



Occurrence and activity pattern of leopard cat (*Prionailurus bengalensis*) in Bhitarkanika Wildlife Sanctuary, Odisha, India

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ABSTRACT

The leopard cat (*Prionailurus bengalensis*) is a medium-sized cat endemic to South and Southeast Asia. It is an IUCN Red list of 'Least Concern' species because of habitat loss and poaching. The presence and activity pattern of leopard cats in Bhitarkanika Wildlife Sanctuary, Odisha, India is reported through camera trap surveys from 10th July 2021 to 30th June 2022 in five blocks. From a total of 13350 camera-trapping nights at 160 sampling sites, 73 independent detections of leopard cats at 22 sites in the sanctuary were detected. Leopard cats were nocturnal, with peak activity at 03.00 AM to 06.00 AM and 07.00 PM to 09.00 PM. Present study suggests that it is the need of the hour to conserve the leopard cats in the identified potential habitats including its major prey species. Further, extensive research and monitoring are required for these cats in the protected areas of the state of Odisha.

Key words: Activity pattern, Bhitarkanika Wildlife Sanctuary, camera trapping, leopard cat

INTRODUCTION

The leopard cat (*Prionailurus bengalensis*) is a small wild cat native to continental South, Southeast and East Asia. Since 2002, it has been listed as Least Concern (LC) on the IUCN Red List as it is widely distributed although threatened by habitat loss and hunting in parts of its range (Ghimirey et al., 2022). The leopard cat has got the broadest geographic distribution among all small Asian cats. It is found in most part of the Southeast Asia. It's distribution range includes countries such as: Afghanistan, northern Pakistan, India, Korea (Nowell and Jackson 1996), Bhutan, Myanmar, Bangladesh, Laos, Cambodia, Vietnam, Thailand (Sunquist & Sunquist 2002), extant wild felids in Asia with a range extending from northern Pakistan, through most of India and China, south through Malaysia, Indonesia and Borneo (Ross et al., 2015). The leopard cat, *Prionailurus bengalensis*,

is approximately the size of a domestic cat, but with longer legs. The tail is about 40-50% of the length of head and body. The body color can be pale to reddish or grayish yellow. Individuals from the northern part are pale silver grey, whereas those from the south are yellow, ochre or brownish. The spots can form stripes on the neck and back. The underbelly and neck are white. The tail is spotted, with a few indistinct rings near the black tip (Yu and Wozencraft, 1991; Sunquist and Sunquist, 2002). Leopard cat's daily activity patterns have been documented as arrhythmic (Rabinowitz, 1990), arrhythmic with crepuscular and nocturnal peaks (Grassman 2000, 2004; Austin, 2002), and crepuscular and nocturnal (Rajaratnam, 2000; Mohd Azlan and Sharma, 2006; Schmidt et al., 2009; Oh et al., 2010). Despite most felids exhibiting crepuscular and nocturnal behaviour (Kitchener, 1991), they are capable to adapt to a wide range of light conditions (Sunquist and Sunquist, 2002).

In Odisha, leopard cats are distributed sporadically and confined to the coastal area and reportedly Similipal Tiger Reserve (Palei et al., 2016; Palei et al., 2018, 2021; Mishra and Mohan, 2022). In this paper, the occurrence, relative abundance, activity pattern and photographic evidence of leopard cats have been reported in Bhitarkanika Wildlife Sanctuary, Odisha, India.

MATERIALS AND METHODS

Study Area

The study is undertaken in the Bhitarkanika Wildlife Sanctuary (BWS; 86° 46' to 87° 03' E and 20° 30' to 20° 48' N), a mangrove forest area of Odisha, India occupying an area of 672 sq km (Fig. 1). It is established by rich alluvial deposits of the Brahmani, Baitarani and Dhamra rivers. The area receives an annual rainfall of 1680 mm, with the minimum and the maximum monthly temperatures of 15°C and 40°C, respectively. The land elevation ranges from 3.66 m to 8.23 m. The BWS has a wide network of rivers and creeks, which are mainly fed by tidal water. It is the unique habitat of mangrove forests, numeric creeks and mud flats located in Kendrapara District of Odisha. The deltaic region is a unique habitat with mangrove vegetation on

either side of the creeks and tidal mudflat. The mangrove ecosystem is one of the largest in the Indian sub-continent and the floral diversity is the second highest in world after Papua New Guinea. Bhitarkanika is home to diverse flora and fauna out of which some are endemic. It is an ideal habitat for reptiles like estuarine crocodile, water monitor lizard, king cobra and python. Important avifauna includes the kingfishers, storks, ibises, waders, and a variety of migratory ducks like bar-headed goose, brahminy duck, gadwall, pintail, etc. The major vegetation associations along the creeks consist of tree species, such as *Heritiera fomes*, *Sonneratia apetala*, *Avicennia officinalis* and *Excoecaria agallocha* (Misra et al., 2018). Apart from the leopard cat, other carnivores found in Bhitarkanika Wildlife Sanctuary are fishing cat (*Prionailurus viverrinus*), jungle cat (*Felis chaus*), jackal (*Canis aureus*), hyeana (*Hyaena hyaena*), Indian fox (*Vulpes bengalensis*), small Indian civet (*Viverricula indica*), common palm civet (*Paradoxurus hermaphroditus*) and smooth coated otter (*Lutra lutra*). Major herbivore species recorded in the study area are sambar (*Rusa unicolor*), spotted deer (*Axis axis*), wild pig (*Sus scrofa*), porcupine (*Hytrix indica*) and hanuman langur (*Semnopithecus entellus*).

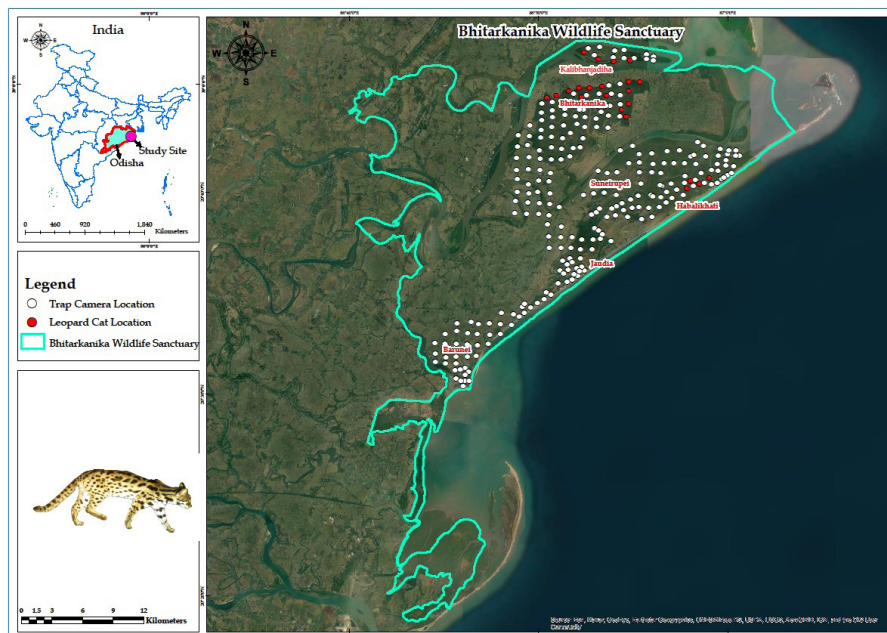


Fig. 1. Study area showing locations of camera traps and leopard cat (*Prionailurus bengalensis*) in Bhitarkanika Wildlife Sanctuary, Odisha.

Camera trap survey

Camera trap survey was carried out from 10th July 2021 to 30th January 2022 (Table 1) as a part of a broader study of mammalian diversity. The survey was conducted within the “intensive study area” (ISA) of 10 km², representing all major habitat found in the BWS (Fig. 1). Camera trap surveys were conducted in five blocks of the sanctuary from 10th July 2021 to 17th June 2022. (Table 1). Most suitable camera trap locations were selected (along animal trails, forest roads & near creeks) which are likely trap animals based on preliminary sign surveys. At each camera trap station, a pair of automated motion-triggered digital camera-traps (Cuddeback Model C1; Non-Typical, Inc., Green Bay, WI) was placed on both sides of roads, facing each other, placed around 30-40 cm above the ground without using lure or bait. In this survey, all cameras were operational 24 hours per day. Cameras were checked every week to replace the batteries and memory cards and to ensure their proper functioning. Total sampling effort was calculated as the sum of the effective days across all stations that each camera was functioning (Boitani and Powell, 2012). We considered photos separated by at least 30 minutes as independent events (Ohashi et al., 2013;

Guo et al., 2017). All camera traps were strapped to trees approximately 50 cm above ground. Camera traps were set to operate 24 h per day and programmed to delay sequential photographs by 30 s recording time. Each camera trap was checked at least once a week for battery level, positioning and to replace memory (SD) cards. Each photograph was manually checked to identify the species. Date, time and temperature were noted for each identified species.

To estimate the abundance of leopard cat, RAI (relative abundance index) was calculated based on following formula (O’Brien et al., 2003; Palei et al., 2016):

$$\text{RAI} = (\text{Number of independent picture events} / \text{Total sampling effort}) \times 100$$

The authors used independent detections to evaluate the temporal activity pattern of the leopard cat and calculated the proportion of time active on day and night to describe the temporal activity pattern of leopard cat as per the methodology undertaken by Karanth et al. (2017). Under the study, the authors used the ‘radar plot’ in window excel, which fits a circular distribution to the 24-h cycle time.

Table 1. Survey efforts and detection of leopard cat with the number of trap-nights in Bhitarkanika Wildlife Sanctuary

Blocks	Sampling Period	No. of Camera stations	Trap nights (effort)	Leopard cat photo captured
Barunei	10th July 21 to 17th June 22	30 (Five phases)	2250	No photo captured
Suneirupei	16th Oct 21 to 17th June 22	30 (Five phases)	2250	No photo captured
Jaudia	2th May 22 to 17th June 22	20	750	No photo captured
Habalikhati	16th Oct 21 to 1 Dec 21	10	450	15
Bhitarkanika	7th Jan 2022 to 10th Apr 22	40 (Two phases)	3600	46
Kalibhanjadiha	14th Feb 22 to 30th June 22	30 (Three phases)	4050	12
Total		160	13350	73

RESULTS AND DISCUSSION

The data from the installation of camera traps in the survey area from 10th July 2021 to 30th June 2022, covering 160 locations with an area of 672 sq km in Bhitarkanika Wildlife Sanctuary (BWLS), a total effort of 13350 trap nights from 160 camera trap locations with five blocks were interpreted

(Table 1). A total of 73 photos of leopard cats were recorded in different blocks of BWLS (Table 1). The highest leopard cats were recorded in Bhitarkanika block n=46, 63%, followed by Habalikhati block n=16, 08%, Kalibhanjadiha block n=12, 22% (Fig. 3, 4 & 5). There were no records of presence of leopard cats from Barunei Block, Suneirupei block and Jaudia block of Bhitarkanika Wildlife

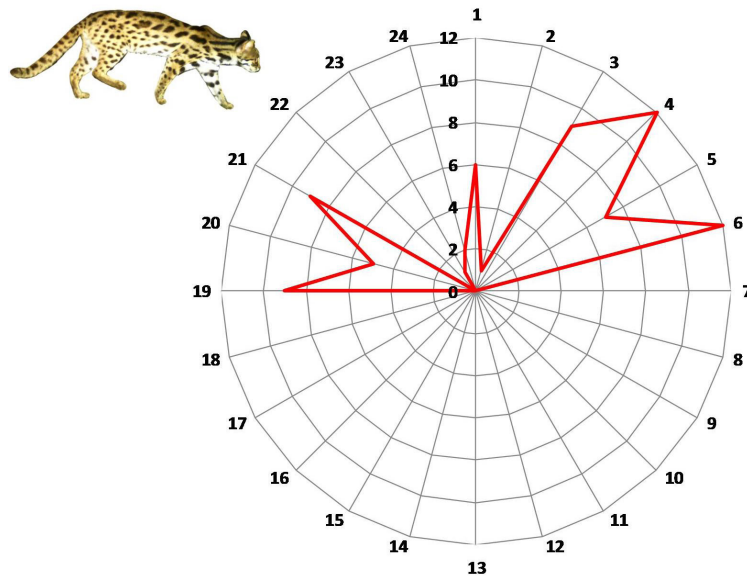


Fig. 2. Daily activity pattern of leopard cat (*Prionailurus bengalensis*) in Bhitarkanika Wildlife Sanctuary, Odisha. Circular plot is divided in 24 intervals of 1 h, and filled diamond points represent the number of independent detections of leopard cat in each interval.

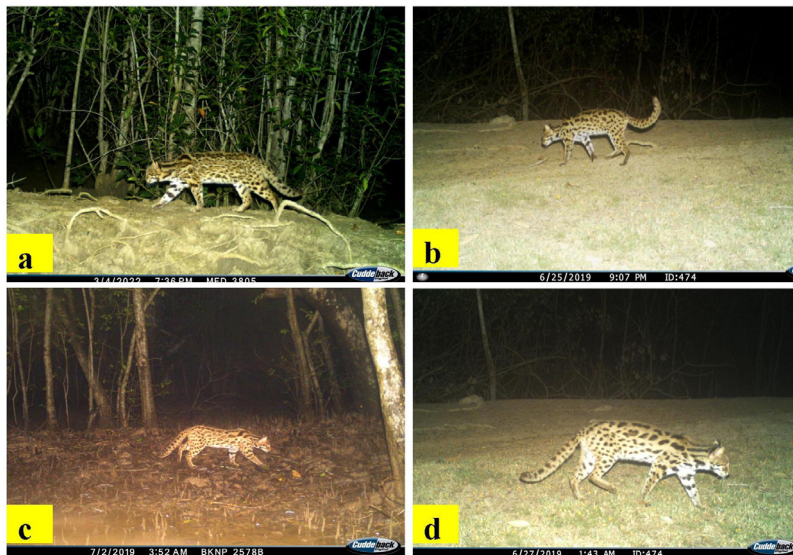


Fig. 3. Leopard cat (*Prionailurus bengalensis*) in Kalibhanjadiha, Bhitarkanika Wildlife Sanctuary, Odisha. (Photo: Odisha Forest Department)

Sanctuary. The RAI of Leopard cat was equal to 0.54 events per 100 camera trap days. Leopard cats were mostly nocturnal, with the maximum photo captured during the night hours (58 independent detections, 89.39% more actively between 08:00-10:00 PM (62.0% of the independent movement) with a peak around 04.00 AM to 6.00 AM (Fig. 2). Leopard cats showed bimodal peaks in their activity; the first peak was observed from late evening to midnight and the next in the late night with 3.00 AM to 6.00 AM (Fig. 3). Though leopard cats were active throughout the night, they exhibited reduced activity during the daytime (Fig. 2).

This is the first comprehensive study on occurrence and activity pattern of leopard cat in Bhitarkanika Wildlife Sanctuary. From the present study, it can be inferred that leopard cats are distributed in Bhitarkanika block, Habalikhathi block and Kalibhajadiha block of Bhitarkanika Wildlife Sanctuary (Fig. 1). The other areas like Jaudia, Suneirupei and Barunei are highly vulnerable to various anthropogenic activities such as agriculture, intensive fishing and aquaculture practices. Leopard cats can be flexible in their activity patterns; in areas with higher human disturbance, they are more active at nighttime,

whereas in National Parks or Wildlife Sanctuaries, their activities are more evenly throughout the day (Chen et al., 2016).

Conservation of small cat (Leopard cat, fishing cat and jungle cat) is a major focus in Bhitarkanika Wildlife Sanctuary, Odisha. The current study establishes baseline information on leopard cats in the above sanctuary. Similar studies have shown a low abundance, suggesting that good tree cover and small prey greatly influences the presence of the leopard cat in tropical regions (Bashir et al., 2013). In the present study area, a diverse assemblage sympatric species, such as leopard cat, jungle cat, and fishing cat (Lyngdoh et al., 2011; Gopi et al., 2012) have been reported to occur. Such habitats, thus, need to be protected from conservation point of view. Therefore, further detailed study needs to be undertaken to focus on leopard cats in the Bhitarkanika Sanctuary and other vulnerable coastal parts of Odisha to have better understanding of the ecology of the species. The present study can be useful for preparing future management plan and conservation strategies of leopard cats in Bhitarkanika Wildlife Sanctuary, Odisha, India.

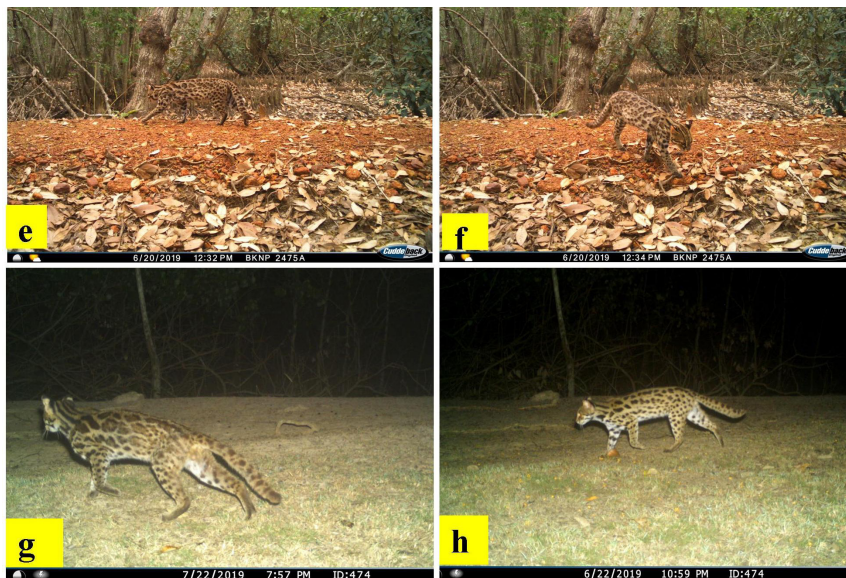


Fig. 4. Leopard cat (*Prionailurus bengalensis*) in Bhitarkanika block, Bhitarkanika Wildlife Sanctuary, Odisha. (Photo: Odisha Forest Department)



Fig. 5. Leopard cat (*Prionailurus bengalensis*) in Habalikhati, Bhitarkanika Wildlife Sanctuary, Odisha. (Photo: Odisha Forest Department)

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REFERENCES

- Austin, S.C. 2002. *Ecology of Sympatric Carnivores in Khao Yai National Park, Thailand*. Ph.D. Thesis, Texas A&M University-Kingsville and Texas A & M University, College Station, p. 126.
- Bashir, T., Bhattacharya, T., Poudiyal, K., Saythya kumar, S. and Qureshi, Q. 2013. Estimating leopard cat using photographic capture and recaptures. *Wildlife Biol.* **19**: 462-471.
- Boitani, L. and Powell, R.A. 2012. *Carnivore Ecology and Conservation: A Handbook of Techniques*. Oxford University Press.
- Chen, M.T., Liang, Y.J., Kuo, C.C. and Pei, K.J.C. 2016. Home ranges, movements and activity patterns of leopard cats (*Prionailurus bengalensis*) and threats to them in Taiwan. *Mammal Study* **41**(2): 77-86.
- Ghimirey Y., Petersen, W., Jahed, N., Akash, M., Lynam, A.J., Kun, S., Din, J., Nawaz, M.A., Singh, P., Dhendup, T., Marcus, C., Gray, T.N.E. and Phyo Kyaw, P. 2022. "*Prionailurus bengalensis*". *IUCN Red List of Threatened Species*. 2022: e.T18146A212958253. doi:10.2305/IUCN.
- UK.2022-1.RLTS.T18146A212958253.en. Retrieved 22 July 2022.
- Gopi, G.V., Habib, B., Selvan, K.M. and Lyngdoh, S. 2012. *Conservation of the endangered Asiatic Wild Dog Cuon alpinus in Western Arunachal Pradesh: linking ecology, ethnics and economics to foster better coexistence*. DST Project Completion Report. Dehradun: Wildlife Institute of India. TR-2012/003, pp. 137.
- Grassman, L.I. Jr. 2000. Movements and prey selection of the leopard cat (*Prionailurus bengalensis*) in a dry evergreen forest in Thailand. *Acta Theriol.* **45**: 421-426.
- Grassman, L.I. Jr. 2004. *Comparative Ecology of Sympatric Felids in Phu Khieo Wildlife Sanctuary, Thailand*. Ph. D. Thesis, Texas A&M University-Kingsville and Texas A&M University, College Station, pp. 156.
- Guo, W., Cao, G. and Quan, R.C. 2017. Population dynamics & space use of wild boar in a tropical forest, Southwest China. *Glob. Ecol. Conserv.* **11**: 115-124.
- Karanth, K.U., Srivathsa, A., Vasudev, D., Puri, M., Parameshwaran, R. and Kumar, N.S. 2017. Spatio-temporal interactions facilitate large carnivore sympatry across a resource gradient. *Proceeding of the Royal Society. B* **284**: 20161860.
- Kitchener, A. 1991. *The Natural History of the Wild Cats*. Cornell University Press, Ithaca, New York, p. 280.
- Lyngdoh, S., Selvan, K.M., Gopi, G.V. and Habib, B. 2011. First photographs of two rare cats from Pakke Tigers Reserve, Arunachal Pradesh. *Curr. Sci.* **101**: 1282-1286.
- Mishra, S.R. and Mohan, M. 2022. Distribution of leopard cats in Similipal Tiger Reserve, Mayurbhanj, Odisha. *e-planet* **20** (1): 79-82.
- Misra, R.C., Pani, D.R., Kumar, P. and Das, P. 2018. Vegetation mapping and management strategy of mangroves of Bhitarkanika wildlife sanctuary, Odisha: A remote sensing approach. *e-planet* **16** (2): 89-101.
- Mohd Azlan, J. and Sharma, D.S.K. 2006. The diversity and activity patterns of wild felids in a secondary forest in Peninsular Malaysia. *Oryx* **40**: 1-6.
- Nowell, K. and Jackson, P. 1996. *Wild Cats -status survey and conservation action plan*. IUCN/ SSC Cat Specialist Group. IUCN, Gland, Switzerland, p. 383.

- O'Brien, T.G., Kinnaird, M.F. and Wibisono, H.T. 2003. Crouching tigers, hidden prey: Sumatran tiger and prey populations in a tropical forest landscape. *Anim. Conserv.* **6**: 131-139.
- Oh, D., Moteki, S., Nakanishi, N. and Izawa, M. 2010. Effects of human activities on home range size and habitat use of the Tsushima leopard cat *Prionailurus bengalensis euphilurus* in a suburban area on the Tsushima Islands, Japan. *J. Ecol. Field Biol.* **33**: 3-13.
- Ohashi, H., Saito, M., Horie, R., Tsunoda, H., Noba, H., Ishii, H., Kuwabara, T., Hiroshige, Y., Koike, S., Hoshino, Y., Toda, H. and Koichi, K. 2013. Differences in the activity pattern of the wild boar *Sus scrofa* related to human disturbance. *Eur. J. Wildl. Res.* **59**: 167-177.
- Palei, H.S., Das, U.P. and Debata, S. 2018. The vulnerable leopard cat *Prionailurus viverrinus* in Odisha, eastern India: status and conservation implications. *Zool. Ecol.* **28** (2): 69-74.
- Palei, H.S., Palei, N.C., Rath, B.P. and Mishra, A.K. 2019. Records of the globally threatened rusty-spotted cat in Odisha, India. *Nat. Conserv. Res.* **4**(3): 112-116.
- Palei, H.S., Pradhan, T., Sahu, H.K. and Nayak, A.K. 2016. Estimating mammalian abundance using camera traps in the tropical forest of Similipal Tiger Reserve, Odisha, India. *Proc. Zool. Soc.* **69** (2): 181-188.
- Palei, N.C., Rath, B.P., Behura, S. and Palei, H.S. 2021. New elevation record of fishing cat occurrence in Odisha, eastern India. *Cat News* **72**: 16-17.
- Rabinowitz, A.R. 1990. Notes on the behavior and movements of the leopard cat, *Felis bengalensis*, in a dry tropical forest mosaic in Thailand. *Biotropica* **22**: 397-403.
- Rajaratnam, R. 2000. Ecology of the Leopard Cat (*Prionailurus bengalensis*) in Tabin Wildlife Reserve, Sabah, Malaysia. Ph. D. Thesis, Fakulti Saing Dan Teknologi University, Malaysia, pp 249.
- Ross, J., Brodie, J., Cheyne, S., Hearn, A., Izawa, M., Loken, B. and Wilting, A. 2019. *Prionailurus bengalensis*. The IUCN Red List of Threatened Species 2015: e. T18146A50661611.
- Schmidt, K., Nakanishi, N., Izawa, M., Okamura, M., Watanabe, S., Tanaka, S. and Doi, T. 2009. The reproductive tactics and activity patterns of solitary carnivores: the Iriomote cat. *J. Ethol.* **27**: 165-174.
- Sunquist, M. and Sunquist, F. 2002. *Wild Cats of the World*. University of Chicago, Chicago, pp. 452-462.
- Yu, J. and Wozencraft, W.C. 1991. *Prionailurus bengalensis*. The American Society of Mammalogist, p. 32.