

Camera-trap records of small carnivores from Gedu Territorial Forest Division, Bhutan

Tashi DHENDUP^{1, 2*} and Rinzin DORJI³<http://www.smallcarnivoreconservation.org>

ISSN 1019-5041

¹. Ugyen Wangchuck Institute for Conservation and Environmental Research, Lamai Goempa, Bumthang Bhutan 32001.

². Wildlife Biology Program, University of Montana, US. 59812.

³. Senior Forestry Officer, Gedu Territorial Forest Division, Department of Forest and Park Services, Chukha Bhutan

Correspondence:

Tashi Dhendup
tashid@uwice.gov.bt

Associate editor:

Daniel Willcox

Abstract.

During Bhutan's nationwide Tiger *Panthera tigris* survey in 2014, a camera-trapping survey in Gedu Territorial Forest Division in western Bhutan recorded five species of small carnivore: Red Panda *Ailurus fulgens*, Yellow-throated Marten *Martes flavigula*, Siberian Weasel *Mustela sibirica*, Masked Palm Civet *Paguma larvata* and Spotted Linsang *Prionodon pardicolor*. It is likely that a few additional small carnivore species could be occurring in the division; further targeted surveys are warranted, as well as a thorough review of other camera-trap data from the Tiger focused surveys in 2014.

Keywords: Red Panda, Yellow-throated Marten, Spotted Linsang, Masked Palm Civet, Siberian Weasel.

Introduction

Bhutan is located in the Eastern Himalayas at the junction of two biogeographic realms, the Indomalayan and the Palaearctic. Bhutan features in numerous conservation priority exercises (Tempa *et al.* 2013) including as a biodiversity 'hotspot' (Myers *et al.* 2000) and as part of the Kachenjunga Conservation Landscape (Shakya & Joshi 2008). Currently, 71% of the country is forested (DoFPS 2017) and these forests are home to approximately 200 species of mammals (NEC 2011). Approximately 50% of Bhutan is covered by protected areas (WCD 2016); the remaining areas fall under the jurisdiction of territorial forest divisions.

Despite having a relatively large area of contiguous forest cover, the territorial forest divisions in Bhutan have received less attention and funding regarding biodiversity surveys and conservation compared to protected areas. There have been few surveys carried out in the territorial forests and there are hardly any published studies on these areas' flora and fauna. However, a nationwide Tiger *Panthera tigris* survey in 2014 revealed that the territorial forest divisions are very important areas for Tigers and other carnivores.

Small carnivore conservation is underfunded, and therefore they have remained one of the least studied groups of mammals in Bhutan. Red Panda has received relatively better attention in recent years due to its charismatic nature and its Endangered status on The

IUCN Red List of Threatened Species (*e.g.*, Dorji *et al.* 2011a, 2011b). Extensive camera-trapping activities studying larger charismatic mammals can produce considerable information on small carnivores and other ground-dwelling mammals as by-catch images (*e.g.*, Zaw *et al.* 2008, Sangay *et al.* 2014, Scotson *et al.* 2017, Dhendup & Dorji, 2018). However, such information in Bhutan has not yet been compiled and published in any form and should be a priority for small carnivore conservation in the country.

This manuscript documents information on small carnivores in Gedu Territorial Forest Division from a nationwide Tiger survey conducted in 2014. This contribution will serve as a baseline data of small carnivores for the division and as a reference for future research on these species.

Materials and methods

Study area

Gedu Territorial Forest Division (Figure 1) covers the entire district of Chukha in western Bhutan and is a part of the Kanchenjunga transboundary landscape. With a total area of 1,991 km², the elevation ranges from 150 to 4,450 m asl. Cool, moist sub-tropical forest and temperate forest dominate the entire landscape with few alpine scrubs in the high hills. The division is drained by Wangchhu River which flows down south into India. The first road and the first hydroelectric power plant in Bhutan were constructed in this division.

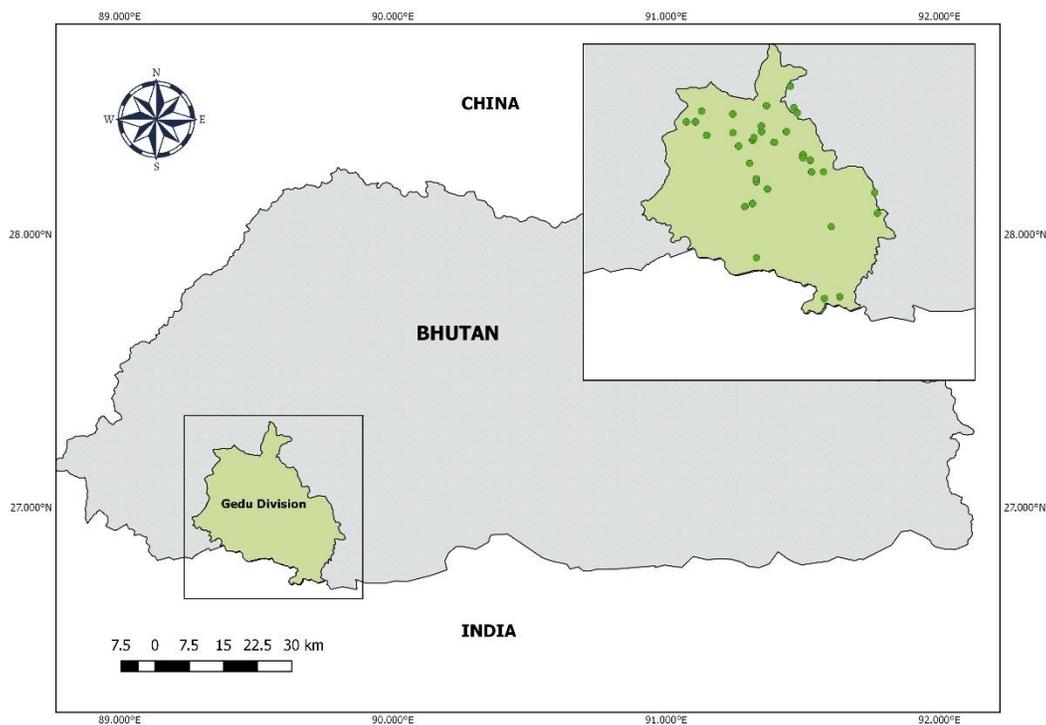


Figure 1. Map of Gedu Territorial Forest Division showing camera-trap locations.

Camera-trapping

For the nationwide Tiger survey (DoFPS 2015), the entire country was divided into 5×5 km grid cells, and on each of the cells, potential sites to maximize the capture probabilities of Tiger were located through sign surveys and public consultations. Sites with Tiger and/or prey evidence and the presence of animal or human trails were considered for camera-trapping. At each station, two camera-traps were set up, except in areas which were much less likely to hold Tigers, where one camera-trap was deployed; this allowed a larger area to be covered with the available number of camera-traps. The cameras were set at a height of 45–50 cm above the ground and positioned in such a way that no two cameras were in the same line of view. This was done to avoid the flashes from one camera triggering or spoiling the image quality of the other. Cameras were set to record both day and night and no baits or lures were used. Additional information about the camera-trapping sites was recorded in a data sheet and geographic locations were spatially referenced using a GPS unit. Camera-traps were monitored once every two weeks or if in remote locations, once per month. The cameras were kept in the field for approximately seven months in 2014. Out of the total 45 camera-trap stations which were set, data from 35 stations were used. The remaining ten stations fell out of the division's jurisdiction.

Data Analysis

Overall data organization, storage, and analysis followed Sanderson & Harris (2013). Camera-trap images were downloaded and archived in folders specific to each camera-trap station. The images were then automatically renamed with the date of capture using ReNamer and were archived in a “Site / Location / Species / # [number] of individuals” folder. The species were first identified by the two authors and then later validated by experts. For a series of photographs of the same species at the same station, if the visit to a station occurred after more than 60 minutes, it was considered a notionally independent event (Sanderson & Harris 2013).

Results and Discussion

The data were analysed from a total of 35 camera-trap stations from a trapping period of 206 days. In 17 camera-trap stations, five species of small carnivore belonging to four families were recorded. These comprised Red Panda *Ailurus fulgens*, Masked Palm Civet *Paguma larvata*, Spotted Linsang *Prionodon pardicolor* (Figure 2), Siberian Weasel *Mustela sibirica* and Yellow-throated Marten *Martes flavigula*. Of these five, four are listed as Least Concern, and one is listed as Endangered (Red Panda) on The IUCN Red List of Threatened Species. Except for Yellow-throated Marten for which the highest number of capture locations and notionally independent events were observed, the other four carnivores were photographed relatively rarely (Table 1).

Table 1. Capture records of small carnivores from Gedu Territorial Forest Division, Bhutan.

Species	Notionally Independent Event	No of Camera Stations recorded	Elevation (m)
Yellow-throated Marten <i>Martes flavigula</i>	34	16	2149–3595
Masked Palm Civet <i>Paguma larvata</i>	12	4	1079–3204
Red Panda <i>Ailurus fulgens</i>	2	2	2984–3309
Spotted Linsang <i>Prionodon pardicolor</i>	3	2	2150–2718
Siberian Weasel <i>Mustela sibirica</i>	1	1	2718

**Figure 2.** Camera-trap picture of a Spotted Linsang *Prionodon pardicolor* from Gedu Territorial Forest Division, Bhutan in 2014.

The Red Panda is one of the better studied small carnivores in Bhutan (Dorji *et al.* 2011a; 2011b, Dendup *et al.* 2016). The present survey recorded the species at only two camera-trap stations, each once only, at 07h31 and at 10h42. The habitat comprised oak (*Quercus* sp.) and mixed coniferous forests (*Abies* sp. and *Pinus* sp.) with bamboo (*Yushania* sp.) understorey. Yellow-throated Marten is one of the most versatile mustelids in South Asia (Appel *et al.* 2013) and is a habitat generalist; it can be found across a wide range of habitats and elevations. It was by far the most frequently and widely camera-trapped small carnivore in this survey. It was primarily diurnal in activity with no records between 22h00 and 03h00.

Masked Palm Civet was the second most widely and frequently camera-trapped small carnivore. All records came between 20h00 and 05h00 and no image showed more than one animal. The Spotted Linsang was recorded at only two stations, both in cool broad-leaved forests with sparse stands of rhododendron (*Rhododendron arboreum*) in between. The records were at 00h27, 01h10 and 04h14. The single Siberian Weasel was recorded at 09h49 in the morning.

This documentation of small carnivores is the first of its kind in a territorial forest division in Bhutan. Camera-trapping in Gedu Territorial Forest Division recorded only five species of small carnivores. However, it is likely that a few more species may occur there; the survey was targeted towards Tiger, and therefore other small carnivore species may have gone undetected. This could be due to the height of camera-trap placement (30cm or below is ideal for small carnivores, not the 40–50cm used in the Tiger survey) and also because the small carnivores may have been avoiding these areas because of the presence of Tigers.

Small carnivores are known to be threatened by hunting and retaliatory killing (Schipper *et al.* 2008). Recently, a Large Indian Civet (*Viverra zibetha*) was killed in a hamlet in eastern Bhutan for attacking chickens (The Bhutanese 2017). Some parts of Gedu Territorial Forest Division are marred with highways, logging roads, farm feeder roads, power transmission lines and industrial areas; this will lead to habitat disturbance and fragmentation. However, an assessment of the impacts this will have on the area's small carnivores is still lacking. Occasionally, small carnivores are also road-killed, and such incidences need to be reported and recorded. Assessment of the impacts of human-wildlife conflict, habitat fragmentation, and industrial development is needed for the area's small carnivores. There is also an urgent need to review the massive quantities of camera-trap records that exist for Bhutan from the 2014 national Tiger survey, 2015–2016 Snow Leopard survey and other camera-trapping surveys conducted at the local scale. This would dramatically increase knowledge of small carnivore status in Bhutan.

Acknowledgements

We thank the Department of Forest and Park Services, Bhutan and the Director for according approval to use the camera trapping data of Gedu Territorial Forest Division from the nationwide tiger survey data of 2014. We would also like to thank all the field staff of the Gedu Territorial Forest Division for the intensive fieldwork during the survey. The nationwide tiger survey was funded by the World Bank's International Development Association, WWF Bhutan, and the Bhutan Foundation. An anonymous review greatly improved the quality of this manuscript.

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