

[Short communication](#)

Distribution records of Assamese macaques (*Macaca assamensis pelops*) from the Bheri River Basin in western Nepal

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Abstract

The Assamese macaque (*Macaca assamensis*) population in Nepal is one of the least studied mammals. It is legally protected by the National Parks and Wildlife Conservation Act 1973; however, its population status, distribution and conservation threats are ill-documented. The species is thought to have a disjunct distribution having limited information about its occurrence in mid-western and far-western Nepal. This study surveyed the Assamese macaques in the Bheri River Basin of western Nepal and recorded their distribution in the basin for the first time. A total of 117 individuals were observed belonging to six different troops with an average troop size of 19.5 individuals. The elevational range of the distribution ranged between 1132 m and 1840 m asl. The Assamese macaque individuals from the Bheri River Basin are much darker and bear longer relative tail lengths than those of eastern and central Nepal. Further explorations and a detailed assessment of conservation threats in western Nepal are warranted.

Keywords: Conservation threats; Disjunct distribution; Macaques; Mid-western Nepal; New distribution records

suggested the distinct species status of the Nepal population of Assamese macaques. However, it hasn't yet been described taxonomically.

1 | Introduction

Assamese macaque (*Macaca assamensis*) is a member of the *sinica*-group of macaques (Fooden 1979). It has two known subspecies, the eastern Assamese macaque (*M. a. assamensis*) and western Assamese macaque (*M. a. pelops*) demarcated geographically by the great bend of the Brahmaputra River (Boonratana et al. 2020; Choudhury 2022). The western subspecies of the Assamese macaques is distributed in north-eastern India, Bhutan, Tibet Autonomous Region of China and Nepal (Boonratana et al. 2020; Khanal et al. 2021). The Assamese macaques occur in the plains of the Brahmaputra Valley as well as in hilly and mountainous tracts, from 15 m elevation in the plains of Tripura to 3,500 m in the Great Himalayas (Choudhury 2022). The Nepal population of the species is morphologically different than that of the populations in India and Bhutan and has been considered to be a distinct taxon (Molur et al. 2003; Chalise 2005). A recent molecular phylogenetic study (Khanal et al. 2021) also

Assamese macaques are one of the least studied mammals in Nepal and lack detailed information about their distribution and conservation status. The International Union for Conservation of Nature (IUCN) has categorized the species as Near Threatened (NT) as they are experiencing declines due to hunting and habitat degradation and fragmentation (Boonratana et al. 2020). Nationally, it has been categorized as Endangered (EN) and the National Parks and Wildlife Conservation Act 1973 of Nepal has listed it as a legally protected mammal (Jnawali et al. 2011; Khanal et al. 2018). Despite being legally protected, Assamese macaques suffer from retaliatory killings because of conflicts with local subsistence farmers as they raid crops (Khanal et al. 2023). Due to morphological similarities with rhesus macaques, which are notorious crop raiders in many parts of Nepal, farmers have negative perceptions of the Assamese macaques also. Such negative perceptions among local people have added conservation challenges. Assamese macaques are less vigilant and have a smaller average troop

size than rhesus macaques making them more vulnerable to retaliatory killings (Khanal et al. 2023).

The IUCN considers Tipling (83°36' E) in central Nepal as the westernmost distribution limit of Assamese macaques (Boonratana et al. 2020), however, recent studies have reported the species from far western Nepal including Achham, Baitadi, Bajura and Darchula districts (Khanal et al. 2019; Khanal et al. 2023). Assamese macaques have been recorded from the Koshi River Basin in eastern Nepal, the Gandaki River Basin in central Nepal and the Karnali and Chamelia River Basins in western Nepal (Chalise 2013; Khanal et al. 2021). The Nepal population of the species is distributed in the elevational range of 130 m asl in Chatara Dham area of Sunsari District to 2650 m asl in Langtang National Park (Khanal et al. 2018; Khanal et al. 2019; Khanal et al. 2021). It has been recorded from Ilam and Panchthar in far-eastern Nepal to Api Nampa Conservation Area in far-western Nepal inhabiting primarily in the riverine broad-leaved forests. It is believed to have a disjunct distribution and hasn't yet been documented from the Bheri River Basin (Wada 2005; Chalise 2013; Khanal et al. 2023).

A fine-scale distribution data of the Assamese macaques is essential to understand their distribution and formulate conservation and management plans, especially outside the protected areas network of the country. The majority of the population of the species is residing in forest patches of mid-

hills outside the protected areas system of the country (Khanal et al. 2019). In many places, Assamese macaques are regarded as pest animals due to their crop-raiding habits and are being killed retaliatorily. The overall population size as well as the average troop size of Assamese macaques in Nepal has been reported to lower noticeably during the last decade (Chalise 2013, average troop size = 21.55; Khanal et al. 2019, average troop size = 19.29). It is important to explore the species from previously unrecorded areas and identify their population size and conservation challenges. This study hypothesized that Assamese macaques could be inhabiting the riverine forests of the Bheri River Basin as it also holds a similar climatic zone and vegetation to other habitats of the species in western Nepal. We conducted extensive field surveys and reported the occurrence of Assamese macaques in Bheri River Basin.

2 | Materials and methods

2.1 | Study area

The Bheri River Basin (Fig. 1) lies in Karnali Province in mid-western Nepal. Bheri River is one of the major tributaries of the Karnali River system and is about 264 km long. It extends between latitudes 28°20' N to 29°25' N and longitudes 81°16' E to 83°41' E with an elevational range from 200 to 7746 m

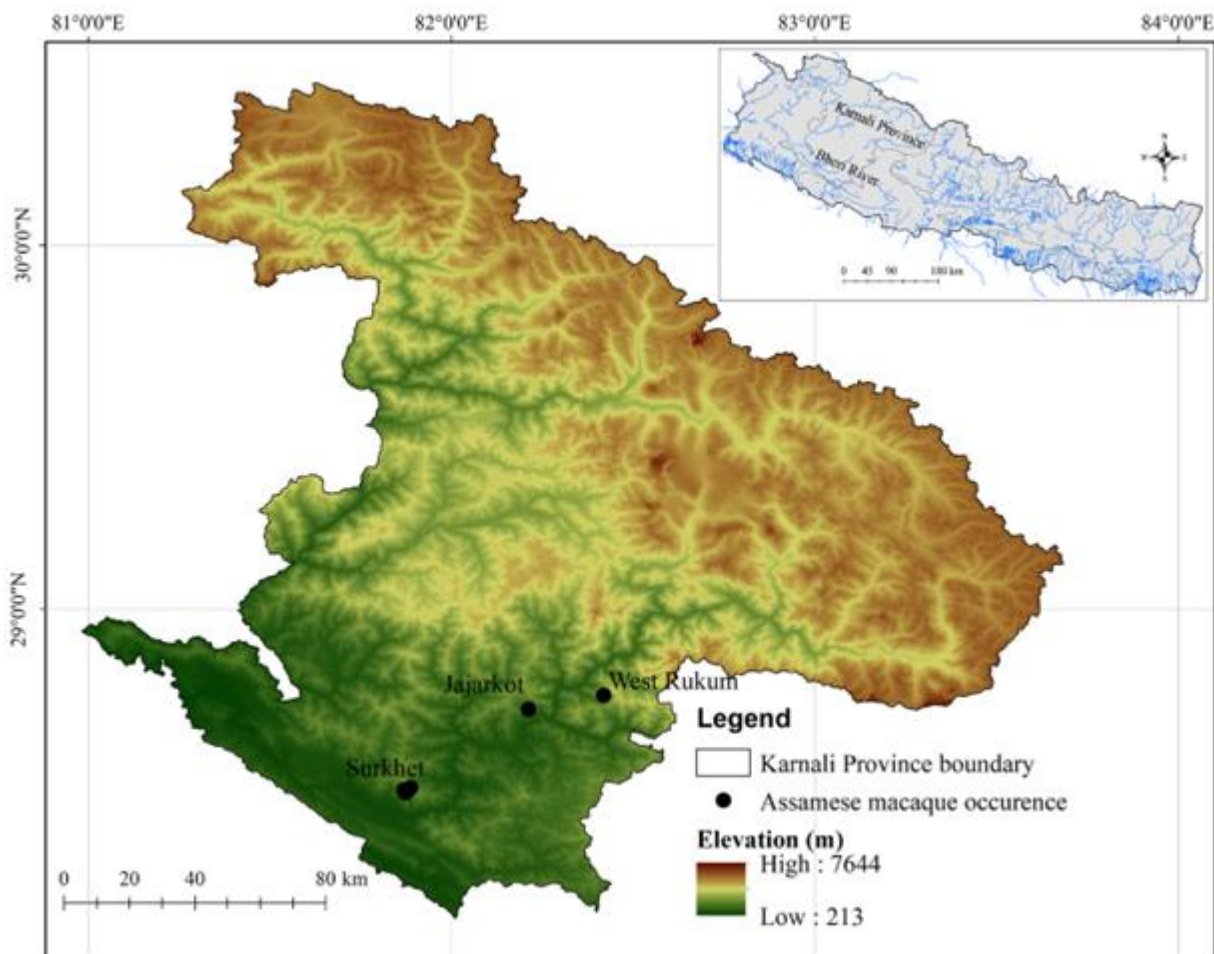


Figure 1. Map of the study area showing the occurrence records of Assamese macaques in the Bheri River Basin of Karnali Province

Table 1. Localities and troop size of Assamese macaques recorded from the Bheri River Basin

S.N.	Locality	Latitude (N)	Longitude (E)	Elevation	Troop size
1	Bheri Municipality, Jajarkot	28.72469	82.21203	1132 m	13
2	Aathbiskot Municipality, West Rukum	28.76276	82.41884	1840 m	19
3	Gurbhakot Municipality, Surkhet	28.50207	81.86892	1354 m	23
4	Gurbhakot Municipality, Surkhet	28.50883	81.88697	1591 m	19
5	Gurbhakot Municipality, Surkhet	28.50308	81.88093	1343 m	21
6	Gurbhakot Municipality, Surkhet	28.49433	81.87256	1137 m	22

asl (Mishra et al. 2018). Sani Bheri, Thuli Bheri and Uttar Ganga are the three major tributaries of the Bheri River. The Bheri River drains water from the hilly and mountainous areas of mid-western Nepal including Dolpa, Jajarkot, Rukum, and Surkhet districts and joins the Karnali River within the Mahabharata range.

The Bheri River Basin has a wide spatial heterogeneity in biophysical and climatic characteristics. The average annual maximum and minimum temperatures of the basin are 23.35 °C and 11.38 °C, respectively (Mishra et al. 2018). The whole basin is dominated by forests (34.7%), followed by snow cover/glaciers (15.9%), and grasslands (15.8%). The lower area of the basin is located in the subtropical region and is primarily covered by *Schima-Castanopsis* forest, with certain parts being dominated by chir-pine (*Pinus roxburghii*) and alder (*Alnus nepalensis*) forest. Higher elevations of the basin comprise a temperate climate with Western Himalayan subalpine conifer forests, alpine shrubs and grassland habitats (Lama et al. 2022). Major mammalian fauna of the area include blue sheep (*Pseudois nayaur*), Himalayan black bear (*Ursus thibetanus*), Himalayan goral (*Naemorhedus goral*), Himalayan serow (*Capricornis thar*), Himalayan red panda (*Ailurus fulgens*), Himalayan tahr (*Hemitragus jemlahicus*), musk deer (*Moschus* spp.), northern red muntjac (*Muntiacus vaginalis*), rhesus macaques (*Macaca mulatta*), Himalayan langurs (*Semnopithecus* spp.), etc. (Acharya & Paudel 2020). Some representative birds include cheer pheasant (*Catreus wallichii*), bearded vulture (*Gypaetus barbatus*), Egyptian vulture (*Neophron percnopterus*), Himalayan griffon (*Gyps himalayensis*), red-headed vulture (*Sarcogyps calvus*), satyr tragopan (*Tragopan satyra*), Himalayan monal (*Lophophorus impejanus*), etc. (Lama et al. 2022).

2.2 | Field surveys

Field surveys were conducted along the river axis of Bheri River and its major tributaries- Nalgadh, Sani Bheri and Thuli Bheri. Surveys in the eastern part of Surkhet District along the Bheri River were conducted from 02 January to 28 February 2023. Further surveys were conducted in Bheri Municipality, and Barekot Rural Municipality of Jajarkot District, and Aathbiskot Municipality of West Rukum District from 29 March to 23 April 2024. The researchers walked along walking trails in the riverine broad-leaved forest area following the river axis and also conducted unstructured interviews with the local people about the possible occurrence of Assamese macaques in the area. The survey was conducted between the elevation of 650 masl in Surkhet to 2816 masl in Barekot Rural Municipality of Jajarkot District. Whenever a troop of monkeys was observed, a detailed observation was done with the help of binoculars (Celestron Nature DX 10×42) to confirm the

species and GPS point of occurrence was recorded with handheld GPS (Garmin GPSMAP 62S). Photographs of the macaque individuals were captured using a Nikon DSLR 7200 camera (18–300 mm lens) and Nikon Coolpix p1000 (24–3000 mm lens). A detailed population survey was done for every observed troop and the individuals were categorized into the age-sex categories following Chalise (2013).

2.3 | Data analysis

The average troop size of the observed Assamese macaque troops was calculated as-

$$\text{Average troop size} = \frac{\text{Total number of individuals observed}}{\text{Total number of troops observed}}$$

Relative tail length is one of the major morphological characteristics used extensively in describing the morphological variations in Assamese macaques. As handling the animals was not permitted and is also technically not feasible in the wild population, relative tail lengths were estimated using the photographs taken in the field. A total of 15 images of adult Assamese macaque individuals from the Bheri River Basin were used to calculate the average relative tail length. Tail length and head-body length (Fig. 2) were estimated using imageJ2 software (Rueden et al. 2017). Tail length was measured from the root of the tail to its tip excluding the tip hairs. The head-body length was measured from the frontal bone of the head to the root of the tail along the dorsal line. Relative tail length was calculated as the ratio of the tail length to the head and body length.



Figure 2. Schematic representation of head-body length and tail length measurement in an adult male Assamese macaque using ImageJ2 software.

3 | Results

A total of 117 individuals of Assamese macaques were observed from six different troops in the Bheri River Basin (Table 1) accounting for an average troop size of 19.5 individuals (Table 1). Out of the six troops, four troops were recorded from the Gurbhakot Municipality of Surkhet District. The Assamese macaque habitats in Gurbhakot Municipality ranged between 1137 m and 1591 m asl constituting the major plants such as the Indian butter tree (*Diploknema butyracea*), Indian laurel (*Terminalia elliptica*), Indian wild persimmon (*Diospyros malabarica*), katus (*Castanopsis* sp.), bhimal (*Grewia optiva*), etc. A troop was recorded from Bheri Municipality Ward No. 1 of Jajarkot District on the bank of Bheri River containing subtropical

vegetation such as sal (*Shorea robusta*), cedar (*Toona ciliata*), malu creeper (*Bauhinia vahlii*), dhairo (*Woodfordia fruticosa*), etc. The next troop was observed from the Aathbiskot Municipality, Ward No. 8 of West Rukum District (1840 m asl). The habitat of the troop comprised a rocky cliff area on the side of a small stream containing plants such as wild Himalayan pear (*Pyrus pashia*), dhairo (*Woodfordia fruticosa*), etc.

The visual inspection revealed that the Assamese macaques in the Bheri River Basin have darker pelage than those in eastern and central Nepal (Figs. 3A–F). The average relative tail length of Assamese macaques in the Bheri River Basin was 0.634, higher than that of eastern Nepal.



Figure 3. Assamese macaques photographed from the Bheri River Basin. A- A group of Assamese macaques from Gurbhakot Municipality of Surkhet District; B- An adult male crossing the stream through a fallen tree in Surkhet; C- An adult male from Aathbiskot Municipality, West Rukum; D- A pair of adult Assamese macaques from Rukum; E- A group of Assamese macaques from Bheri Municipality, Jajarkot; and F- An adult male from Jajarkot (Photos by: Bijay Chand and Gobinda Bahadur Singh).

4 | Discussion

This study recorded the occurrence of Assamese macaques in the Bheri River Basin of western Nepal. All the observed six troops of the macaques were from outside the protected area network of the country. They are inhabiting fragmented and degraded forests. Additionally, the average troop size (19.5) is lower than the national average for the species for a decade-old data of Chalise (2013) (21.55). A smaller average group size could indicate conservation challenges for the species in light of human-macaque conflicts and habitat deterioration. Small and isolated populations pose a threat to the conservation of the species (Dyke & Lamb 2020). Therefore, it requires conservation interventions.

Assamese macaques are considered to have a disjunct distribution in Nepal (Chalise 2013). This consideration, which might not be true, is caused by a lack of comprehensive surveys covering the entire potential distribution range of the species. Previously, they were considered to have distribution only east of central Nepal (Wada 2005; Chalise 2013; Boonratana et al. 2020). However, recent studies (Khanal et al. 2018; Khanal et al. 2019; Khanal et al. 2023) reported them from far-western Nepal including Achham, Baitadi, Bajhang and Darchula districts. However, Khanal et al. (2023) also did not survey the Bheri River Basin leaving a gap in the distribution of Assamese macaques between the Gandaki River Basin and Karnali River Basin. The findings of this study help to speculate that they have a continuous distribution from east to west of Nepal in most of the river basins. Therefore, a detailed exploration is essential to understand the distribution pattern of Assamese macaques.

Assamese macaques show a great level of morphological variations across the latitudinal and altitudinal gradients (Choudhury 2022). Additionally, such variations are seen between the populations from eastern and western Nepal (Chalise 2013). The western population of the species have a darker pelage colour than the eastern ones. Sometimes, variations in pelage colour are noticeable among individuals of the same group based on their age and sex (Choudhury 2022). Another morphological difference seen in Assamese macaques is the higher tail length in the western population than in the eastern population. The average relative tail length of Assamese macaques from the Bheri River Basin (0.634) was higher than that of the average relative tail length of macaques from eastern and central Nepal, i.e., 0.55–0.58 (Chalise 2003). Chalise (2013) hypothesized two distinct taxonomic units/species of Assamese macaques from Nepal based on these morphological variations. Therefore, a detailed taxonomic assessment of the Assamese macaque population from entire Nepal employing morphological, genetic and ecological data is essential.

Assamese macaques are habitat specialists requiring broad-leaved riverine forests (Khanal et al. 2019) and ongoing anthropogenic climate change could have significant effects on the future survival and distribution of the population (Khanal et al. 2023). The majority of the suitable habitat and population currently lie in degraded forests outside protected areas of Nepal. The incidents of human-macaque conflict, especially driven by crop raiding are high. Habitat loss and alteration and retaliatory killings continue to threaten this small population of Assamese macaques in Nepal, emphasizing the need for immediate conservation interventions.

5 | Conclusions

This study confirms the presence of Assamese macaques from the Bheri River Basin in the Karnali Province of Nepal. It provides strong evidence that the species has a continuous distribution from east to west of Nepal, unlike the previously speculated disjunct distribution. Therefore, a detailed distribution survey and reassessment of their conservation status is warranted. Because Assamese macaques in Nepal primarily inhabit fragmented forests outside the protected areas system of the country, immediate conservation and management interventions are essential.

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Authors' contributions

L.K. conceptualized the study, performed field work, analyzed data and prepared the manuscript. G.B.S., A.S., B.C., B.T. and M.K.C. performed fieldwork and revised the manuscript. All authors finalized the manuscript for submission.

Conflicts of interest

The authors declare no conflict of interest.

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