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Population Status and Conservation of Capped Langurs (*Trachypithecus pileatus*) in and around Pakke Wildlife Sanctuary, Arunachal Pradesh, India

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Abstract: A survey of the distribution and population status of the capped langur (*Trachypithecus pileatus*) was conducted in and around the Pakke Wildlife Sanctuary in Arunachal Pradesh, India. From 2001–2003, we surveyed ten selected localities, recording 26 groups and a total of 195 individuals. The data was obtained using line transect surveys and total count methods. Capped langurs were found in a number of different habitats: tropical semi-evergreen forest and moist deciduous forests. Of the 195 individuals registered, 14% were adult males, 52% adult females, 2% unidentified adults, 7% sub-adults, 11% juveniles and 15% infants. The smallest group numbered 3, and the largest 13, with an average group size of 7.5 individuals. The male-female ratio was 1:3.6. The most common size class of the group was of 7–9 individuals.

Key words: Capped langur, population status, sex ratio, group size class, Pakke Wildlife Sanctuary, conservation

Introduction

The capped langur occurs in northeastern India, Bangladesh, northwestern Myanmar, Bhutan and southern China (Zhang *et al.* 1981; Blower 1985; Stanford 1991; Ahsan 1994; Srivastava and Mohnot 2001). It lives in small groups, mostly single-male, multi-female, but occasionally with more than one male (Mukherjee 1978; Green 1981; Stanford 1991; Mukherjee *et al.* 1995). The species occupies a number of different habitats within its range including stands of bamboo, and plantations in northeast India (Choudhury 1989, 1996; Raman *et al.* 1995). Populations have been declining mainly due to habitat loss and degradation (Srivastava *et al.* 2001a, 2001b) and hunting (for food, medicinal purposes, and artifacts for socio-cultural practices and religious and cult ceremonies [Solanki 2002; Kumar and Solanki 2004]). Here we document the status, distribution, and group size and composition of capped langurs in and around the Pakke Wildlife Sanctuary, Arunachal Pradesh, India. We also report on human impacts on the species and their habitats in the sanctuary so that effective conservation measures can be formulated for the species in the region and particularly for the study area.

Methods

Study area

The Pakke Wildlife Sanctuary (PWLS) (formerly known as Pakhui Wildlife Sanctuary) is located between 92°35' to 93°09'E and 26°55' to 27°15'N, and covers 861.95 km²; 20% of the East Kameng district of Arunachal Pradesh (Fig. 1). It is bordered by Bhoreli River (or Kameng River) in the north and west, by Pakke River in the east, and by the Nameri National Park and Nauduar Reserve Forest of Assam in the south. The sanctuary is well drained by tributaries of the Bhoreli and Pakke rivers. The topography is undulating-hilly and the altitude ranges from 200 to 2,040 m above sea level. The climate is tropical and subtropical; cold weather prevails from November to February. Average annual rainfall is 2,599 mm, and the annual mean (\pm se) maximum temperature is $31 \pm 1.1^\circ\text{C}$, and the mean minimum temperature is $18 \pm 1.2^\circ\text{C}$. There are four primates in the Pakke Wildlife Sanctuary—the rhesus macaque (*Macaca mulatta*), Assamese macaque (*M. assamensis*), the capped langur (*Trachypithecus pileatus*), and the Bengal or northern slow loris (*Nycticebus bengalensis*). The vegetation is Assam Valley type (2B/C1); tropical semi-evergreen with a high density and diversity of trees, woody lianas and climbers (Champion and Seth 1968). Tropical, semi-evergreen forests dominate the lower plains

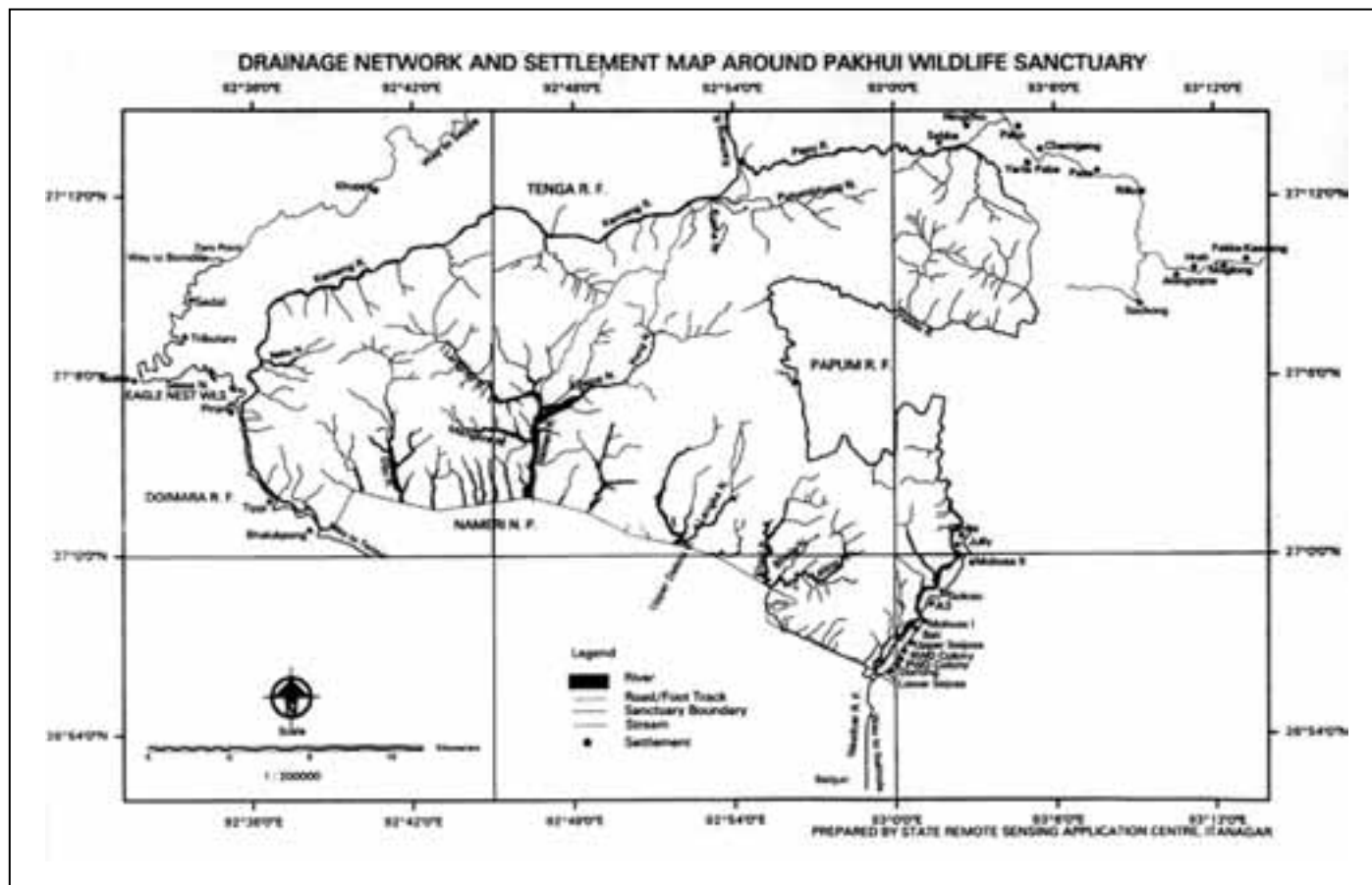


Figure 1. The location of villages around the Pakke Wildlife Sanctuary, Arunachal Pradesh, India.

and foothills, while subtropical, broadleaved, evergreen and dense forests occur at elevations of 900 to 1,800 m above sea level. The Nyishi tribe lives around the sanctuary, one of the major elements of the human population living in the region, which also includes Nepalis, Kuli-bengalies and Bodo tribes.

Methods

A population survey was carried out at selected sites in and around the sanctuary over three years (2001–2003). We interviewed the sanctuary patrols, the range officer and the residents of peripheral villages for information as to the occurrence of capped langur groups in the area. A line-transect method was used to cover all areas in the sanctuary (Brockelman and Ali 1987). Total-count sampling was used in the areas of undulating terrain (NRC 1981). Repeat surveys were conducted on foot, recording group size and structure, sex ratio, vegetation type and any disturbances due to human activities such as settlements, grazing, logging, agriculture, hunting and poaching. Surveys were carried out by one researcher and two local guides from 06:00 to 11:00 and 14:00 to 18:00 or sunset. The langurs were classified into four age categories; adult, sub-adult, juvenile and infant based on the morphological differences described by Stanford (1991).

Results

Population distribution

The surveys covered 201 km of transect in ten different locations (Table 1). Most of the groups sighted were at altitudes of around 800 m (26 groups), and mostly in tropical semi-evergreen forest and moist deciduous forests. Of the 26 groups, 20 were in the sanctuary and six were on the periphery. The maximum number of groups (4) and individuals (38) were recorded at Bhola Nallah Pung (Table 1). Groups ranged in size from 2 individuals to 13, with an average of 7.5 individuals per group.

Group composition

The group structure and composition of capped langurs is shown in Figure 2. Nearly 90% of the population was recorded in one male–multi female social system. The male–female sex-ratio for identified adults was 1:3.6. A group size of 7–9 individuals was most commonly sighted.

Demography of the villages and the livestock

Demographic information on the villages and livestock around the sanctuary, and who are dependent on the sanctuary for their daily needs, is shown in Table 2. We counted 37 villages, totaling 815 houses, 4,787 people in the

Table 1. Numbers and average size of the groups and population density of capped langur.

Location	Distance (km)	No. of groups	No. of individuals	Relative abundance (groups/10 km)	Average group size
Khari	28	3	23	1.07	7.7
Upper Dekorai	25	2	13	0.80	6.5
Bhola Nallah Pung	16	4	38	2.50	9.5
Lalung Nallah Pung	18	2	11	1.10	5.5
Mahauth Palti Nallah	06	2	17	3.30	8.5
West Bank	25	2	14	0.80	7.0
Dichu	28	2	15	0.71	7.5
Tipi (Mithun Nallah)	32	3	25	0.94	8.3
Hatiputi	15	4	24	2.70	6.0
Nameri	08	2	15	2.50	7.5
Total	201	26	195		
Average			7.5/group	1.29	

surrounding area of PWLS. No human habitation was recorded inside the sanctuary. The number of cattle was 1,967, which generally use the buffer zone of sanctuary for grazing.

Threats

Illegal hunting and the depletion of food plants important to the langurs due to the collection of non-timber forest produce (NTFP) were found to be the most serious threats (Fig. 3). Five capped langur groups totaling 37 individuals were recorded in December 2001 next to the eastern boundary of the sanctuary in Hatiputi area, which comes under the jurisdiction of Nauduar RF, Assam, but by the end of December 2002, the number had dropped to 13; twenty-four lost within a year (Kumar and Solanki 2004). Of these, four died due to accidents (two electrocutions, one bitten by a domestic dog and one fell out of a tree during ground foraging and social playing respectively) and the remaining individuals were hunted by tribal groups for bushmeat, ethno-medicine and socio-cultural practices (Table 3). They are also traded in local and external markets.

Extraction of plant resources

The plants exploited by the local people are shown in Table 4. A number of them are also important foods for the langurs. We recorded 37 plant species of 29 families being used by local people inhabiting the surrounding area of the sanctuary (Table 4). Of these, 21 were also used by the capped langur and other primate species in their diet (Kumar and Solanki 2003; Kumar 2006).

Discussion

Capped langurs occupy all types of habitat inside and outside the sanctuary, but the tropical evergreen and semi-evergreen, deciduous forests with such trees as *Ficus bengalensis*, *Ficus glomerata*, *Bombax ceiba*, *Altinga excelsa*, *Gmelina arborea*, *Morus levigata* have been found to be important for the distribution of capped langurs in the region (Kumar 2006), and the availability of food trees may be a limiting factor (Joseph and Ramachandran 2003). Most of the langur groups

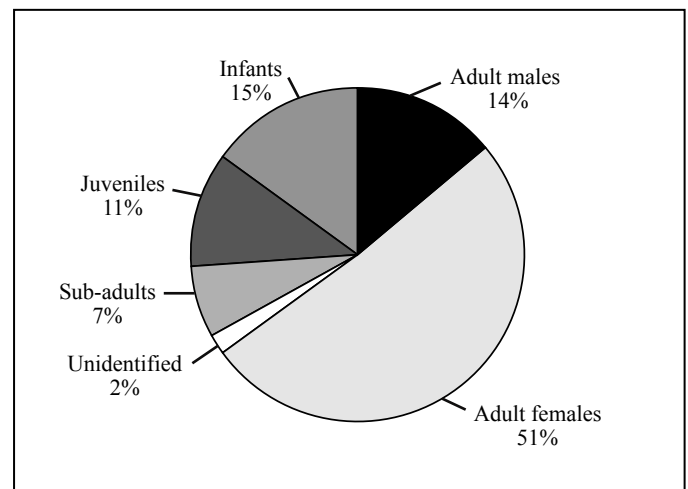
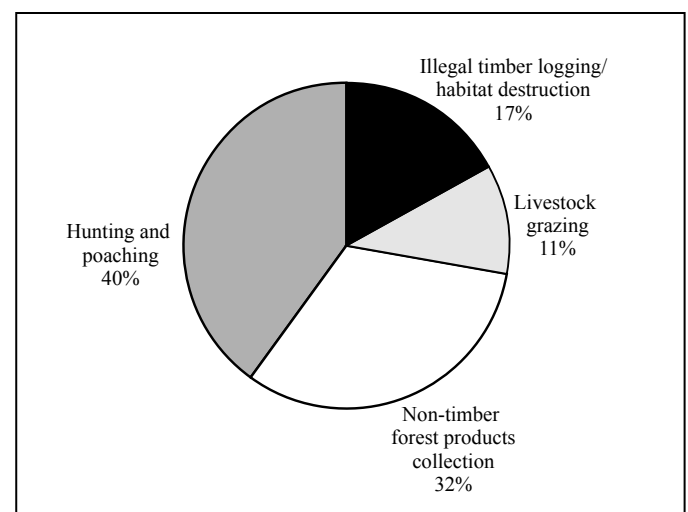
**Figure 2.** Group composition (%) of capped langur (*Trachypitecus pileatus*).**Figure 3.** Categories of threats to species and their habitats in the Pakke Wildlife Sanctuary, Arunachal Pradesh.

Table 2. Demographics of human and cattle's population around the Pakke Wildlife Sanctuary, Arunachal Pradesh, India.

	Village	No. of households	Total human population	Total cattle population	Distance (km) from the sanctuary boundary (approx.)
Eastern border					
1.	Murgaso	8	44	43	7.0
2.	Mabusa II	9	44	71	3.0
3.	Lanka	10	55	18	1.5
4.	Jolly	18	122	156	1.0
5.	Goloso	22	116	225	0.5
6.	A3	5	44	79	0.4
7.	Mabusa I /A2	29	148	174	0.4
8.	Upper Bali	18	87	74	0.3
9.	Lower Bali	13	88	94	0.3
10.	Upper Seijosa	120	800	133	0.4
11.	RWD Colony	15	45	25	0.3
12.	Dorlong	53	323	178	0.3
13.	Lower Seijosa	55	350	90	0.4
14.	West Dekorai	20	56	32	0.2
15.	Lomta	5	33	4	2.0
16.	Yayak	6	36	9	3.0
17.	Sochang	9	30	11	3.0
18.	Longpung	6	22	3	3.5
19.	Alongtopte	11	34	20	5.0
20.	Hrah	7	39	18	6.0
21.	Moglong	7	40	10	7.0
22.	Pakke Kessang	65	500	209	9.0
North-eastern border					
23.	Sebba	7	34	12	1.0
24.	Ningcho	8	40	10	4.0
25.	Pako	9	44	0	5.0
26.	Yarte Pabe	11	51	12	3.0
27.	Chemgeng	8	38	3	6.0
28.	Pasa	10	34	12	8.0
Western border					
29.	Balukpong	150	900	156	2.5
30.	Tipi	45	325	56	0.5
31.	Pinjoli	7	40	6	0.5
32.	Sessa	6	32	4	12.0
33.	Tributary	6	36	3	11.0
34.	Sedal	8	42	8	10.0
Northern border					
35.	Kuppi	11	40	3	10.0
36.	Kimi	8	36	2	1.5
37.	Sakchakchum	10	39	4	2.2
Total		815	4,787	1,967	

Table 3. Ethnozoological uses and trading of body parts of capped langur (*Trachypithecus pileatus*).

Body part	Use	Market value (Rs)
Skin with fur (body)	Making children's clothing and small bags	500–800/piece
Skin with fur (tail)	Used for wrapping around the Dao (a big knife)	400–500/piece
Meat	Food	10–115/kg
Dry liver	Eaten by women for safe and easy childbirth	400–450/item
Bones	Headache and cure for rheumatism	-
Teeth	Ornamentation (men, women and children)	-
Skull	Home decoration and used in some cult and religious practices	-
Dry gall bladder	Treatment of malaria, typhoid and other kinds of fever	-
Skin of forehead	An amulet for curing undiagnosed prolonged disease	-

recorded were between 400 m and 1,500 m above sea level. The largest numbers were recorded in the south-eastern part of the sanctuary, from Dichu to west of Tipi. Harwich (1972) argued that evergreen forest is necessary and is always present in the home ranges of this arboreal species.

The size and composition of social groups varies geographically (Chivers and Raemakers 1980) because of habitat structure and food availability. Mukherjee (1978) recorded a group size of 7–13 for this species in the Manas Wildlife Sanctuary, Assam, and 5–16 in Tripura (Mukherjee 1982). In the Tinsukia district of Assam, Choudhury (1995/1996) recorded group sizes of 5–15 individuals. Disturbance, especially hunting, in the Pakke Wildlife Sanctuary may have been the cause of slightly smaller group sizes (2 to 15 individuals). Gupta (1994) recorded smaller groups, averaging of 5.7 individuals, in Gumati Wildlife Sanctuary, Tripura, and similar or slightly larger average group sizes have been recorded elsewhere in northeast India (9.7—Mukherjee 1978; 10.0—Choudhury 1995/1996) and

Bangladesh (6.4—Islam and Husain 1982; 7.0—Green 1978; and 7–9—Stanford 1987, 1989). The average group size of capped langur is small when compared to other Indian colobine monkeys such as *Trachypithecus geei*, *T. obscura*, *T. johnii*, *T. phayrei*, *T. senex*, *T. vetulus*, *P. melalophos*, *Semnopithecus entellus*, *Presbytis thomasi*, and *Presbytis rubicunda* (Table 5). Variation in group size in different habitats may be due to the difference in the distribution, abundance and quality of the food resources in the habitat and the population density.

The Pakke Wildlife Sanctuary is also a tiger reserve; hence the core area is mostly free of biotic pressures except for the occasional organized hunting and poaching trips, as informed by the local hunters. Hunting, poaching and habitat destruction, is frequent in the adjacent forest areas of PWLS such as Hatiputi, Nauduar, Charduar reserve forests and Nameri National Park in the Sonitpur District of Assam (Choudhury 1996; Kumar and Solanki 2004; Kushwaha and Hazarika 2004).

Table 4. Plants used by local people and included in the diet of the capped langur (*Trachypithecus pileatus*).

No.	Scientific name	Family	Habit	Commercial/ subsistence use
1.	<i>Spondias axillaries</i> ¹	Anacardiaceae	Tree	Edible fruits, bark is chewed as substitute for betel nut
2.	<i>Mangifera sylvatica</i> ¹	Anacardiaceae	Tree	Edible fruits
3.	<i>Spondias pinnata</i>	Anacardiaceae	Tree	Edible fruits, firewood
4.	<i>Livistona jenkinsiana</i>	Arecaceae	Shrub	Leaves for thatch roofing, fruits/seeds edible
5.	<i>Horsfieldia kingii</i>	Arecaceae	Tree	Seeds used as betel nut
6.	<i>Calotropis procera</i>	Asclepiadaceae	Tree	Edible seeds
7.	<i>Oroxylum indicum</i>	Bignoniaceae	Tree	Medicinal value of seeds
8.	<i>Bombax ceiba</i> ¹	Bombacaceae	Tree	Cotton from pods
9.	<i>Canarium bengalense</i>	Burseraceae	Tree	Resin used as insect repellent
10.	<i>Bauhinia variegata</i> ¹	Caesalpiniaceae	Tree	Flowers used as vegetable
11.	<i>Terminalia chebula</i> ¹	Combretaceae	Tree	Medicinal value of fruits/seeds
12.	<i>Terminalia bellerica</i>	Combretaceae	Tree	Medicinal value of fruits/seeds
13.	<i>Dillenia indica</i> ¹	Dilleniaceae	Tree	Fruit used as souring agent in food
14.	<i>Elaeocarpus floribundus</i> ¹	Elaeocarpaceae	Tree	Seeds used as rosary beads
15.	<i>Turpinia pomifera</i> ¹	Staphyleaceae	Shrub	Firewood, bark is used for making fine rope
16.	<i>Gynoccardia odorata</i>	Flacourtiaceae	Tree	Bark is used as fish poison
17.	<i>Gmelina arborea</i> ¹	Verbenaceae	Tree	Important timber and fodder species
18.	<i>Talauma hodgsonii</i>	Magnoliaceae	Tree	Low-grade timber, firewood
19.	<i>Polyalthia simiarum</i>	Anonaceae	Tree	Firewood, bark is used for making coarse rope
20.	<i>Chisocheton paniculatus</i> ¹	Miliaceae	Tree	Low-grade timber, firewood
21.	<i>Baccaurea ramiflora</i> ¹	Averriaceae	Tree	Edible fruits
22.	<i>Bridelia retusa</i> ¹	Euphorbiaceae	Tree	Firewood
23.	<i>Artocarpus chaplasha</i> ¹	Moraceae	Tree	Timber
24.	<i>Garcinia cowa</i> ¹	Clusiaceae	Tree	Edible fruits
25.	<i>Castanopsis</i> sp.	Fagaceae	Tree	Timber
26.	<i>Altingia excelsa</i> ¹	Hamamelidaceae	Tree	Edible fruits
27.	<i>Kydia calliciana</i> ¹	Malvaceae	Tree	Firewood
28.	<i>Dendrocalamus hamiltonii</i> ¹	Poaceae	Bamboo	Young tender shoots
29.	<i>Sterculia villosa</i> ¹	Sterculiaceae	Tree	Flowers used as vegetable
30.	<i>Anthocephalus Kadamba</i> ¹	Rubiaceae	Tree	Flowers used as vegetable
31.	<i>Aquilaria agallocha</i>	Thymelaeaceae	Tree	Resin
32.	<i>Musa</i> spp.	Musaceae	Tall herb	Young leaves, stem, root has medicinal value
34.	<i>Syzygium formosum</i> ¹	Myrtaceae	Tree	Edible fruits
35.	<i>Paederia foetida</i>	Rubiaceae	Climber	Medicinal uses, body pain, kidney trouble
36.	<i>Vangueria spinosa</i> ¹	Rubiaceae	Tree	Edible fruits, medicinal value
37.	<i>Mikania micrantha</i> ¹	Moraceae	Climber	Leaves used for clotting of blood

¹ Plant species included in the capped langur diet.

Table 5. Summary of different colobine monkey social systems.

Species	Average group size	Group type	Study area	Source
<i>Trachypitecus pileatus</i>	7.50	1 or 2-male	Pakke Wildlife Sanctuary, Arunachal Pradesh, India	Present study
<i>T. pileatus</i>	9.70	1 or 2-male	Assam	Mukherjee 1978
<i>T. pileatus</i>	6.40	1 or 2-male	Madhupur National Park, Bangladesh	Islam and Husain 1982
<i>T. pileatus</i>	7.00	1 or 2-male	Madhupur National Park, Bangladesh	Stanford 1987
<i>T. pileatus</i>	9.00	1-male	Madhupur National Park, Bangladesh	Stanford 1989
<i>T. pileatus</i>	5.70	1 or 2-male	Gumati Wildlife Sanctuary, India	Gupta 1994
<i>T. geei</i>	8.20	1-male	Western Assam, India	Srivastava et al. 2001
<i>T. obscura</i>	17.00	1 or 2 male	Krau Game Reserve	Curtin 1980
<i>T. obscura</i>	10.30	1 or 2 male	Krau Game Reserve	MacKinnon and MacKinnon 1980
<i>T. johnii</i>	17.00	1 or 2 male	Ootacumnd Area Nilgiri Hill	Poirier 1970
<i>T. johnii</i>	18.50	1 male	Mundanthurai Plateau	Sunderraj 2001
<i>T. johnii</i>	5.89	1-male/multi-male	Silent Valley National Park, India	Joseph and Ramachandran 2003
<i>T. phayrei</i>	15.00	1 or 2 male	Gumati Wildlife Sanctuary, India	Gupta and Kumar 1994
<i>T. phayrei</i>	11.00	1 or 2 male	Bangladesh	Ahsan 1994
<i>T. phayrei</i>	8.80	1 or 2 male	Rajkandi Reserve Forest, Bangladesh	Stanford 1988
<i>T. senex</i>	11.00	1-male	—	Rudran 1973
<i>T. vetulus</i>	8.40	—	Polonnaruwa	Rudran 1973
<i>T. vetulus</i>	8.90	—	Horton Plains	Rudran 1973
<i>P. melalophos</i>	15.00	1-male	Krau W. Malaysia	Bennett 1983
<i>Semnopithecus entellus</i>	11.00	Multi-male	—	Curtin 1975
<i>S. entellus</i>	5–100 (range)	1-male/multi-male	North India	Jay 1965
<i>S. entellus</i>	22.00	1-male (most)	—	Hladik 1977
<i>Presbytis thomasi</i>	1.00	1-male	—	Gurmaya 1986
<i>Presbytis rubicunda</i>	7.00	1-male	—	Davies 1984
<i>Presbytis aygula</i>	7.00	1-male	—	Ruhayat 1983
<i>Procolobus badlus</i>	20.00	multi-male	—	Struhsaker 1975
<i>Presbytis cristata</i>	15.00	1-male	—	Wolf and Fleagle 1977
<i>Colobus satanas</i>	15.00	two-male	Douala-Edea, Cameroon	Mckey and waterman 1982
<i>Colobus guereza</i>	12.00	1-male/multi-male	Kibale, Uganda	Oates 1974
<i>Colobus guereza</i>	7.00	1-male/multi-male	—	Dunbar 1987
<i>Nasalis larvatus</i>	12.00	1-male	—	Yeager 1989

Habitat destruction for agricultural activities, permanent settlement, fuel and fodder, and for minor forest produce is also a threat to the sanctuary, and has been since the mid 1990s. There has been an unprecedented number of encroachments by the Bodo tribe, involving clear felling of mature forests for agriculture and settlements in the area bordering the Nameri National Park (Assam) and Pakke Wildlife Sanctuary. Choudhury (2002) reported that reserved forested areas close to the sanctuary and Nameri National Park had been fully converted into agricultural lands and permanent settlements by the end of 2000. The macaques adapted, occupying nearby tea gardens and village woodlands, but the capped langur is now restricted to a few fragmented forests. Crop raiding began following this loss of habitat, as was also reported by Das (1998) in Tripura. The villages close to the sanctuary are using it for grazing; regularly sending large numbers of cattle into the forest there. Grazing pressure is highest from September to November in the sanctuary when agricultural fields are sown with paddy and others crops.

Capped langur, one of the most threatened primates of India due to hunting for their fur and Bushmeat, requires special attention for its long-term survival. The species is

declining due to habitat loss and fragmentation and hunting in the entire distribution range of northeast India (Srivastava 2001a, 2001b; Kumar and Solanki 2004) and particularly in Arunachal Pradesh (Solanki and Chutia 2004; Kumar 2006). Preventing hunting and habitat destruction in these protected and non-protected areas is vital for protecting and conserving the species from extinction.

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Social group of capped langur (*Trachypithecus pileatus*) at Pakke Wildlife Sanctuary, Arunachal Pradesh, India. Photograph by Awadhesh Kumar.



Adult capped langur male presenting sexual solicitation during the mating season to attract the female. Photograph by Awadhesh Kumar.



Fur of capped langur is used to decorate the sheath of a traditional Dao (a big knife). Photograph by Awadhesh Kumar.



A group of local people carrying the traditional Dao in sheaths decorated with capped langur fur. Photograph by Awadhesh Kumar.



Pregnant female capped langur (*Trachypithecus pileatus*). Photograph by Awadhesh Kumar.



Deforestation around the Pakke Wildlife Sanctuary, Arunachal Pradesh. Photograph by Awadhesh Kumar.

Literature Cited

- Ahsan, M. F. 1994. Feeding ecology of the primates of Bangladesh. In: *Current Primatology Volume 1. Ecology and Evolution*, B. Thierry, J. R. Anderson, J. J. Roeder and N. Herrenschmidt (eds.), pp.79–86. Université Louis Pasteur, Strasbourg.
- Bennett, E. L. 1983. The Banded Langur: Ecology of a Colobine in a West Malaysian Rain Forest. PhD thesis, University of Cambridge, Cambridge, UK.
- Blower, J. G. 1985. Millipedes. Keys and notes for the identification of the species. Synopses of the British Fauna, No. 35. E. J. Brill, Leiden.
- Brockelman, W. Y. and R. Ali. 1987. Methods of surveying and sampling forest primate populations. In: *Primate Conservation in the Tropical Forest*, C. W. Marsh and R. A. Mittermeier (eds.), pp.23–62. Alan R. Liss, New York.
- Champion, H. G. and S. K. Seth. 1968. *A Revised Survey of the Forest Types of India*. The Manager of Publications, New Delhi.
- Chivers, D. J. and Raemaekers, J. J. 1980. Long-term changes in behaviour. In: *Malayan forest Primates: Ten years' Study in Tropical Rain Forest*, D. J. Chivers (ed.), pp.209–260. Plenum Press, New York.
- Choudhury, A. 1989. Ecology of the capped langur (*Presbytis pileatus*) in Assam, India. *Folia Primatol.* 52: 88–92.
- Choudhury, A. 1995/1996. Primates in Bherjan, Borajan, and Podumoni Reserved Forests of Assam, India. *Asian Primates* 5(3–4): 10–11.
- Choudhury, A. 1996. Primates in Assam—status and conservation. *Tiger Paper* 23(3): 14–17.
- Choudhury, A. 2002. Massive habitat loss for primates in Assam's Sonitpur district. *Asian Primates* 8(1–2): 18–20.
- Curtin, R. 1975. Socioecology of the Common Langur (*Presbytis entellus*) in Nepal, Himalaya, PhD thesis, University of California, Berkeley.
- Curtin, S. H. 1980. Dusky and banded leaf monkeys. In: *Malayan Forest Primates: Ten Years' Study in Tropical Rain Forest*, D. J. Chivers (ed.), pp.107–146. Plenum Press, New York.
- Das, S. 1998. Depredations on crops by langurs in Tripura. *Tiger Paper* 25(4):29–31.
- Davies, A. G. 1984. An Ecological Study of the Red Leaf Monkey (*Presbytis rubicunda*) in the Dipterocarp Forest of Sabah, Northern Borneo. PhD thesis, University of Cambridge, Cambridge, UK.
- Dunbar, R. I. M. 1987. Habitat quality, population dynamics, and group composition in colobus monkeys (*Colobus guereza*). *Int. J. Primatol.* 8(4): 299–329.
- Green, K. M. 1978. Primates of Bangladesh: a preliminary survey of population and habitat. *Biol. Conserv.* 13(2): 141–160.
- Green, K. M. 1981. Preliminary observations on the ecology and behavior of the capped langur, *Presbytis pileatus* in the Madhupur Forest of Bangladesh. *Int. J. Primatol.* 2(2): 131–151.
- Gupta, A. K. and A. Kumar. 1994. Feeding ecology and conservation of Phayre's leaf monkey *Presbytis phayrei* in northeast India. *Biol. Conserv.* 69: 301–306.
- Gupta, A. K. 1994. Status and conservation of non-human primates in Tripura, India. In: *Current Primatology Volume 1: Ecology and Evolution*, B. Thierry, J. R. Anderson, J. J. Roeder, and N. Herrenschmidt (eds.), pp.101–111. Université Louis Pasteur, Strasbourg.
- Gurmaya, K. J. 1986. Ecology and behavior of *Presbytis thomasi* in northern Sumatra. *Primates* 27: 151–172.
- Hladik, C. M. 1977. A comparative study of the feeding strategies of two sympatric species of leaf monkeys: *Presbytis senex* and *Presbytis entellus*. In: *Primate Ecology*, T. H. Clutton-Brock (ed.), pp.323–353. Academic Press, London.
- Horwich, R. H. 1972. Home range and food habits of the Nilgiri langur *Presbytis johnii*. *J. Bombay Nat. Hist. Soc.* 69(2): 255–267.
- Islam, M. A. and K. Z. Husain. 1982. A preliminary study on the ecology of the capped langur. *Folia Primatol.* 39: 145–159.
- Jay, P. 1965. The common langur of North India. In: *Primate Behavior: Field Studies of Monkeys and Apes*, I. DeVore (ed.), pp.197–249. Holt, Rinehart, and Winston, New York.
- Joseph, G. K. and K. K. Ramachandran. 2003. Distribution and demography of the Nilgiri langur (*Trachypithecus johnii*) in Silent Valley National Park and adjacent areas, Kerala, India. *Primate Conserv.* (19): 78–82.
- Kumar, A. 2006. Studies on Ecological and Behavioural Aspects of Capped Langur, *Trachypithecus pileatus* (Blyth 1843) in Pakhui Wildlife Sanctuary, Arunachal Pradesh, India. PhD thesis, North Eastern Hill University, Meghalaya, India.
- Kumar, A. and G. S. Solanki. 2003. Food preference of rhesus monkey *Macaca mulatta* during the pre-monsoon and monsoon season, Pakhui Wildlife Sanctuary, Arunachal Pradesh. *Zoos's Print Journal* 18(8): 1172–1174.
- Kumar, A. and G. S. Solanki. 2004. Ethno-sociological impact on capped langur (*Trachypithecus pileatus*), and suggestions for conservation: a case study of Reserve Forest in Assam, India. *J. Nat. Conserv.* 16(1): 107–113.
- Kushwaha S. P. S. and R. Hazarika. 2004. Assessment of habitat loss in Kameng and Sonitpur Elephant Reserve, *Current Science* 87(10):1447–1453.
- MacKinnon, J. R. and K. S. MacKinnon. 1980. Niche differentiation in a primate community. In: *Malayan Forest Primates: Ten Years' Study in Tropical Rain Forest*, D. J. Chivers (ed.), pp.167–190. Plenum Press, New York.
- McKey, D. B. and P. G. Waterman. 1982. Ranging behavior of a group of black colobus (*Colobus satanas*) in the Douala Edea Reserve, Cameroon. *Folia Primatol.* 39: 264–304.

- Mukherjee, R. P. 1982. Survey of non-human primates of Tripura, *J. Zool. Soc. India* 34: 70–81.
- Mukherjee, R. P., S. Chaudhuri and A. Murmu. 1995. Population survey of South-Asian non-human primates in and around Darjeeling. *Prim. Rep.* 41: 23–32.
- Mukherjee, R. P. 1978. Further observations on the golden langur (*Presbytis geei* Khajuria, 1959) with a note to capped langur (*Presbytis pileatus* Blyth, 1843) of Assam. *Primates* 19(4): 737–747.
- NRC. 1981. *Techniques for the Study of Primate Population Ecology*. National Research Council (ed.), National Academy Press, Washington, DC.
- Oates, J. F. 1974. The Ecology and Behaviour of the Black and White Colobus Monkey (*Colobus guereza* Ruppell) in East Africa. PhD thesis, University of London, UK.
- Poirier, F. E. 1970. The Nilgiri langur (*Presbytis johnii*) of south India. In: *Primate Behavior: Developments in Field and Laboratory Researches*, Rosenblum, L.A. (ed.), pp. 254–383. Academic Press, New York.
- Raman, T. R. S., C. Mishra and A. J. T. Johnsingh. 1995. Survey of primates in Mizoram, north-east, India. *Primate Conserv.* (16): 59–62.
- Rudran, R. 1973. Adult male replacement in one-male troops of purple-faced langurs (*Presbytis senex senex*) and its effect on population structure. *Folia Primatol.* 19: 166–192.
- Ruhayat, Y. 1983. Socio-ecological study of *Presbytis aygula* in West Java. *Primates* 24: 344–359.
- Solanki, G. S. 2002. Socio-cultural and faunal diversity of Arunachal Pradesh. *Himalayan J. Environ. Zool.* 16(2): 159–170.
- Solanki, G. S. and Chutia, P. 2004. Ethno-zoological and socio-cultural aspects of Monpas of Arunachal Pradesh. *J. Hum. Ecol.*, 15(4): 251–254.
- Srivastava, A. and M. S. Mohnot. 2001. Distribution, conservation status and priorities for primates in northeast India. *Envis Bulletin: Wildlife and Protected Areas* 1(1): 102–108.
- Srivastava, A., D. Chetry, P. Bujarbarua, J. Das and P. Sarkar. 2001a. Status of primates in the Gibbon Wildlife Sanctuary, Assam, India. *Biosphere Conserv.* 4(1): 43–49.
- Srivastava, A., J. Das, J. Biswas, P. Bujarbarua, P. Sarkar, I. S. Bernstein and S. M. Mohnot. 2001b. Primate population decline in response to habitat loss: Borajan Reserve Forest of Assam, India. *Primates* 42(4): 401–406.
- Stanford, C. B. 1987. Ecology of the capped langur (*Presbytis pileata*) in Bangladesh. *Am. J. Primatol.* 12: 373. Abstract.
- Stanford, C. B. 1988. Ecology of the capped langur and Phayre's leaf monkey in Bangladesh. *Primate Conserv.* (9): 125–128.
- Stanford, C. B. 1989. Predation on capped langurs (*Presbytis pileata*) by cooperatively hunting jackals (*Canis aureus*). *Am. J. Primatol.* 19: 53–56.
- Stanford, C. B. 1991. The capped langur in Bangladesh: behavioral ecology and reproductive tactics. *Contrib. Primatol.* 26: 1–179.
- Struhsaker, T. T. 1975. *The Red Colobus Monkeys*. University of Chicago Press, Chicago.
- Sunderraj, S. F. W. 2001. Ecology and conservation of Nilgiri langur (*Trachypithecus johnii*). *Envis Bulletin: Wildlife and Protected Areas* 1(1): 49–59.
- Wolf, K. and J. G. Fleagle. 1977. Adult male replacement in a group of silvered leaf-monkeys (*Presbytis cristata*) at Kuala Selangor, Malaysia. *Primates* 18: 949–955.
- Yeager, C. P. 1989. Feeding ecology of the proboscis monkey (*Nasalis larvatus*). *Int. J. Primatol.* 10: 497–530.
- Zhang, Y. Z., S. Wang and G. Q. Quan. 1981. On the geographical distribution of primates in China. *J. Hum. Evol.* 10: 215–226.

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