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Camera Trap Evidence of Polymorphic Golden Asiatic Cat (*Catopuma temminckii*) in Trashigang Forest Division, Eastern Bhutan

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Abstract

The Asiatic golden cat, *Catopuma temminckii,* is a medium-sized felinae distributed throughout South Asia. It is currently categorized as Near Threatened on the IUCN Red List and listed in Appendix I by CITES and Schedule I of the Forest and Nature Conservation Act of Bhutan, 1995. The six colour morphs of Asiatic golden cats have been recognized from their geographic range. The present study (2014-2015) was conducted as a part of the third nationwide tiger survey and wildlife monitoring assessments (2017-2021) in the Trashigang Forest Division. We used camera traps as a tool for the survey. The camera trap photographs confirmed the occurrence of five morphs of Asiatic golden cat from the present locality. All five morphs were photographed at altitudes ranging from 2200-3800 m. The results highlight the importance of conserving eastern Himalayan landscapes to ensure the safe refuse to globally threatened felids, including Asiatic golden cat.

Keywords: Asiatic golden cat, camera trap, polymorphs, threatened

Introduction

Asiatic Golden Cat, *Captopuma temminckii* Vigors and Horsfield, 1827, is a medium sized elusive and the largest group of smaller oriental felines (Bashir *et al.*, 2011; *Gouda et al.,* 2016; Ghose *et al.*, 2019). Golden Cat has been categorized as Near Threatened on the IUCN Red List of Threatened Species (Dhendup, 2016; Wangyel *et al.*, 2020) and is listed in Appendix I of CITES (McCarthy *et al.*, 2015; Chatterjee *et al.*, 2018) and Schedule I of the Forest and Nature Conservation Act of Bhutan, 1995 (FNCA, 1995). The species is more widely distributed in the Himalayas (Tenzin and Dorji, 2021), native to the North-eastern forest of the Indian subcontinent (Bhutan, Bangladesh, Nepal, Northeast India) through southern China to across Southeast Asia (Myanmar, Thailand, peninsular Malaysia, Sumatra, Lao PDR, Vietnam, Cambodia, Indonesia) (Bashir *et al.*, 2011; Jigme 2011; Vernes *et al.,* 2015; Wangyel *et al.,* 2020). In Bhutan, It inhabits tropical broadleaved forests from an elevation of 80 m to montane forests at 4282 m in

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the north (Dhendup *et al*., 2016).

Asiatic golden cat is the most polymorphic felid species (Poor *et al.,* 2017) and exhibits at least six distinctive colour morphs (Nijhawan *et al.,* 2019). The most common colour morphs include golden or red-brown, less frequently in dark brown (Jutzeler *et al.,* 2010), grey, and rare melanistic form (Ghimirey and Pal 2009; McCarthy *et al.,* 2015; Nijhawan *et al.,* 2019). The spotted morph was previously known only from China (Smith and Xie, 2008) and Bhutan (Wang 2007; Wang and Macdonald, 2009). Until the recent discovery of two new additional morphs (Tenzin and Dorji, 2021), only four different colour morphs were reported from Bhutan (Jigme, 2011; Vernes *et al.,* 2015; Dhendup, 2016). Most of these reports of this elusive cat in Bhutan come exclusively from protected areas (PA) networks, and little is known about its distribution outside protected areas. Therefore, the results of this study contribute important new information about the presence of Asiatic golden cat in the landscape outside PAs in eastern Bhutan and the co-occurrence of its five distinctive morphs in a single locality with a relatively narrow altitudinal band. Here, we report the five distinctive morphs of Asiatic golden cat and their spatial distribution in Trashigang Forest Division.

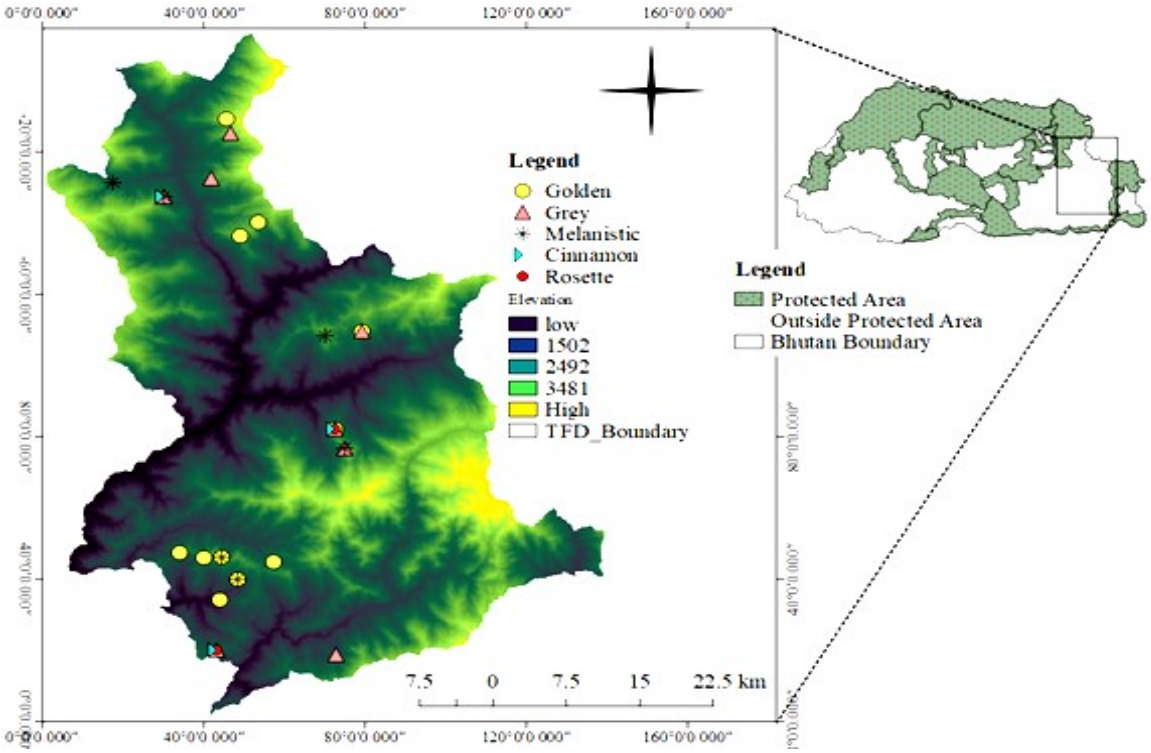

Figure 1: Study area in TFD showing locations where a different form of Asiatic golden cats was recorded between in third NTS (2014-2015) and wildlife monitoring (2017-2021)

Materials and Method

Study area

Trashigang Forest Division (TFD), which was established in 1997, is located between (27° 22' to 27°29' latitude and 91°22' to 92°07' longitude) and extends its jurisdiction over two districts Trashigang and Trashiyangtse (Figure 1). Straddled between the international border to Arunachal Pradesh (Indian state) in the east, TFD is strategically corridor connecting to larger landscape of many other PAs and Forest Division (FD) in eastern Bhutan. It is an outside protected area (PA) network system with

wide altitude variation ranging from 480 to above 4400 m (Koirala, 2021). The 2,447.40 km^2 landscape area is composed of a mosaic habitat types dominated by Subtropical forest, Warm and Cool Broadleaved Forests (CBL), Mixed Conifer Forest (MCF), Pine forest, Mixed Pine-Cool Broadleaved Forest, Chirpine Forest, Alpine shrubs and Meadows at higher altitude region, and a few plantations (FRMD, 2017). TFD has characteristics of varying altitude, aspects, and forest types with sub-tropical to temperate climate (Norbu et al., 2021) and annual precipitation yield to a maximum level of 2,000 mm (Koirala *et al.,* 2021). The forest (approximately 75%) rich landscape supports the repository of many flora and fauna elements, including apex predator tiger (Thinley *et al*., 2020; Norbu *et al.* 2019), Dhole (Thinley *et al.,* 2021) and a variety of other felid species.

Field sampling

We used images obtained from 87 non-invasive camera traps deployed for the third NTS (2014-2015) and wildlife monitoring assessment (2017-2021) in TFD. Three camera-trap models HCO-ScoutGuard™, U-Way™, and CuddeBack™ were deployed along the forest road, trails, ridge-lines, and water holes to increase the probability of recording tiger and wildlife species. In the case of the third NTS, camera traps were activated inside identified survey grids, each measuring 5 x 5 km (DoFPS, 2015) limited to altitudinal ranges between 1500 m to 3800 m. In each station, a pair or single non-baited camera traps were attached to the tree's base, approximately 40-50 cm above the ground. All camera traps were set to function through the 24-hours cycle, allowing the device to capture images within an interval of five-second time lapses between consecutive images. Geo-coordinates and altitude of camera stations were recorded using a GPS Garmin e-Trex® 30 device set to WGS 84 datum. We defined a hypothetically independent event as an interval of at least 30 minutes between consecutive photographs of the same individual Asiatic golden cat at the exact camera trap location. We computed the overall photographic capture rate index using the formula used by Koju *et al.* (2020), i.e., Photographic Capture Rate Index (PCRI) = ((No. of photographs×100)/Total number of traps per day).

Results and Discussion

Sampling effort and sampling success rate

A sampling effort of 7,830 trap days across 87 chosen camera trap locations was achieved, resulting in 39,994 photographs. Among these, 29.29% (n = 10,517) were wild animals, 14.49% (n = 5,797) were domestic animals and human, and 59.20% (n = 23,680) were either blank or unknown images. Of the 10,517 wild animal images, 1.16% (n = 122) pictures were identified as Asiatic golden cat with 61 independent events (PCRI 0.78) obtained from 32 camera stations deployed at varying degrees of elevations and habitat types. Our findings revealed the first photographic evidence of polymorphic Asiatic golden cat in TFD and its occurrence outside PA networks from eastern Bhutan.

Polymorphs

In the present survey, we recorded five distinctive morphs of Asiatic golden cat (Figure 2, image a, b, c, d & e). The different colour morphs captured in this study were golden, grey, cinnamom, melanistic, and uniquely patterned darker forms with tightly spaced rosettes known as rosetted. The relative photographic capture frequency analysis is shown in (Table 1). The most commonly detected morph was the default golden form (44.3%, n = 27) followed by grey (26.2%, n = 16), the melanistic (18%, n = 11) and cinnamom (6.6%, n = 4), whereas, the rosetted morph contributed only 4.9% (n = 3) of the total detection. Our results suggest that default golden (fox-red coloration) is the most commonly found morph in the locality, and the occurrence of cinnamom and rosetted morphs is relatively rare. These results concur with the findings of Nijhawan *et al.* (2019), where

Figure 2: Representative Image of (a) golden, (b) grey, (c) cinnamon, (d) rosette, and (e) melanistic colour morphs of Asiatic golden cat recorded in Trashigang Forest Division (Photo credit: Trashigang Forest Division)

golden morph was found to be the most common coloration amongst all six morphs recorded from Dibang Valley, Arunachal Pradesh, India.

Earlier authors reported the occurrence of four morphs in Bhutan, including melanistic, spotted, and buff-brown, which is also known as grey morph (Wang, 2007; Jigme, 2011; McCarthy *et al.,* 2015; Dhendup, 2016). Surprisingly, Tenzin and Dorji (2021) published a report in Kuensel (National newspaper) on discovery of two additional new colour morphs viz., cinnamom and the patterned rosette forms for the first time in Bhutan. This succeeds to six-colour morphs in the country ever reported after Dibang valley of Arunachal Pradesh, India (Nijhawan *et al.,* 2019).

We did not find spotted, or ocelot morph in the present study, although it was previously reported in Bhutan by Wang (2007) from Jigme Singye Wangchuck National Park (JSWNP). The possible reasons for not detecting the ocelot morph could be either its rarity or nonexistence in the locality. However, we confirmed that at least five of the six morphs were recorded so far from the present location. Of these, two morphs, viz., cinnamom and rosette, are reported for the first time in Bhutan from TFD after Tenzin and Dorji (2021), who reported these morphs as few records for Bhutan from JSWNP. Most importantly, TFD is now known to host the most diverse range of colour morphs of the species ever reported from a single locality in eastern Bhutan. The occurrence of various color morphs of Asiatic golden cat in the eastern Himalayas, particularly in eastern Bhutan and Arunachal Pradesh (India) could be due to the species sharing similar bio-geographic elements and ecological conditions of diverse habitats in same latitudinal range of eastern Himalayan biodiversity hotspot.

Altitudinal distribution

In Bhutan, the Asiatic golden cat has been recorded from the southern foothills of Royal Manas National Park (RMNP) at elevations of 80 m asl (Tempa *et al.,* 2011; 2013) to montane forests of Wangchuck Centennial National Park (WCNP) at an elevation of 4282 m asl (Dendup *et al.,* 2016). However, it has been found that the species mainly inhabits mid-elevational zone, particularly between 1800 m to 3900 m (Wang, 2007; Jigme, 2011; Thinley *et al.,* 2015; Vernes *et al.,* 2015), in few occasions occurring above 4000 m (Jigme, 2011; Dhendup *et al.,* 2016). The species was recorded at an elevation of 2517 m in Nepal (Yadav and Pal, 2009), and in China, Smith and Xie (2008) photographed the species at 3170 m. A survey in Sikkim, India (Bashir *et al.,* 2011) provided the first photographic evidence of the occurrence of the Asiatic golden cat, all comprising the melanistic colour morph exclusively, with 25 pho-tographic records in altitudinal boundaries ranging from 1980 m to 3960 m. On the contrary, we found multiple morphs at virtually the same altitudinal band showing for the first time that all five colour morphs of this species co-exist at the one locality perhaps due to their adaptability and secure several ecological benefits.

Although our camera traps covered altitudes ranging from 1500 m to 3800 m, we did not observe the species below 2200 m. Our photographs, comprising all morphs, were obtained at altitudes ranging between 2200 m to 3800 m. The grey and spotted morphs were observed only above 3600 m (Jigme, 2011); however, we photographed these morphs in altitudinal boundaries between 2300 m to 3300 m. Our findings deviate from observations of Jigme (2011), nevertheless, closely concur with earlier studies carried out in neighboring countries (Smith and Xie, 2008; Yadav and Pal, 2009; Bashir *et al.,* 2011) and in Bhutan (Vernes *et al.,* 2015). Although some authors (e.g., Jigme, 2011; Sangay *et al.,* 2014) hypothesized that the possible selection for specific morphs at different al-titudes, presumably as a response to changing vegetation cover with altitude, we did not observe any of the morphs restricted to specific range profile in the occupied site, thus no distinct distribution pattern concerning elevation gradients or vegetation covers was recognized.

The golden morph was reported to be the most widely distributed form (Jigme, 2011; Dhendup, 2016; Nijhawan *et al.,* 2019). A similar observation was also made from the northeast state (West Bengal, Assam, Mizoram, Nagaland, and Tripura) of India (Gouda *et al.,* 2016; Chatterjee *et al.,* 2018) and Nepal (Ghimirey and Pal, 2009). Our findings also corroborate with these observations as the golden morph was photographed from relatively wider elevation boundaries than the other co-occurring morphs.

Table 1: Camera trap images of Asiatic golden cat in TFD, Eastern Bhutan

Elevation (m)	Morph colour	Independent event (n)	PCRI (%)	Number of camera stations	Site characteristics
2200-3800	Golden	27	44.30%	13	CBL & pine forest to mixed conifer forest, bamboo and rhododendron, grassland & shrubs.
2300-3300	Grey	16	26.20%	8	
2300-2700	Cinnamon	4	6.60%	3	
2300-2700	Rosette	3	4.90%	2	Presence of human disturbances level from low to intense. Site quality differ from site to site (degraded to pristine)
2200-3000	Melanistic	11	18%	7	

Conclusion

Historically, due to the rugged terrains, cold climatic conditions, and largely inaccessible landscape, the biological diversity of Eastern Himalaya remained largely unexplored. However, a tremendous effort has been made in recent decades, and frequent discovery of new colour spectrum in this species from the eastern Himalayas demonstrates a severe need for further exploration in the region.

Co-existence of at least five morphs of Asiatic golden cats occupying same geographic location, sharing similar ecological niches with overlapping altitudinal boundaries is evident from the present findings. However, the geospatial distribution and occurrence of polymorphism in Asiatic golden cat warrant further scientific exploration, perhaps for evolutionary adaption. The findings from this and other recent stu-dies suggest that the montane forest of Bhutan and neighboring regions may play a significant role in terms of conservation of wild cat species including Asiatic golden cat.

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