2009; Starr et al., 2011; Nekaris et al., 2013).

In India, the distribution of *N. bengalensis* is confined to only seven North-eastern states (Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, and Tripura), within a wide variety of habitats: tropical evergreen, semi-evergreen, tropical mixed deciduous and sub-tropical broadleaf forests (Choudhury, 1992; 2001). Several surveys of this nocturnal primate have been conducted to determine the extent of its distribution (Choudhury, 1992; Radhakrishna et al., 2006, 2010; Swapna et al., 2008; Das et al., 2009, 2014). From these results, it appears that the species is rare, found only in some isolated pockets of northeast India. Here we build upon the current knowledge of Bengal Slow Loris distribution by reporting on surveys carried out in Pakke Tiger Reserve, Arunachal Pradesh, India.

METHODS

Study area

The survey site, Pakke Tiger Reserve (PTR) (26°54'–27°16' N and 92°36'–93°09' E), is situated in the foothill forests of East Kameng district of western Arunachal Pradesh, India, and spread over 862 km² (Fig. 1). The north and west sides are bounded by the Bhareli River, the east side by the Pakke River and the southern edge has a common boundary with the state border of Assam. The area is characterized by undulating and hilly terrain with altitudes ranging from 200 m to about 2000 m above sea level (Kumar & Solanki, 2008). This area was declared as the 'Pakhui Wildlife Sanctuary'

in 1977 which was changed to 'Pakke Tiger Reserve' in 2002 due to the large tiger population within the protected area. For the period 2001 to 2003, PTR has a tropical and subtropical climate with an average annual rainfall of 2,545 mm, with the annual mean maximum temperature at 31°C and the annual mean minimum temperature at 18°C (Kumar & Solanki, 2014). The forest type of PTR is Assam Valley tropical semi-evergreen forest 2B/C1 (Champion & Seth, 1968) and vegetation is composed of several canopy layers with high density and tree diversity, woody lianas, epiphytic flora, and climbers. The lower plains and foothills are dominated by tropical semi-evergreen forests while at the elevations of 900 to 1800 m, subtropical broadleaf evergreen dense forests occur.

Survey method

We surveyed for *N. bengalensis* within the study area for four nights from 20 February 2015 to 23 February 2015 on foot. We consulted with local people and forest guards regarding the best potential locations, using photographs. Reconnaissance survey techniques (White & Edwards, 2000) were adopted for spotlighting surveys of lorises using pre-cut paths

to maximize access to forested areas (Burnham et al., 1980; Hedges & Lawson, 2006). Each night we selected two transects (at 18:00–21:30 h & 22:00–01:00 h), a minimum of 1 km apart to reduce (though not eliminate) the risk of counting the same individual more than once. Slow lorises generally move at a rate of c. 1 km/h (Nekaris, 2003), therefore the chances of re-counting a slow loris were very low. Our previous studies in this area showed that *N. bengalensis* generally rest between 21:00 h and 24:00 h, and would therefore move at a slower rate, if at all, during the period of our second transect walk for that night. Each night, new transects were surveyed (Peres, 1999), and four surveyors walked a 2 km-long transect marked with flagging tape at every 50 m. We maintained a pace of no more than 1 km/h, observing both sides of the transect (Nekaris et al., 2014). We used Petzl 4.5 headlamps (with xenon micro halogen bulb), searching all types of vegetation and different levels of the canopy for the loris's characteristic orange eye shine. A red filter was mounted on each headlamp to minimize disturbance (Nekaris et al., 2008). To facilitate comparisons with other nocturnal primate studies (Singh et al., 2000; Nekaris et al., 2008), we used the

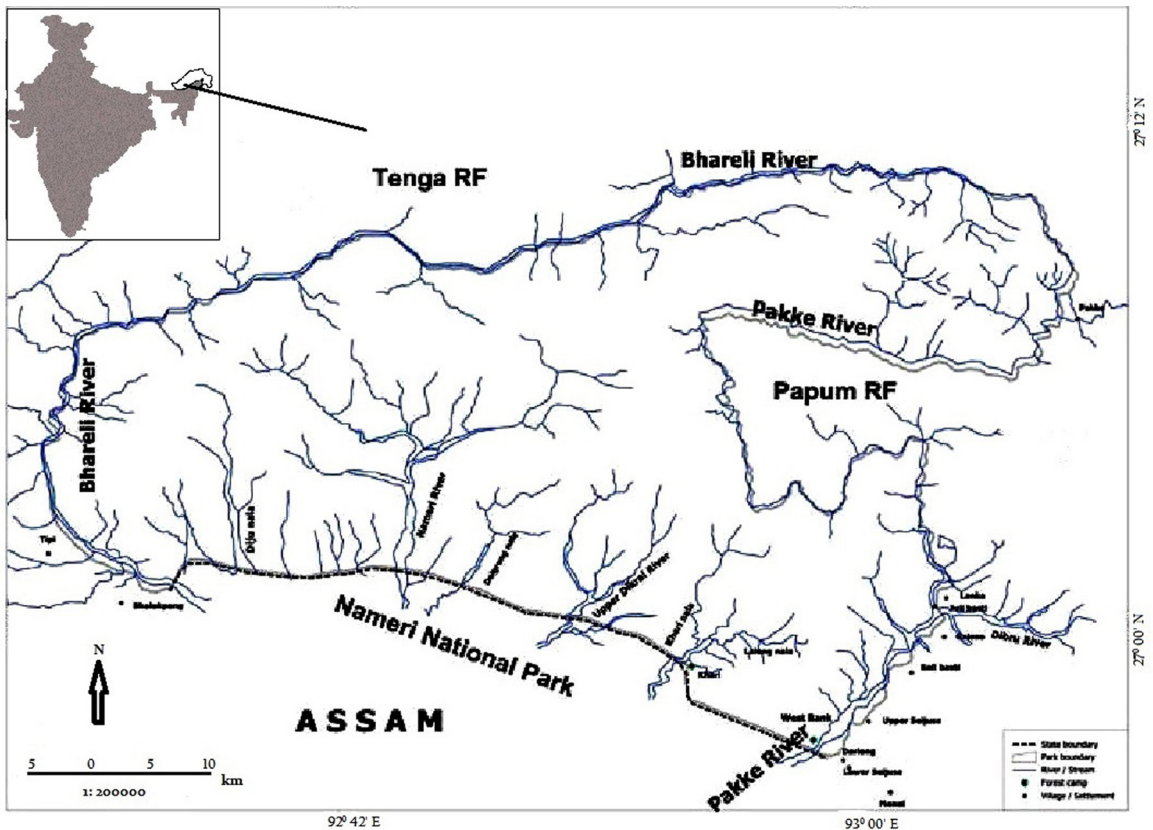


Fig. 1. Pakke Tiger Reserve, Arunachal Pradesh, India.

linear encounter rate as an index of relative abundance: the number of sightings per km (Sutherland, 2002).

Whenever a loris was encountered, the following data was recorded: the loris's distance from the start of the transect; GPS location, distance (m) from observer to loris, perpendicular distance from loris to transect, height of loris in the tree, activity, habitat type, number of individuals, ages of individuals observed (adult, infant, other immature following Rode-Margono et al., 2014), sex, time, and tree species where the loris was encountered. Tree species identification was made on the spot by a trained local forest guide, and unidentified trees were marked and re-visited the following day for identification. Photographs of the encountered lorises were taken when possible.

RESULTS

Field observations

We encountered four *N. bengalensis* over 7 transects, during 4 survey nights covering a total of 15.3 km in PTR. The mean transect length was 3.83 ± 1.10 km. The encounter rate of Bengal Slow Lorises was calculated as 0.26 lorises /km. The mean sighting distance from the transect was 12.25 ± 2.06 m and mean perching height of lorises was 11.25 ± 2.75 m (Table 1).

We encountered a single *N. bengalensis* on 20 February 2015 at 22:20 h in *Duabanga grandiflora* (DC) Walp. in Khare area of the PTR, an area characterized by undulating hills with woody forests. We observed the loris travelling rapidly in the mid to upper level of the canopy and observed the animal clearly at a distance of 10 m for approximately 10 minutes. Based on body size and testes, the individual was identified as an adult male. The next encounter was a sub-adult of unknown sex at 21:45 h, on *Gmelina arborea* Roxb. We observed the individual moving rapidly downwards (hilly terrain) for 2.5 minutes. We encountered the third individual at 22:05 h on another *Duabanga grandiflora*

plant, approximately 50 m from the previous one, at 10 m from the transect. We identified the animal as an adult pregnant female based on her distinct swollen abdomen above the rib cage. We spotted the fourth loris at 20:30 h, on *Garcinia xanthochymus* Hook.f. ex T.Anderson, 12 m from the transect line. We saw the animal clearly for 2.5 minutes, confirming it to be a sub-adult of unknown sex.

DISCUSSION

Our study provides an important new distribution record for Bengal Slow Lorises in Northeast India. Our encounter rate falls among the average of rates from previous studies (Table 2). Both the speed of walking (Nekaris et al., 2014) and the number of surveyors have a significant effect on the detectability of this shy animal (Nekaris et al., 2008), with smaller teams recommended. PTR may hold substantial populations of Bengal Slow Lorises and should be targeted as a key site for conservation efforts.

Bengal Slow Lorises have been found in a wide variety of habitats across their distribution range in Southeast Asia. Our study supports previous work on this species within India, providing further confirmed sightings in subtropical and tropical semi-evergreen forests (Swapna et al., 2008; Das et al., 2014). Similarly, Bengal Slow Lorises are known to occur in semi-evergreen and evergreen forests within their range in Laos (Duckworth, 1994; Evans et al., 2000). In Thailand, they have also been observed in old plantations (Pilosungnoen et al., 2010); and in Cambodia, they are found in dry dipterocarp forest (Starr et al., 2010). The species can, however, also occur in heavily disturbed areas, including home gardens. In India, many slow lorises found in such conditions are translocated to semi-evergreen forests such as the PTR (Kumar et al., 2014). An understanding of the ecology and behaviour of Bengal Slow Lorises in these very different habitats is necessary to know if such translocations are beneficial or detrimental to the species' conservation.

Table 1. Ecological characteristics and localities of four Bengal Slow Lorises encountered in Pakke Tiger Reserve, Arunachal Pradesh, India.

Tree species where loris encountered	Tree family	GPS location	Perching height (m)	Distance from transect (m)
<i>Duabanga grandiflora</i>	Lythraceae	N27°00'29", E92°53'06"	13	12
<i>Gmelina arborea</i>	Lamiaceae	N26°58'31", E92°54'54"	14	10
<i>Duabanga grandiflora</i>	Lythraceae	N26°58'45", E92°55'07"	10	15
<i>Garcinia xanthochymus</i>	Clusiaceae	N27°02'44", E92°46'45"	8	12

Table 2. A summary of encounter rates for the Bengal Slow Loris in India and Southeast Asia based on 18 studies.

Study site	Encounter rate (Loris/km)	Reference
Pakke Tiger Reserve, Arunachal Pradesh, India	0.26	This survey
Protected areas in Assam, India	0.06–0.18	Das et al., 2014
Namdapha NP, Arunachal Pradesh, India	0.2	Das et al., 2014
Samkos WLS, Cambodia	0.38–0.50	Coudrat et al., 2011
Meghalaya, India	0.04–0.10	Radhakrishna et al., 2010
KhaoAng Rue Nai WLS, Thailand	0.34–1.02	Pliosungnoen et al., 2010
Phnom Kulen NP, Cambodia	0.50	Starr et al., 2010
Gibbon WLS, Assam, India	0.18	Das et al., 2009
Trishna & Sepahijala WLS, Tripura, India	0.22	Swapna et al., 2008
Assam, India	0.03–0.33	Radhakrishna et al., 2006
Muang Hom, Central Lao PDR	0.10–0.21	Evans et al., 2000
Nam Kading, Central Lao PDR	0.10–0.22	Evans et al., 2000
Nam Ao, Central Lao PDR	0.14–0.30	Evans et al., 2000
Bang Navang, Central Lao PDR	0.09–0.20	Evans et al., 2000
Xe Namoy, Southern Lao PDR	0.40–0.87	Evans et al., 2000
Nakay-Nam Theun, Central Lao PDR	0.04–0.08	Duckworth, 1998
Phou Xang He, Central Lao PDR	0.30–0.65	Duckworth, 1994
Xe Pian, Central Lao PDR	0.13–0.27	Duckworth et al., 1994

NP=National Park; WLS=Wildlife Sanctuary

Only a handful of surveys have been conducted on the distribution and population density of the Bengal Slow Loris in Northeast India (Radhakrishna et al., 2006, 2010 in Assam and Meghalaya; Swapna et al., 2008 in Tripura; Das et al., 2009, 2014 in Assam and Arunachal Pradesh). This species is threatened by a number of factors including habitat destruction through selective logging, encroachment, 'jhum' or shifting cultivation (by the hill tribes) and monoculture forest plantations, resulting in habitat fragmentation. Hunting for meat and medicinal purposes as well as the pet trade are also serious threats in central and eastern Arunachal Pradesh. Remoteness and insurgencies affect all states in Northeast India, making conducting field research a security concern, especially at night. Hence, monitoring slow loris populations and their threats is a challenge.

The core area of the PTR is nearly free from anthropogenic pressure, apart from the occasional organized hunting and poaching trips, although severe

habitat destruction, hunting and poaching are very frequent in the adjacent forest areas of PTR (Kumar & Solanki, 2004; Kushwaha & Hazarika, 2004). Since the mid-1990s, an unprecedented number of encroachments by ethnic-minority tribes have converted mature forests to agricultural land and permanent settlements in bordering areas of Nameri National Park (Assam) and PTR, and pose a major threat to this protected-area complex. Still, we feel that PTR is a relatively safe area to begin a long-term study of this species.

In this report we confirm a new distribution area for Bengal Slow Loris and show densities largely similar to the mid to lower estimates of other studies. A comprehensive survey of Bengal Slow Lorises and other threatened primates is essential to assess their status effectively in this important forest complex that encompasses PTR. In addition, a primate monitoring program is crucial to understand how populations of this species are changing.

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