

Macaca munzala*: A New Species from Western Arunachal Pradesh, Northeastern India

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Received July 26, 2004; revision November 9, 2004; accepted November 26, 2004

Macaca, comprising 20 well-characterized species, represents the largest and one of the most ecologically and socially diverse of all the nonhuman primate genera. We report the discovery of a macaque that is new to science from the high altitudes of western Arunachal Pradesh, a biodiversity-rich state in northeastern India. We propose the scientific name *Macaca munzala* and the vernacular name Arunachal macaque for the species. It shares morphological characteristics independently with the Assamese macaque (*Macaca assamensis*) and with the Tibetan macaque *M. thibetana*; like them, it appears to belong to the *sinica* species-group of the genus. However, the species is distinctive in relative tail length, which is intermediate between those of Tibetan and Western Assamese macaques, the subspecies with which it is sympatric. It is also unique in its altitudinal distribution, occurring largely at altitudes between 2000 and 3500 m. We provide a morphological characterization of the species, report preliminary data on its field biology and discuss possible taxonomic identity in relation to the other closely-related species of *Macaca*.

KEY WORDS: Arunachal macaque; *Macaca munzala*; *Macaca assamensis*; *Macaca thibetana*; *sinica* species-group; Arunachal Pradesh; India.

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*This paper is dedicated to Dr. A. J. T. Johnsingh for his immense contributions to the study and conservation of India's wildlife and for being an inspiration to a whole generation of students.

INTRODUCTION

The northeastern Indian state of Arunachal Pradesh ($26^{\circ}28'–29^{\circ}30'N$ and $91^{\circ}30'–97^{\circ}30'E$; $83,743\text{ km}^2$) is uniquely located at the junction of the Eastern Himalaya and Indo-Burma, a region that is among the world's 25 global biodiversity hotspots. The state is home to a diverse array of large mammals including primates. Wildlife research and exploration in Arunachal Pradesh has so far largely remained restricted to low and mid-elevation habitats, with high altitude ($>3000\text{ m}$) wildlife being virtually unexplored and unprotected. It was, therefore, not entirely surprising when 2 expeditions (August–September 2003 and April–May 2004) to inventory the high altitude wildlife of Arunachal Pradesh led to the discovery of a fairly large population of an undescribed macaque (*Macaca*) in the state's westernmost districts of Tawang and West Kameng (Fig. 1; Mishra *et al.*, 2004; Sinha, 2004). We observed 14 multimale, multifemale troops of this largely terrestrial primate—the Arunachal macaque (earlier referred to as the Tawang macaque; Sinha *et al.*, 2004)—in different habitats over an area of *ca.* 1200 km^2 (Table I). We propose the scientific name *Macaca munzala* for the species,

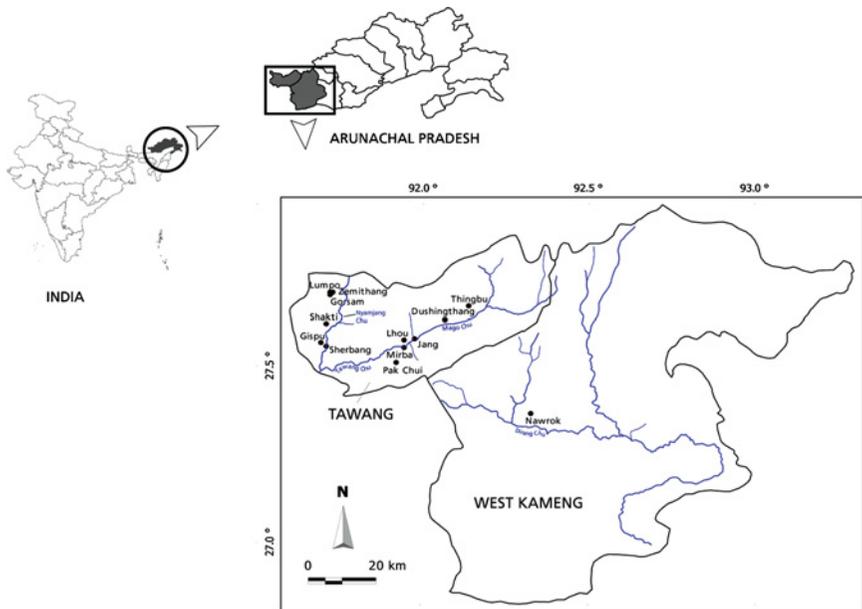


Fig. 1. Map of Tawang and West Kameng Districts, Arunachal Pradesh, showing sighting locations of *Macaca munzala*.

Table 1. Sightings of *Macaca munzala* in Tawang and West Kameng Districts, western Arunachal Pradesh

| Serial Number | Locality | Date | Troop Size | Substrate | Habitat |
|---------------|--------------------------------------|-------------------------------|------------------------|------------------------------------|--|
| 1 | Gispu, Lower Nyamjang Chu Valley | 19 August 2003 | >4 | On the ground | 2230 m, roadside in degraded broadleaved forest, close to an isolated crop field |
| 2 | Zemithang, Upper Nyamjang Chu Valley | 20 August 2003, 29 April 2004 | >6, 17, with 6 infants | On the ground | 2180 m, roadside in degraded broadleaved forest, close to crop fields |
| 3 | Gorsam | 21 August 2003 | >18, with 2 infants | On trees, at a height of 15–20 m | 2030 m, early in the morning, roosting in the canopy of a riverine forest |
| 4 | Mirba, Mukto | 27 August 2003 | 5 | On the ground | 2620 m, roof of an abandoned hut in a crop field |
| 5 | Pak Chui, Mukto | 28 August 2003 | >7 | On the ground | 2670 m, undisturbed oak forest; heard vocalizing |
| 6 | Jang | 1 September 2003 | >5 | On the ground | 2120 m, roadside in degraded open scrub forest |
| 7 | Jang | 23 September 2003 | >4 | On the ground | 2470 m, broadleaved forest |
| 8 | Dushingthang | 23 September 2003 | >8 | In the canopy, at a height of 15 m | 2700 m, broadleaved forests by a steep cliff |
| 9 | Nawrok, Lower Namshu Valley | 26 April 2004 | >17 | On the ground | 2870 m, sloping grassland by a broadleaved forest |
| 10 | Lhou | 27 April 2004 | 34, with 5 infants | On a rocky outcrop | 2100 m, roadside in degraded open scrub forest |
| 11 | Lumpo, Upper Nyamjang Chu Valley | 29 April 2004 | >16, with 5 infants | On a rocky outcrop | 2180 m, degraded broadleaved forest |
| 12 | Shakti, Upper Nyamjang Chu Valley | 29 April 2004 | >8 | On the ground | 1650 m, roadside in degraded broadleaved forest |
| 13 | Sherbang, Lower Rong Chu Valley | 5 May 2004 | >6 | On the ground | 2100 m, roadside adjacent to broadleaved forests |
| 14 | Thingbu | 9 May 2004 | >9 | On the ground | 3000 m, undisturbed conifer forest |

and provide an account of its morphology with some observations on its field biology.

Although the elevation in Tawang and West Kameng Districts generally ranges between 1000 and >6000 m and we surveyed much of this gradient, the macaques were generally encountered at altitudes between 2000 and 3000 m (Table I). Reports from local people suggest that they occur up to 3500 m. The species thus occurs at the highest altitude reported for any macaque in the Indian subcontinent (Menon, 2003). Subtropical broadleaved forests dominate the vegetation within this elevational range, though cultivation is common in areas where the terrain is less rugged. The macaques appeared to be relatively tolerant of human presence and habitation, occasionally occurring close to villages and crop fields (Table I). They were, nevertheless, wary in the presence of people, and in most cases, moved away on being closely observed. Inside undisturbed forests, they seemed extremely shy, rapidly disappearing through the undergrowth as soon as they sensed human presence.

THE ARUNACHAL MACAQUE

Order Primates Linnaeus, 1758

Superfamily Cercopithecoidea Gray, 1821

Family Cercopithecidae Gray, 1821

Subfamily Cercopithecinae Gray, 1821

Genus *Macaca* Lacépède, 1799

Macaca munzala species novum

Holotype: An adult male, photographed by M. D. Madhusudan (Fig 2 Top panel)

Paratypes: Two adult and one subadult males, photographed by M. D. Madhusudan (Fig. 2 Bottom panel). We are trying to collect specimens of the species. These will be designated as paratypes and deposited in the State Forest Research Institute in Itanagar, Arunachal Pradesh. If live specimens are obtained, they will be maintained in an appropriate captive facility and their skins, skulls and skeletons again deposited in the State Forest Research Institute upon their demise.

Type locality: Zemithang (27°42'N, 91°43'E), Tawang District, Arunachal Pradesh; altitude 2180 m above sea level. The holotype belonged to a multimale multifemale troop of ca. 17 individuals, and was photographed on August 20, 2003 while he foraged in degraded broadleaved forest, close to crop fields.

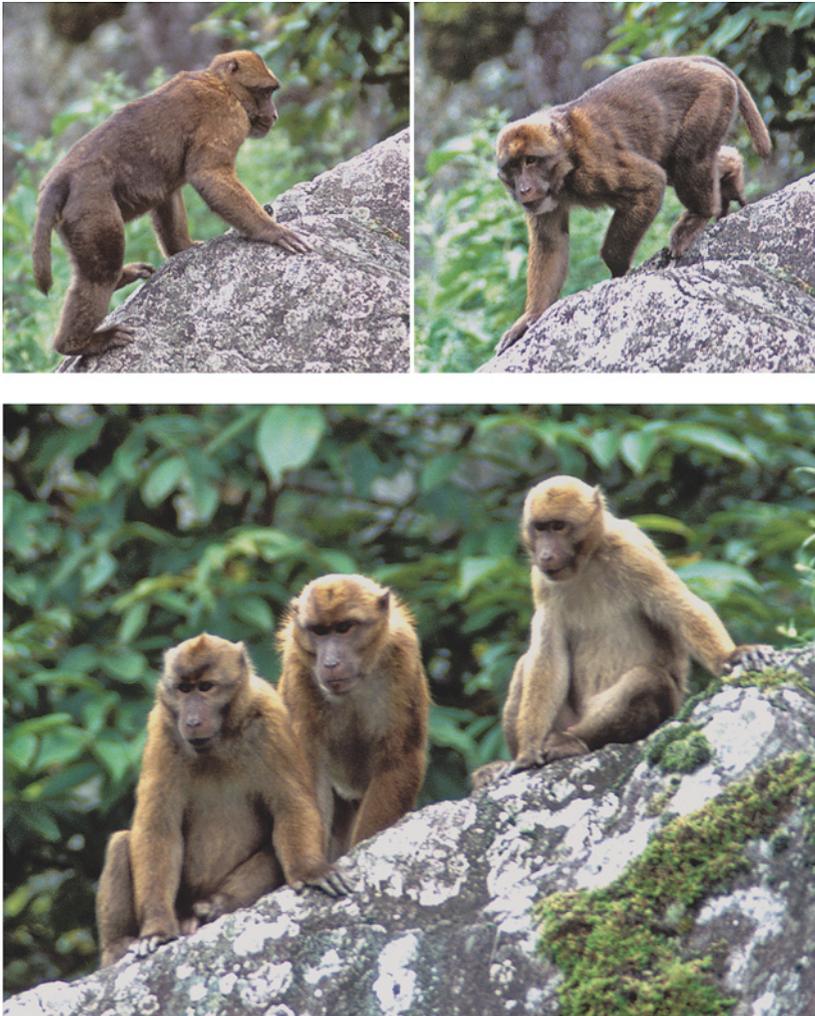


Fig. 2. *Macaca munzala*. Top panel: The adult male (left: right lateral view; right: left lateral view) is the holotype for the new species. For relative body-size measurements of adult individuals, we used profile photographs like this one. Bottom panel: The 2 adult males (left and center) and the subadult male (right) represent paratypes for the species.

Diagnosis: A species within the *sinica* species-group of *Macaca* (Fooden, 1980), as evidenced by penile morphology. The taxon can be distinguished from *Macaca sinica*, *M. radiata*, *M. assamensis pelops* and *M. thibetana* by relative tail length and external morphology and from *M. assamensis assamensis* by distinctive facial features and external morphology. More

uniquely, it can be differentiated from all the species of the *sinica* species-group by a suite of traits including a prominently dark crown patch, characteristic facial marks on the temple and forehead, pale collar of hair around the neck and distinctive relative tail length.

Description: Individuals are generally large and heavyset with a short tail (Fig. 2). The body of adults is dark brown to dark chocolate dorsally, with the upper part of the torso and the distal parts of the limbs becoming paler (ranging from light brown to olivaceous). The hands and feet are also pale brown (similar to the fore limbs), though they are relatively darker in juveniles. The ventral part of the trunk is lighter in some individuals, but similar to that of the upper torso in most individuals. The general pelage is long and dense, especially in the upper torso, while the lower torso and ventral part of the trunk have shorter, smoother hairs.

The tail is very dark, similar to the dorsal surface of the lower torso and the hind limbs. Although juveniles appear to be similar to adults in their general appearance and pelage characteristics, a striking feature common to all juveniles are their relatively hairless, whip-like tails, tapering distally to a narrow tip. The tail length of the species is distinctive, both in adults and in juveniles. The relative tail length of 2 adult males, measured (from photographs) as the ratio of the length of the tail to that of the head and body, are 0.39 and 0.45 (Table II, Fig. 2), while that of 3 captive juveniles (measured directly) are 0.36, 0.39 and 0.40.

The front of the crown of every individual is very characteristic in having a prominent pale-yellow patch with a central group of dark hairs. In one

Table II. Relative tail length measurements of Arunachal macaques, 2 subspecies of Assamese macaques and Tibetan macaques

| Species and age-sex category | Measure and range | Reference |
|--|----------------------------------|--------------|
| | Tail length/Head and body length | |
| <i>Macaca munzala</i> Adult males | 0.39–0.45 | This study |
| <i>Macaca munzala</i> Juveniles | 0.36–0.40 | This study |
| <i>Macaca assamensis assamensis</i> Adult males | 0.26–0.44 | Fooden, 1982 |
| <i>Macaca assamensis pelops</i> Adult males | 0.50–0.69 | Fooden, 1982 |
| <i>Macaca assamensis pelops</i> Juveniles | 0.40–0.69 | This study |
| | Tail length/Hindfoot length | |
| <i>Macaca munzala</i> Adult male, juvenile | 1.52, 1.28 | This study |
| Macaque described by Choudhury (1998) Adult males | 0.80–1.20 | Fooden, 2003 |
| <i>Macaca assamensis assamensis</i> Adult males | 1.11–1.56 | Fooden, 2003 |
| <i>Macaca assamensis pelops</i> Adult males | 1.73–2.07 | Fooden, 2003 |
| <i>Macaca thibetana</i> Adult males | 0.33–0.54 | Fooden, 2003 |

adult male, it formed an erect tuft, though in every other individual it was more reminiscent of a whorl of hairs. Surprisingly, when we surveyed them during the second expedition, in early summer, the dark patch was present but the pale yellow patch was not as distinct, which raises the possibility that the species may exhibit minor seasonal variation in coat color.

The head is very prognathous with the upper part of the face significantly broader than the muzzle, especially in adult males. The facial skin is generally dark brown (darker than that of the body in several of the adult males). There is a prominent dark patch on either temple, occasionally extending as a stripe from the outer corner of the eye or the upper cheek to the ear. We observed this feature in virtually every individual, and it appears to be a distinctive species-specific morphological trait. Many individuals also have a long, thin, dark stripe that runs along the lower forehead above the eyes, a feature relatively more prominent in juveniles. The skin around the eyes is usually pale in some individuals, producing a faintly spectacled appearance.

The nose is relatively flaring and occasionally lighter in color, particularly in adults. In contrast to Tibetan macaques, side-whiskers and beard are not prominently developed and the dark ears are, therefore, often clearly visible in anterior view. In several adult males and females there is also a dorsal ring of lighter-colored hair between the head and trunk, which distinctly appears as a pale collar even when viewed from afar.

The glans penis, on superficial examination, is distinctive in being prominently inflected relative to the shaft of the penis, broad with an acute apex, and sagittate in dorsal view. The dark pink glans has a prominently thickened corona and a subterminal urethral meatus that is dorsoventrally oriented.

Distribution: We list the locations where the taxon has been sighted in Table I. The species is distributed over much of Tawang District and in the western part of West Kameng District of Arunachal Pradesh. They may also occur in other parts of Arunachal Pradesh, and in adjoining areas of Bhutan and Tibet.

Etymology: The proposed specific name for the taxon is derived from its local name in Dirang Monpa: *mun zala*, literally meaning deep forest (*mun*) monkey (*zala*). The dialect is spoken by the Monpa, an important Buddhist tribe of West Kameng and Tawang Districts of Arunachal Pradesh.

TAXONOMIC IDENTITY

Although reminiscent of Assamese macaques in general physiognomy, Arunachal macaques are strikingly different from either *Macaca*



Fig. 3. *Macaca assamensis pelops*, which is sympatric with *M. munzala*. This adult male was photographed at Kurseong (altitude 1480 m) in West Bengal, eastern India.

assamensis pelops (Figure 3) or *M. a. assamensis* (Fooden, 1982) in their extremely dark coat color, hirsute underside of the body, relatively stocky tail, dark brown facial skin, distinctive facial marks on the temples and forehead, and lack of prominent chin and cheek whiskers (Fig. 2 vs. 3). Further, all Arunachal macaques have a prominent dark patch on the crown, while most Assamese macaques have a smooth hair arrangement on a pale crown (with an occasional central parting), though rare individuals may have a whorl or tuft of hair there (Fooden, 1982; Sinha, *pers. obs.*).

The 2 subspecies of the Assamese macaque apparently have disjunct geographical distributions, though their exact limits are unknown (Fig. 4;

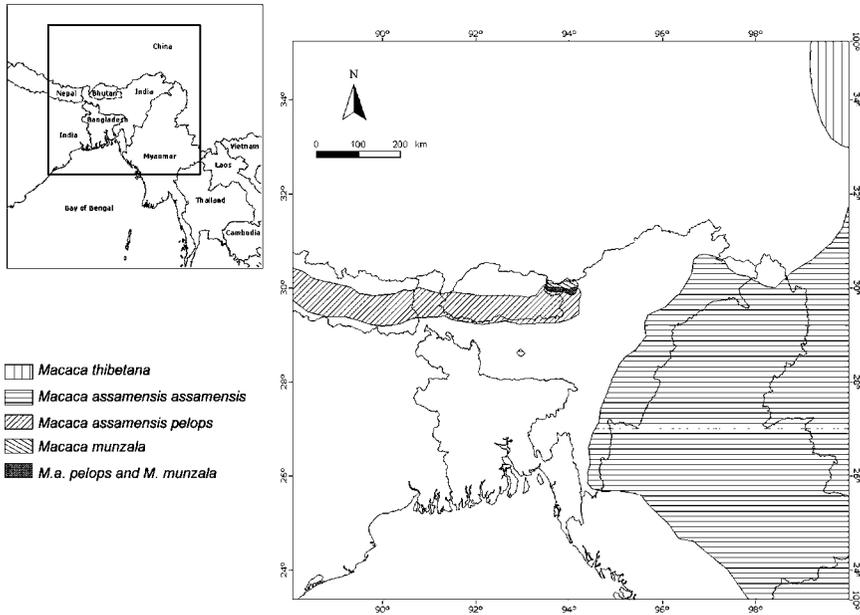


Fig. 4. Map of India and adjoining countries in southeastern Asia showing the partial distributions of *Macaca assamensis pelops*, *M. a. assamensis* and of *M. thibetana* (adapted from Fooden, 1982 and Sinha, *unpubl.*) relative to that of *M. munzala*. Although *Macaca assamensis pelops* and the *M. munzala* are sympatric, they have nonoverlapping altitudinal distributions. The eastern limit of *Macaca assamensis pelops*, the western limit of *M. a. assamensis*, and both the eastern and western limits of *M. munzala* are unknown.

Fooden, 1982; Brandon-Jones *et al.*, 2004; Sinha, *unpubl.*). Western Assamese macaques (*Macaca assamensis pelops*) occur from central Nepal eastward through the Indian states of Sikkim and northern West Bengal to western Arunachal Pradesh. *Macaca assamensis assamensis*, the eastern subspecies, ranges from the Indian states of eastern Arunachal Pradesh, Assam, Nagaland, Manipur, Mizoram eastward through northern and eastern Burma to Thailand, Laos, Vietnam and the Chinese provinces of Yunnan and Guangxi, though Jiang *et al.* (1993) suggest that they may be heterogeneous, divisible into 2 or 3 subspecies. Morphologically, the 2 Assamese macaque subspecies can only be distinguished from each other by relative tail length (Table II; Fooden, 1982).

Surprisingly, the relative tail lengths of Arunachal macaque males overlaps those of Eastern Assamese macaques (Table II) though, in its distribution, it is sympatric only with the Western Assamese macaque, the adult males of which have significantly longer relative tail lengths (Table II; see Fig. 3). This is also true of juveniles of the species; in contrast to the

relative tail length of the Arunachal macaque that range from 0.36 to 0.40, the relative tail lengths of 2 captive Western Assamese macaque juveniles that we measured are 0.49 and 0.63 (Table II). While relative tail length of *Macaca assamensis* varies by age and sex differently in its 2 subspecies (Fooden, 1982), our preliminary evidence indicates that there may be similar age differences in the relative tail length of the Arunachal macaques.

Another index of relative tail length that Fooden (2003) has used recently primarily due to the absence of reliable data on head and body length is the ratio of tail length to that of the pes. There is a clear progressive decline in the ratio in adult males across species of the *sinica* species-group: from a mean of 1.86 in *Macaca assamensis pelops* to 1.26 in *M. a. assamensis* and 0.41 in *M. thibetana* (Fooden, 2003; Table II). A photographic analysis post hoc of the ratio for an adult male and a juvenile Arunachal macaque indicates once again that they are relatively closer in morphometric ratios to Eastern Assamese macaques rather than to the Western Assamese macaques, with which they are sympatric.

With rare exceptions, both Assamese macaque subspecies are restricted to a relatively narrow altitudinal zone between 150 and 2000 m over their entire distributional ranges (Fooden, 1982; Sinha, *unpubl.*). The significant morphological differences between Arunachal macaques and the 2 Assamese macaque subspecies (which are otherwise remarkably similar to each other) as well as the altitudinal specificity of their respective distributions thus make it highly improbable that Arunachal macaques are a subspecies of *Macaca assamensis*.

Arunachal macaques strikingly resemble Tibetan macaques (*Macaca thibetana*) in having dark, long pelage, dark facial skin, and the almost ubiquitous dark patches (or occasionally, stripes) on the crown and the temples (Li, 1999). Tibetan macaques are distributed principally in east-central China, at similar altitudes of 1000–2500 m, but *ca.* 1000 km away (calculated from Fooden, 1986; Fig. 4). Most importantly, Arunachal macaques differ from the much heavier, stockier and more hirsute Tibetan macaques in having a prognathous head and a prominent tail, which is virtually absent in the latter (Table II). They also lack the prominent bushy pale buff-colored beard and full cheek whiskers characteristic of Tibetan macaques.

In conclusion, Arunachal macaques display unique morphological features, consistently shared by all individuals in a population spread over 1200 km², and an unusual altitudinal distribution not exhibited by any other macaques in the area. Their distinctive penile morphology, characteristic of the *sinica*-group of *Macaca* (Fooden, 1980), together with a suite of morphological traits shared independently with the Assamese macaque and the Tibetan macaque clearly indicates that they are a new species within the *sinica* species-group with possibly strong evolutionary connections to both Assamese and Tibetan macaques.

Choudhury (1998, 2000, 2002) described a troop of macaques from an altitudinal range similar to that of the Arunachal macaque in the Eagle's Nest Wildlife Sanctuary of West Kameng District. He provisionally identified them to be Tibetan macaques or a subspecies of Assamese macaques on the basis of their relatively short tails, more prominent buffy side-whiskers, and differences in their vocalizations. Subsequently, Fooden (2003) calculated the tail-to-pes of 2 individuals from sketches made by Choudhury and suggested that the population may actually represent the *Macaca assamensis assamensis*. The new species that we report here have relative tail lengths significantly larger than the macaques sighted by Choudhury, and they also lack the buffy side-whiskers. They also differ significantly from Assamese macaques in having dark pelage and facial skin, stocky tail (which is relatively hairless in juveniles) and distinctive facial markings. Choudhury's (1998) incomplete description could well apply to the Arunachal macaque, which has a notably dark pelage and facial skin and a dark crown patch, that were not mentioned by Choudhury. A comparative analysis of our photographs with the solitary one of Choudhury (1998), failed to resolve the issue primarily due to a lack of clarity in his photograph.

Among extant primates, *Macaca* with 20 well-characterized species (Brandon-Jones *et al.*, 2004) occupies a geographical range that is only smaller than that of *Homo*. In terms of wide distribution, numerous populations and range of habitat types exploited, macaques have thus achieved outstanding evolutionary success. Although their distribution and numbers have reduced drastically since the Pleistocene, when macaques reached the pinnacle of their evolution, the ecological adaptability and behavioral flexibility of the genus has undoubtedly contributed to their colonizing success and the ability of some species to thrive in habitats undergoing drastic human modification (Lindburg, 1980; Fa and Lindburg, 1996). Accordingly, the discovery of the Arunachal macaque and our continuing work on the behavioral ecology and population genetics of the species should significantly contribute to the growing understanding of their evolutionary ecology.

CONSERVATION STATUS

During our surveys, local people reported that the macaques frequently damage crops and are sometimes killed in retaliation. The people of Tawang and the high altitudes of West Kameng belong predominantly to the Buddhist *Monpa* tribe and, in general, do not eat primates. However, some hunting of primates for meat is reportedly carried out by government employees from other Arunachali tribes stationed there.

The intensive survey currently being conducted in the Tawang and West Kameng Districts of Arunachal Pradesh should enable us to more closely examine the survival threats confronting this species and, if necessary, consider their inclusion in the IUCN's Red List of Threatened Species (IUCN, 2000) and the Indian Wildlife (Protection) Act of 1972 (Anon, 2003). Establishment of community awareness and conservation programs and designation of a protected area that is locally appropriate (such as a conservation or community reserve) may also be urgently required to safeguard the future of this enigmatic species alongside that of the fascinating, but threatened, wildlife assemblage of western Arunachal Pradesh.

ACKNOWLEDGMENTS

The study was undertaken by the Nature Conservation Foundation jointly with the International Snow Leopard Trust and the Wildlife Conservation Society. Financial support came from the Rufford Maurice Laing Foundation (UK), the Van Tienhoven Foundation (The Netherlands), the International Snow Leopard Trust, the Wildlife Conservation Society and the Centre for Wildlife Studies (India). We are grateful to the following individuals/ organizations; the Arunachal Pradesh Forest Department, particularly S.K. Raha, Pekom Ringu, and the Divisional Forest Officers of Tawang and Bomdila divisions for permissions and cooperation; Omak Apang, Lobsang Genchen, Dorje Norbu and Jimmy Gyatso for invaluable support; Saandeep R. for drawing the maps; Irwin Bernstein, Colin Groves, Mewa Singh, Niranjana V. Joshi and an anonymous referee for constructive comments on an earlier version of the manuscript; and Herbert H. T. Prins, Josh Cole, H. P. Nooteboom, K. Ullas Karanth and Kakoli Mukhopadhyay for their support. Anindya Sinha would also like to thank Prabal Sarkar for first drawing his attention to a photograph of a captive juvenile Arunachal macaque, which, the latter believed, could represent a new species.

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