

Original Research Article

A Status Survey of the Phayre's Leaf Monkey *Trachypithecus phayrei* Blyth, 1847 (Primates: Cercopithecidae) within the Inner-line Reserve Forests and its Fringe Areas of Assam, India

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Abstract: The Phayre's Leaf Monkey (*Trachypithecus phayrei* Blyth, 1847) is one of the least studied species amongst all the primates in India. This is primarily due to its small population size and limited zoogeographic distribution. In India they are found in the states of Assam, Mizoram and Tripura and in Southern Asia (Bangladesh, Myanmar, China, Laos, Thailand, and Vietnam). The present work is in the fragmented areas of Barak valley of Southern Assam, India where there is rapid settlement of human population. This is the first systematic study on the distribution and population size of the Phayre's leaf monkey in the Inner-line Reserve Forest, Cachar, Assam and in the fringe areas outside the ILRF. A study on the distribution and population size of the species was conducted from September 2015 to August 2018 in four localities from ILRF and seven localities in the forest fringe areas outside the protected area, using the stratified random method. Transect method was followed, supplemented by sign searches and villagers' information. Nine troops comprising 156 individuals i.e., four troops (37 individuals) from ILRF and seven troops (119 individuals) from outside the ILRF were recorded. A comparison was made in the population of this species in some of the same sites like Silcoorie TE, Iringmara TE and Allenpur where a similar work was carried out 14 years ago and found increase in their population. Habitat loss, livestock grazing, timber loggings etc. were observed the major anthropogenic interferences and issues of concern related to conservation.

Key words: Habitat fragmentation, Inner-line Reserve Forests, Phayre's leaf monkey, primates

Introduction

Of the five Colobine monkeys present in India (Borah, 2010), the Phayre's Leaf Monkey, *Trachypithecus phayrei* Blyth, 1847 (Fig. 1) is found only in the North-eastern states viz. Assam, Mizoram, and Tripura (Bose, 2005). In Assam, it is distributed in southern districts of Assam, particularly in Cachar, Karimganj, and Hailakandi (Bose, 2003; Choudhury, 2001; Mazumder, 2014; Mukherjee, 1982). *T. p. phayrei* is globally distributed in Bangladesh, Myanmar, China, Laos, Thailand, and Vietnam (Aziz and Feroz, 2009; Gupta and Kumar, 1994; Srivastava, 1999). Phayre's Leaf Monkey have three sub-species i.e. *Trachypithecus phayrei phayrei*, *T. p. crepuscula* and *T. p. shanicus*, among these, *T. p. phayrei* is found in northeast India. In northeast, India, *T. p. phayrei* is found in

a small geographic distribution and have been recorded only three states of India viz. Assam, Mizoram and Tripura (Choudhury 2001). The species is globally Endangered (A2cd ver 3.1) under International Union for Conservation of Nature (IUCN) Red List (Bleisch *et al.*, 2008) and CITES has categorised under Appendix II and In India, Phayre's Leaf Monkey is enlisted as Schedule-I species under the Wildlife (Protection) Act, 1972 which showed that species is highly threated and need high level of conservation effort for their existence. As compared to the other primates found in the country, comparatively *T. p. phayrei* is least studied in this region (Bose 2005; Choudhury 1998; Gupta and Kumar 1994; Srivastava 1999).

The present study was carried out with aim to collect data on distribution and population status of *T. p. phayrei* along with their conservation issues in the Southern part of Assam with special focus reference to in and around the Inner-line Reserve Forest (ILRF) of Cachar district, Assam. The studied area is covered by tropical semi-evergreen forest type (Majumdar

ILRF is the largest reserve forest of Assam of which approximately 15% is common with Manipur border, 40% common with Mizoram border while the remaining 45% is common with Cachar district and Hailakandi district of Assam. Climatic condition of study area varies from 10°C to 39°C and received annual rainfall between 2600-2700 mm/yr. ILRF

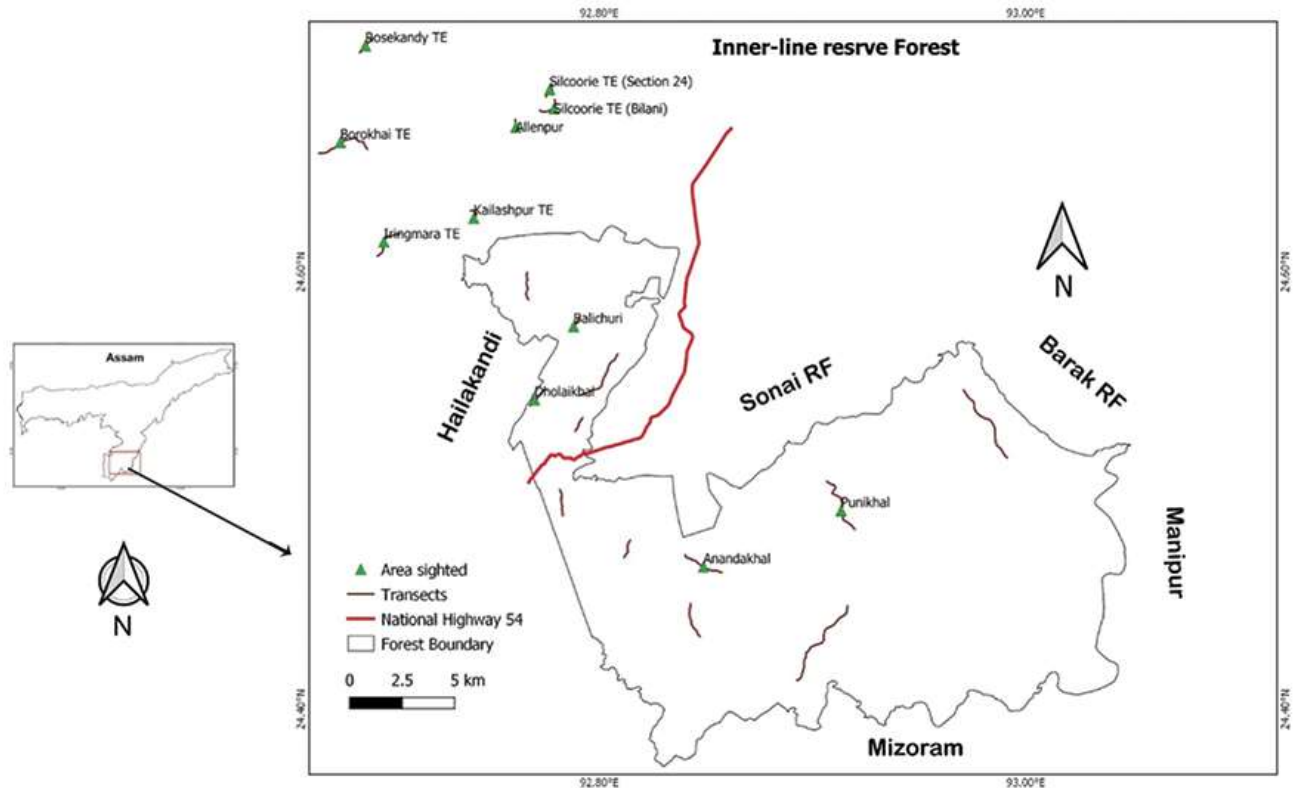


Fig. 1. Phayre's leaf monkey sighted in and around the Inner-line Reserve Forest, Cachar.

and Datta 2015) and fragmented due to human habitations and its associated anthropogenic activities.

Methodology

Study area

The present study was conducted in the ILRF of Cachar district of Assam and its fringes. ILRF lies between 24°22'N and 25°8'N Latitude and 92°24'E and 93°15'E Longitude and covers an area of 424 sq. km geographical area Cachar district and situated in the southern part of Assam, popularly known as 'Barak Valley' which potentially harbors eight primate species out of nine species found in Assam, India (Choudhury 2001).

is surrounded by several rivers namely Barak, Sonai, Dholai and Rukni. ILRF has a tropical semi-evergreen, mixed

evergreen and deciduous forest vegetation type. Some of the dominant tree species present in the study area are *Artocarpus lakoocha*, *Artocarpus chama*, *Ficus bengalensis*, *Syzygium jambulana*, *Garcinia cowa*, *Pterospermum acerifolium*, *Dillenia indica*, *Careya arborea*, *Acanthocephalus cinensis*, *Mangifera indica*, *Sterospermum personarum*, *Dysoxylum benectariferum* along with some bamboo species (*Bambusa*

cacharensis, *Bambusavulgaris*, *Bambusa balcooa*, *Schizostachyum dullooa*, *Bambusa nutans*, *Bambusa assamica*, *Gigantochloa albociliata*) found in this area (Islam *et al.*, 2013b).

Adjacent to the ILRF, all fringe villages partially degraded forest patches of secondary forest, mixed-vegetation, and degraded with hill tops surrounds by the jhum-fields (Islam *et al.*, 2013a). Other than the Phayre's leaf monkey,

bengalensis (Islam 2014). The reserve forest is also enriched with several other small mammals like Chinese Pangolin *Manis pentadactyla*, Barking Deer *Muntiacus muntjak*, Sambar *Cervus unicolor*, Red Serow *Capricornis rubidus*, Golden Jackal *Canis aureas*, Porcupine *Hystrix brachyura*, Jungle Cat *Felis chaus*, Marble Cat *Pardofelis marmorata*, Large Indian Civet *Paradoxurus hermaphrodites*, Small Indian Civet *Vivericula indica*, and other (Islam 2014; Talukdar *et al.*, 2018), many of which includes in the IUCN Red List and WPA, 1972.



Fig. 2. Activities of Phayre's leaf monkey: a. group of Phayre's leaf monkey feeding in different layers of forest canopy b. An adult female foraging c. an infant clinging on mother d. an allotropic grooming activities.

ILRF is an adobe to others primates that includes the Western Hoolock Gibbon *Hoolock hoolock*, Capped Langur *Trachypithecus pileatus*, Northern pig-tailed macaque *Macaca leonina*, Rhesus Monkey *Macaca mulatta*, Assamese Monkey *Macaca assamensis* and Bengal Slow Loris *Nycticebus*

Sampling and data collection

Initially a preliminary survey was conducted to identify the potential sites where the species were present. As the ILRF is divided into parts by the national highway, the sites were divided into two segments. For sampling, stratified random method (Kumar *et al.*, 2009) was done. Grids were generated over the

sampling areas using software QGIS 3.4.11 for systematic random sampling. For each grid the transect method on the forest trails were followed which were supplemented by sign searches and judicious use of villager's information (Steinmetz *et al.*, 2011). Out of a total of 18 transects, 12 transects were placed on the existing forest trails (within the ILRF) and 6 in the fringes areas. The population survey was conducted from September 2015 to August 2018. While sighting the Phayre's leaf monkey, age and sex of individual was recorded in the field note along with their location and anthropogenic threats present in the area.

Equipment and software used in the survey

Equipment such as Garmin GPS eTrex 20x and mobile phone (ASUS Zenfone Max) were used for the intensive surveys. Additionally, mobile app such as Geo tracker Version 3.3.0.1338, GPS Test Version 1.5.8 was used when mobile battery was drained off. This software was standardized and setting was done prior for maximum accuracy. The data

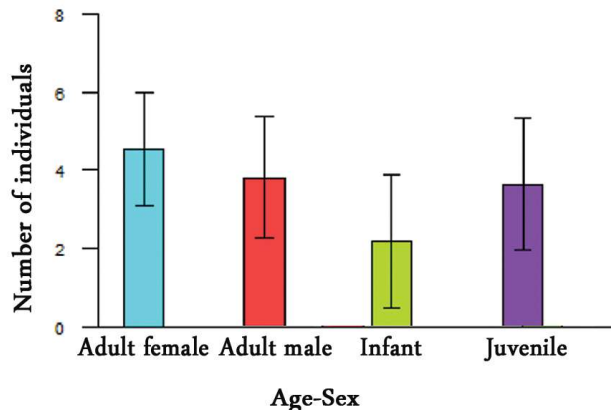


Fig. 3. Mean population (\pm SD) of adult male, adult female, Juvenile and infant.

collected was graphically interpreted using R Studio (Version 1.1.456) (R Core Team 2018).

Results

Distribution, population size and group composition

The survey identified four localities from within the ILRF (Balichuri, Anandakhal, Dholaikhal, and Punikhal) and seven localities in the fringe areas [Silcoorie TE (Section 24), Silcoorie

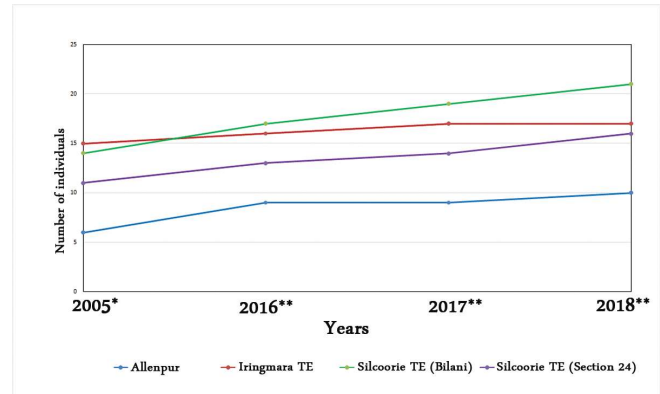


Fig. 4. Changes in the population size in study sites over last ten years (*Bose 2005; ** present study).

TE (Bilani), Rosekandy TE, Iringmara TE, Allampur and Borokhai TE and Kailashpur TE] (Fig. 2). A total of 11 troops comprising of 156 individuals out of which, 4 troops (37 individuals) were recorded from within the ILRF and 7 troops (119 individuals) were from the forest fringe areas. The average group composition size was estimated to be 14.18 individuals with ranging from 7–25 individuals. Population was comprised of 42 individuals of adult males, 50 individuals of adult females, 40 individuals of juveniles, and 24 individuals of infants (Table 1). The mean and standard deviation of adult males, adult females, juveniles, and infants were found to be 3.82(\pm 1.54), 4.55(\pm 1.44), 3.64(\pm 1.69) and 2.18(\pm 1.72), respectively (Fig. 3). The average range of adult male adult females, juveniles, and infants was 3.82 (Range: 3-6), 4.55 (Range: 7), 3.64 (Range: 2-4 and 2.18 (Range: 0-5) respectively. The sex ratio of adult male to adult female was 0.84:1, adult female to juvenile was 0.8:1 and adult female to infant was 0.48:1 (Table 2).

Change in population size

We compared the present population status enumerated in present study (2015-2018) with the previous study conducted by Bose (in 2005) to identify the ten-year change in the population size of Phayre's leaf monkey. Fig. 4 presented the population changed from 2005 to 2016, 2017 and 2018.

Habitat type and anthropogenic disturbances

The survey recognized mainly five habitat types i.e., secondary forest, mix-vegetation, partially degraded forest, degraded forest and plantation forest. While Anandakhal and Punikhal

Table 1. Group composition of Phayre's leaf monkey (*Trachypithecus phayrei*) recorded in and around the Inner-line Reserve Forest, Cachar district, Assam (2015-2018).

Study site	Location	Transect length (m)	No. of Individuals				Total
			Adult Male	Adult Female	Juvenile	Infant	
Inner-Line Reserve Forest (ILRF)	Balichuri	709.87	2	3	3	1	9
	Anandakhal	4015.66	2	4	2	0	8
	Dholaikhal	1380.80	4	5	3	1	13
Outside ILRF	Punikhal	3328.60	3	2	2	0	7
	Silcoorie TE (Section 24)	1404.38	4	5	3	4	16
	Silcoorie TE (Bilani)	897.11	5	6	5	5	21
	Rosekandy TE	656.75	6	7	8	4	25
	Iringmara TE	842.69	5	5	4	3	17
	Allenpur	777.45	2	3	3	2	10
	Borokhai TE	2750.35	3	5	3	1	12
	Kailashpur TE	825.60	6	5	4	3	18
Total			42	50	40	24	156
Average			3.82	4.55	3.64	2.18	14.18

Table 2. Age-sex ratios of Phayre's Leaf Monkey *Trachypithecus phayrei*.

Age-sex	No. of individuals	Ratio
Adult male: Adult female	42:50	0.84:1
Juvenile: Adult female	40:50	0.8:1
Infant: Adult female	24:50	0.48:1

had the most satisfactory habitat type among the study area sites explored the survey of Phayre's leaf monkey. Allenpur and Iringmara TE on the other hand were found to be most unfavorable areas. Six anthropogenic disturbances such as jhum cultivation, timber logging, human settlements, monoculture plantation, crop cultivation and hunting were recorded in the study area (Table 3). In regard to anthropogenic disturbances, the most affected areas were Dholaikhal and Rosekandy TE, whereas the least affected area was Kailashpur TE.

Discussion

The present work is a systematic study on the changes of population size of Phayre's leaf monkey both within and in the fringe area of the ILRF. Previous studies on the Western side of ILRF were conducted 14 years ago (Bose 2005; Choudhury 2008), and besides Hollock gibbon (Islam *et al.*, 2013b) none of the rest seven primates of ILRF were studied. Due to fragmentation of the reserve forest, Phayre's leaf monkey is now confined to few pockets within the ILRF and its fringe areas. Overall troop size was comparatively smaller (ranges between 7-25 individuals). Bose (2005) reported their presence in Balichuri area within ILRF. In addition to this, we

Table 3. Types of habitat and anthropogenic disturbances in the ILRF and forest fringe areas (2015-2018).

Site	Coordinates	Elevation (m)	Habitat type	Anthropogenic disturbances (AD)	Ranking of AD
Iringmara TE	N 24°36'50.35" E 92°41'55.74"	55.0	Partially degraded forest, Plantation forest, Degraded forest	Timber logging, human settlements, crop cultivation, hunting	1
Allenpur	N 24°39'59.63" E 92°45'38.87"	30.0	Partially degraded forest, Degraded forest	Human settlements, crop cultivation	2
Punikhal	N 24°29'27.85" E 92°54'48.02"	80.0	Secondary forest, Mix-vegetation	Jhum cultivation, timber logging, hunting	3
Silcoorie TE (Bilani)	N 24°40'29.97" E 92°46'43.02"	36.0	Mix-vegetation, Partially degraded forest, Plantation forest,	Timber logging, human settlements, crop cultivation, hunting	4
Anandakhal	N 24°27'55.32" E 92°50'55.62"	109.0	Secondary forest, Mix-vegetation	Jhum cultivation, timber logging, hunting	5
Borokhai TE	N 24°39'34.36" E 92°40'42.36"	67.0	Secondary forest, Mix-vegetation Partially degraded forest	Jhum cultivation, timber logging, human settlements, crop cultivation, hunting	5
Silcoorie TE (Section 24)	N24°41'1.14" E 92°46'35.93"	41.0	Mix-vegetation, Partially degraded forest, Partially degraded forest, Plantation forest	Timber logging, human settlements, monoculture plantation, crop cultivation, hunting	6
Balichuri	N24°34'31.05" E 92°47'16.22"	130.0	Secondary forest, Mix-vegetation, Partially degraded forest	Jhum cultivation, timber logging, human settlements,	7
Dholaikhal	N24°32'30.41" E 92°46'10.18"	129.0	Secondary forest, Mix-vegetation, Partially degraded forest	Jhum cultivation, timber logging, human settlements, monoculture plantation, crop cultivation	7
Kailashpur TE	N24°37'29.51" E 92°44'27.62"	82.0	Secondary forest, Mix-vegetation, Partially degraded forest	Timber logging and Hunting	7
Rosekandy TE	N24°42'13.70" E 92°41'24.67"	36.0	Secondary forest, Mix-vegetation, Partially degraded forest, Plantation forest	Jhum cultivation, timber logging, human settlements, crop cultivation, hunting	8

have reported three new sites viz. Anandakhal (N 24°27'55.32", E 92°50'55.62"), Dholaikhal (N 24°32'30.41", E 92°46'10.18") and Punikhal (N 24°29'27.85", E 92°54'48.02") within ILRF, Cachar. In the fringe areas of ILRF, we have recorded two additional sites viz. Borokhai TE (N 24°39'34.36", E 92°40'42.36") and Kailashpur TE (N 24°37'29.51", E 92°44'27.62") in compare to previous studies reported by (Bose 2005; Choudhury 2001; Mazumder 2014) Silcoorie TE, Rosekandy TE, Iringmara TE and Allenpur)

A very small increase in population size in four sites (Silcoorie TE (Section 24 & Bilani), Iringmara TE and Allenpur) over past 14 years. Due to fragmentation of the reserve forest, the Phayre's leaf monkey is now confined to few pockets within the ILRF and its fringe areas. Overall troop size is comparatively small (ranges between 7-25 individuals). Earlier works by Bose (2005) reported their presence in Balichuri area within ILRF. In addition to this, we reported three new sites viz. Anandakhal

(N 24°27'55.32", E 92°50'55.62"), Dholaikhal (N 24°32'30.41", E 92°46'10.18") and Punikhal (N 24°29'27.85", E 92°54'48.02") within ILRF, Cachar. In the fringe areas of ILRF, we have recorded two additional sites viz. Borokhai TE (N 24°39'34.36", E 92°40'42.36") and Kailashpur TE (N 24°37'29.51", E 92°44'27.62") (apart from earlier reports from Silcoorie TE, Rosekandy TE, Iringmara TE and Allenpur) (Bose 2005; Choudhury 2001; Mazumder 2014).

Both sites of Silcoorie (Section 24 & Bilani) has recorded a healthy and increase population size (16+21 in Section 24 & Bilani) in compared to study conducted by Bose (2005) 25 (11+14 in Section 24 & Bilani). Marginal increase was seen in Iringmara (17; previously 15) and Allenpur tea estate (10; previously 6). In Section 24 of Silcoorie TE, although a single troop was seen in 2016 and 2017, but in 2018 (June) the same troop of 16 individuals was seen to have split into two halves, one half having 13 and 3 in the other. This phenomenon of isolation is the direct consequence of forest fragmentation seen during this particular study. Thus, a considerable increase of population in all the selected study sites have been observed during last 14 years. This is definitely a good indication but at the same time, the species is made to struggle in the fragmented sites of inner line reserve forest, wherein the habitat is shrinking at a faster rate. This is an alarming situation.

With regard to the ecological status of the habitats, it has been observed that Anandakhal and Punikhal are healthier than rest other sites. Habitat in Allenpur was found to be rapidly deteriorating, with sharp increase in human settlement over past decade. In most of the fringe areas, forest health is deteriorating either due to crop plantation or through forest degradation.

The burden of habitat loss in ILRF and damage of wild fauna due to hunting and poaching for food and illegal trade was recorded by Basumatary and Choudhury (2014). We have also observed the canopy gaps in most parts of the ILRF and fringe areas. The work by Islam *et al.* (2014) observed that the Hoolock Gibbon *Hoolock hoolock* uses different canopy height, but spent most time in the middle canopy for their food resources. Although, that study was on the brachiators (like Hoolock Gibbon) but it has identical impact on the

population and distribution of Phayre's leaf monkey. Phayre's leaf monkey prefer thick branches to thin branches for their movement in quest of food and shelter (Islam *et al.*, 2014). In ILRF, habitat fragmented has started since more than a decade and the gaps thus created compel the canopy dependent species to forage within the fragmented patches. This has lead to the isolation of the troops in small pockets within that area as has been observed in Allenpur. All such areas need immediate attention from conservation point of view. Isolating mechanisms and barrier formation that is taking place in these areas at rapid rate can be addressed with afforestation with food plants of the target primate species.

Islam and Choudhury (2017) observed that anthropogenic disturbances in the ILRF are jhum cultivation, timber logging, human settlements, monoculture plantation, and crop cultivation, hunting and poaching and the present study also reveals the same with equal intensity. Timber logging is the most disturbing factor among in all the sites and similar observation we have also categorically observed. Dholaikhal, Rosekandy TE and Borokhai TE were mostly affected by these disturbances. Anthropogenic interferences and livestock grazing has equal adverse effect on the habitat of the Phayre's leaf monkey, Livelihood enhancement of the forest dwellers through providing alternative livelihood options may be of immediate help improve the forest health scenario.

To stop further destruction of forest areas and encroachment, awareness and people's participation is urgently required in conserving this endangered primate. As they are confined to only few isolated pockets in some countries of South-east Asia, and threat scenario in all such habitats are almost identical, therefore attention from international conservationist community and proper management of habitat by the concerned government agencies might be helpful to save this elusive primate from being Extinct.

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