Journal of Animal Diversity

Online ISSN 2676-685X

Volume 3, Issue 3 (2021)

Research Article

http://dx.doi.org/10.52547/JAD.2021.3.3.7

Do grassland burning practices affect the distribution of the Hispid hare, *Caprolagus hispidus* (Pearson, 1839)? A study at the Shuklaphanta National Park, Nepal

Bipana Maiya Sadadev[1], Thakur Silwal[1*], Bijaya Dhami[1], Nabaraj Thapa[2], Bijaya Neupane[1], Anisha Rana[3], Harsha Bahadur Singh[4]

[1]*Tribhuvan University, Institute of Forestry, Pokhara, Nepal*
[2]*Tribhuvan University, Institute of Forestry, School of Forestry and Natural Resource Management, Kathmandu, Nepal*
[3]*Faculty of Environmental Sciences, Technische Universität Dresden, 01737 Dresden, Germany*
[4]*Department of National Park and Wildlife Conservation, Kathmandu, Nepal*
[*]*Corresponding author*✉: *tsilwal@iofpc.edu.np*

Received: 4 June 2021
Accepted: 18 August 2021
Published online: 30 September 2021

Abstract

Few researches have been conducted on the hispid hare *Caprolagus hispidus*, an endangered small mammal native to the southern foothills of the Himalayas. In major protected areas of Nepal, grassland burning has been considered as one of the most important habitat management tools however its effects on grassland dependent species such as hispid hare has been less explored. Thus, this study was conducted to determine the grassland burning practices and its effect on distribution pattern of hispid hare at Shuklaphanta National Park, far-western Nepal. A total of 90 plots were laid in unburned (n= 45) and burned areas (n= 45) from November 2017 to May 2018. Two different approaches of grassland burning were observed: alternate and complete burning. Grassland burns are conducted from November to April each year, which coincides with the prime breeding season of hispid hares. A total of 89 pellet groups were observed in 22 plots out of 45 unburned plots while a total of 56 pellet groups were found in 17 plots out of 45 burned plots, both showing clumped type of distribution pattern of hispid hare in the study site. Higher number of fresh pellets was observed in the unburned plot. In contrast, higher number of old pellets was found in the burned plots. Thus, it is suggested that alternate year burning practices might have more positive effects on distribution and survival of this endangered species, rather than every year.

Key words: Alternate burning, breeding season, clumped distribution, grassland fire, strip transects

Introduction

The hispid hare (*Caprolagus hispidus*, Pearson, 1839), an endangered lagomorph (Aryal and Yadav, 2019), is found in several South Asian countries such as Nepal, Bhutan, Bangladesh, and India (Nath and Machary, 2015; Khadka et al., 2017). It is listed in Appendix I of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (CITES, 2021) and is protected by the National Park and Wildlife Conservation Act 1973 of Nepal (Jnawali et al., 2011; Tandan and Dhakal, 2013). The hispid hare is referred to as the "bristly rabbit" because of its coarse, dark brown fur on the dorsal side, arising from a mixture of black and brown hair, ventrally brown on the chest and whitish on the abdomen. In contrast, the sympatric Rufous-tailed Indian hare (*Lepus nigricollis*, F. Cuvier) has longer ears and a white underside to the tail (Bell, 1987). Two species of hare (i.e., hispid and Indian) are distinguishable by their relative size, shape, and texture of their pellets. The pellets of the hispid hare are larger, flattened, and rounded

in shape whereas those of the Indian hare are smaller, often darker, elliptical with one end pointed (Oliver, 1985). Very few published records of captures or positive sightings of the hispid hare are known to exist. For example, the hispid hare has been recorded in Chitwan, Bardia, and Shuklaphanta National Parks (Oliver, 1985; Yadav, 2006; Aryal, 2010; Khadka et al., 2017).

Habitat requirements for hispid hare consist of early successional riverine communities, typically tall grasslands (Chapman and Flux, 1990). Grasslands also support a large number of threatened species including the Swamp deer *Cervus duvaucelii* (G. Cuvier), Bengal florican *Eupodotis bengalensis* (Gmelin), and Pygmy hog *Porcula salvania* Hodgson (IUCN, 2017). Grasslands are not only important for biodiversity, but also support the livelihoods of local people (Mishra, 1982; Brown, 1997). However, grasslands are being threatened by continuous grazing, flooding, thatch collection and grassland burning (Maheswaran, 2002, Aryal et al., 2012). The study on the hispid hare in Shuklaphanta National Park (SNP) revealed some information on its behavioral ecology, home range, and potential predators (Bell, 1986; Bell, 1987; Yadav, 2006; Aryal, 2010) but lacks information on distribution and habitat ecology as a result of grassland burning because grassland burning is an important habitat management tool in protected areas such as SNP, despite the presence of an endangered species as it helps to stimulate the regrowth of grasses (Aryal et al., 2012). We conducted this study to identify the grassland burning practices and its effect on distribution pattern of hispid hares in the grasslands of SNP from November 2017 to May 2018.

Material and Methods

Study area

The SNP (latitude 28º45'-29º00'N, longitude 80º10'-81º45'E) is located in the southern part of Kanchanpur District in Far-Western Nepal, Sudur-Paschim Province (Fig. 1). It was designated as a wildlife reserve in 1976 and later upgraded to a national park in 2017 (DNPWC, 2017). SNP covers a total area of 305 km^2. It is bounded by the Syali River in the east, Mahakali River in the west, Siwalik Hills in the north and east, and the Luggabhugga Florican Reserve of India in the south (DNPWC, 2017). The SNP contains more than 665 plant species belonging to 438 genera and 118 families, the highest diversity reported for any protected area in the Terai region. The climax vegetation type has sal forest (*Shorea robusta*) as the dominant species in association with *Terminalia alata*, *Terminalia belerica*, *Lagerstromia parviflora*, and *Pterocarpus marsupium*. The park also provides prime habitat to globally threatened species such as the Asiatic elephant *Elephas maximus* Linnaeus, One-horned rhinoceros *Rhinoceros unicornis* Linnaeus, Royal Bengal tiger *Panthera tigris tigris* (Linnaeus), Sloth bear *Melursus ursinus* (Shaw), Smooth-coated otter *Lutrogale perspicillata* (I. Geoffroy Saint-Hilaire), Fishing cat *Prionailurus viverrinus* (Bennett), Rusty-spotted cat *Prionailurus rubiginosus* (I. Geoffroy Saint-Hilaire) (DNPWC, 2017; Lamichhane et al., 2020).

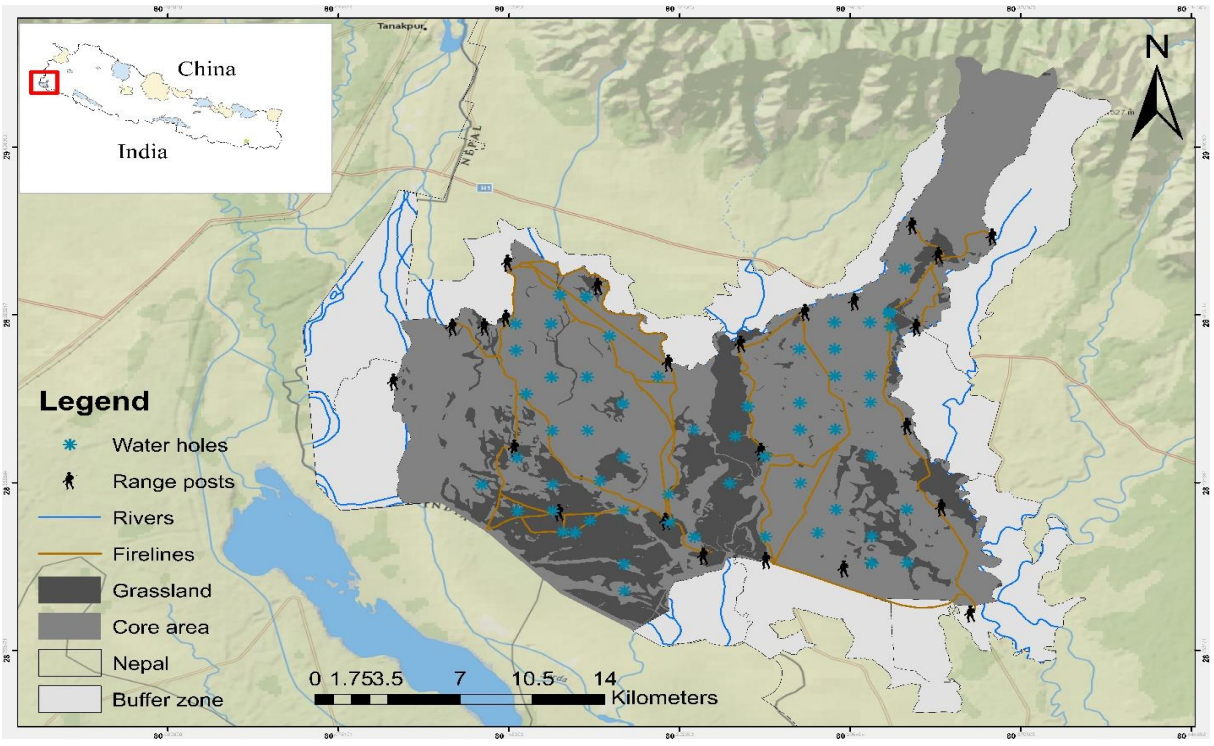

Figure 1: Map of the study area showing both buffer and core area using Arc GIS 10.8.

Data collection

A preliminary field survey (December 2017) was conducted to identify potential habitats of hispid hares at SNP. Information was obtained from park staff, National Trust for Nature Conservation (NTNC) staff and individuals in the buffer zone to assess local distribution of hispid hares and the possible influence of grassland burning practices. Published and unpublished articles were used to distinguish the hares by physical appearances and characteristics of their pellets, including relative size, shape, and texture. For the identification of pellets, we used criteria suggested by Oliver (1985) followed by Yadav (2006) and Aryal (2010). The pellets of the hispid hare are larger, flattened, and rounded in shape whereas those belonging to the Indian hare are smaller, often darker, elliptical (single-pointed end) (Fig. 2).

Field survey

A pellet count followed the field survey (Yadav, 2006) since a direct count of rabbits was not feasible due to their relative distribution on a local scale (Burnham et al., 1980; Buckland et al., 2001) and behavior. This survey was conducted from November 2017 to May 2018, only in the most likely habitats as described by Aryal (2010). The main transect line of 50 m was drawn with a strip transect of 20 m length and 2 m breadth (i.e. 40 m^2) on either side of the transect line was taken into consideration for counting pellet groups (Fig. 3).

A total of 90 plots were established in the study area. Hare signs e.g., pellets were observed in unburned (n= 45) and burned plots (n= 45), and recorded using Garmin Etrex 10 GPS.

Pellets observed in burned and unburned plots were classified as: very fresh (< 24 hours); fresh (1–10 days); and old (< 30 days) based on their condition. Very fresh pellets were greenish in color and wet, fresh pellets were light brown, and old pellets were dark brown in color (Yadav, 2006).

Data analysis

Hispid hare distribution was calculated using the ratio of variance and mean (S^2/a) of total pellet piles observed in the transects (Odum, 1971; Thapa et al., 2014)

If $S^2/a = 1$ i.e., there is a random distribution.
If $S^2/a < 1$ i.e., it has a regular distribution.
If $S^2/a > 1$ i.e., it has clump distribution.

$$\text{Where } S^2 = \text{variance} = \frac{1}{n}\sum (x-a)^2$$

x= sample value,
a= mean value.
In addition, the distribution of hispid pellets in both burned and unburned plots was portrayed with the help of Arc GIS 10.8.

Also, a chi-square test was used to measure significant differences in the distribution of hispid hare pellets between the burned and unburned plots.

Results

Pattern of grassland burning practices

Two types of grassland burning practices were observed in the SNP, i.e., alternate and complete at the different grasslands. Alternate burning was practiced in main Shuklaphanta grassland, whereas complete burning was done in other grasslands, such as Hariyaphanta, Singhpurphanta, Dhaknaghat, Simalphanta, Silalekh and near Barkhaula post. The fire line was taken as a reference while firing in the main Shuklaphanta grassland. An alternate patch of 10–20 km^2 is burned every year between November and April each year to stimulate the re-growth. This grassland management strategy is performed by SNP administration with the support of local labourers and equipment.

Distribution of hispid hare pellets with reference to fire

A total of 89 pellet groups were observed in 22 plots out of 45 unburned plots (Fig. 4). The pellet distribution was found to be clumped (S^2/a= 3). A total of 56 pellet groups were found in 17 plots out of 45 burned plots which also showed the clumped distribution (S^2/a= 1.5).

Pellet condition in reference to fire

More fresh pellets (41%) were observed in the unburned plot, followed by very fresh pellets (37%) and old pellets (23%). More old pellets (48%) were observed in the burned plot, followed by fresh pellets (38%) and very fresh pellets (14%) (Fig. 5). There was a significant difference in the pellet condition percentages between the burned and un-burned plots (χ^2= 13.42, df= 2, p< 0.001).

Discussion

Two types of burning practices were observed in SNP. Alternative fire management is practiced in the main Shuklaphanta grassland so that animals such as *Rucervus duvaucelii*, *Caprolagus hispidus*, *Axis porcinus* and grassland dependent birds can escape the regular burning season (DNPWC, 2017). This is not true for other grasslands which experience complete burning. Therefore, alternate burning, without coinciding with the breeding season of hispid hare, would be preferred over complete burning, to ensure adequate space until regrowth is available for their survival, as well as reproduction (Tandan et al., 2013). Likewise, time of burning also plays a vital role in the hispid hare population's survival. Fire in the late season burning can induce intense damages affecting the survival of species preferring heavy coverage such as hispid hare. Thus, late season burning should be avoided in areas with potential habitat conditions for the species as suggested by Takahata et al. (2010).

On both plots (burned and unburned), pellet distribution was clumped, but variation occurred in the value of variance to mean ratio. This is because hispid hare prefer tall grassland areas, rather than

short or recently burned patches (Maheswaran, 2002). Burned plots, where the study was conducted, were short or recently fired. Taller plant species increase hispid hare reproductive success by decreasing the risk of predation of their offspring and providing cover for adults (Aryal et al., 2012). The mean home range for male hare is found to be 8200 m^2 and for a female is found to be 2800 m^2 (male and female rabbits tend to live in pairs) (Bell, 1987). This shows that male and female hares perform ecological behavior such as eating, excretion, and reproduction within a small area since the pellets was found to be in groups and close to each other, showing clump type distribution.

In total, we found 89 and 56 pellet groups on unburned and burned plots respectively indicating the negative consequences of grassland burning practices for the hispid hare. In contrast to our finding, a study conducted by Tandan et al. (2013) in the seven grassland patches (900 ha.) of the Babai Valley in Bardia National Park, Nepal mentioned that hispid hare pellets were just 29 before burning while 62 after the burning season.

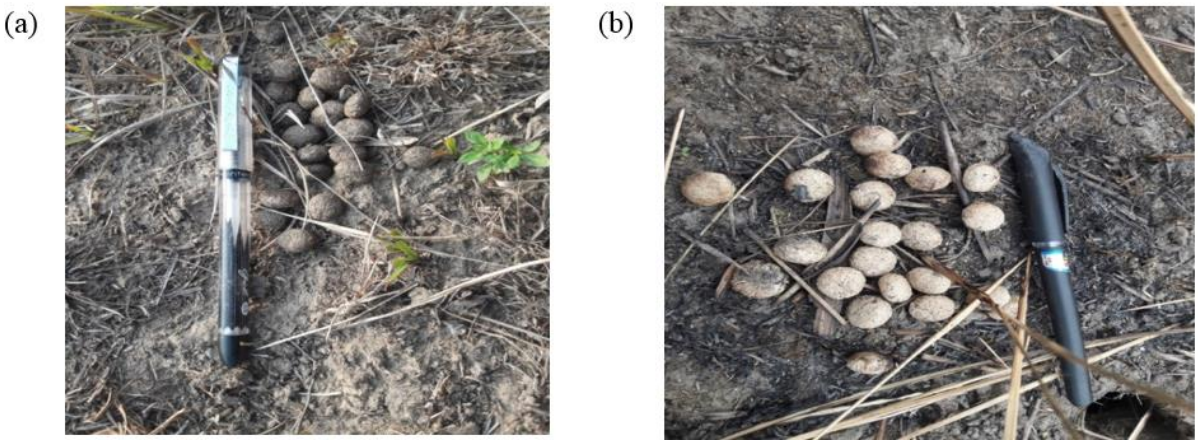

Figure 2: Pellets difference between (a) Indian hare, and (b) hispid hare. © Bipana Maiya Sadadev

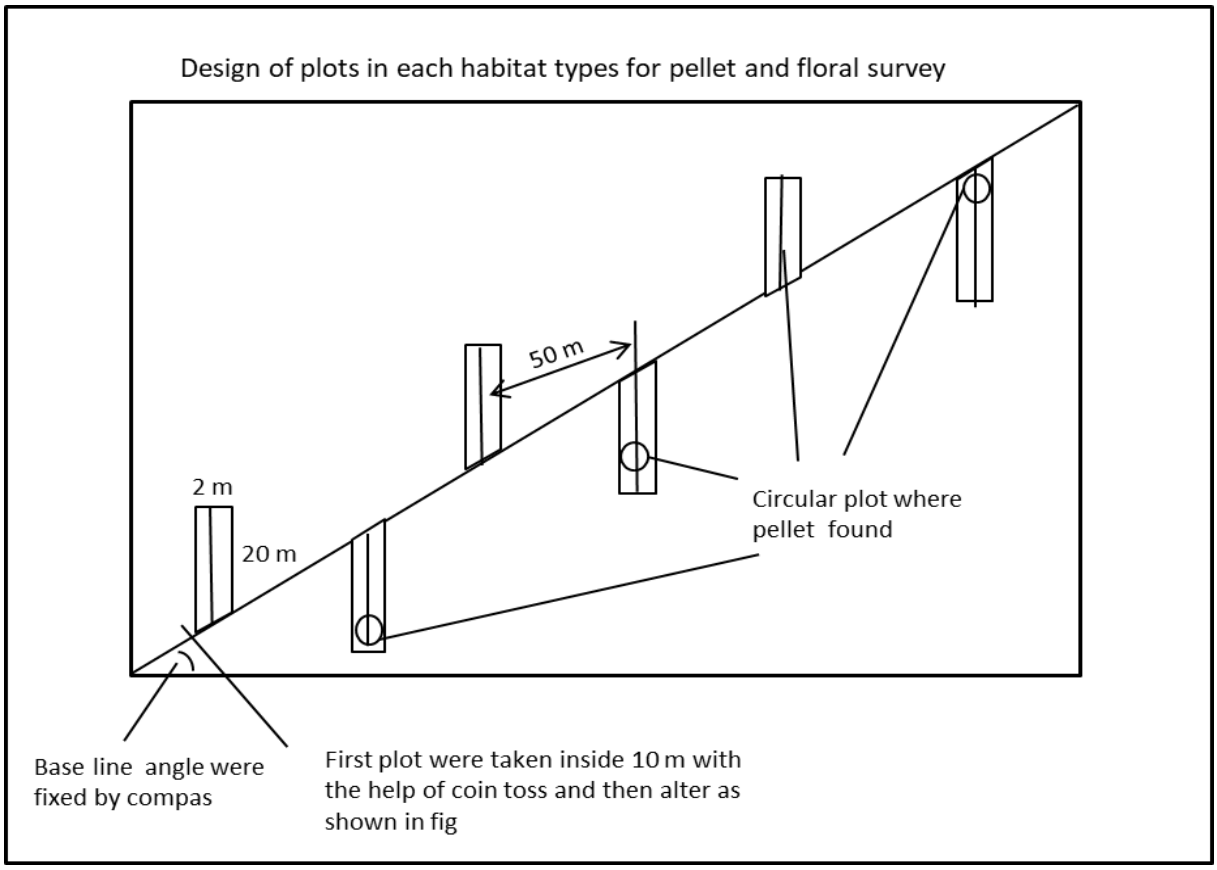

Figure 3: Design of plots in each habitat type for pellets and vegetation survey (adopted from Yadav, 2006).

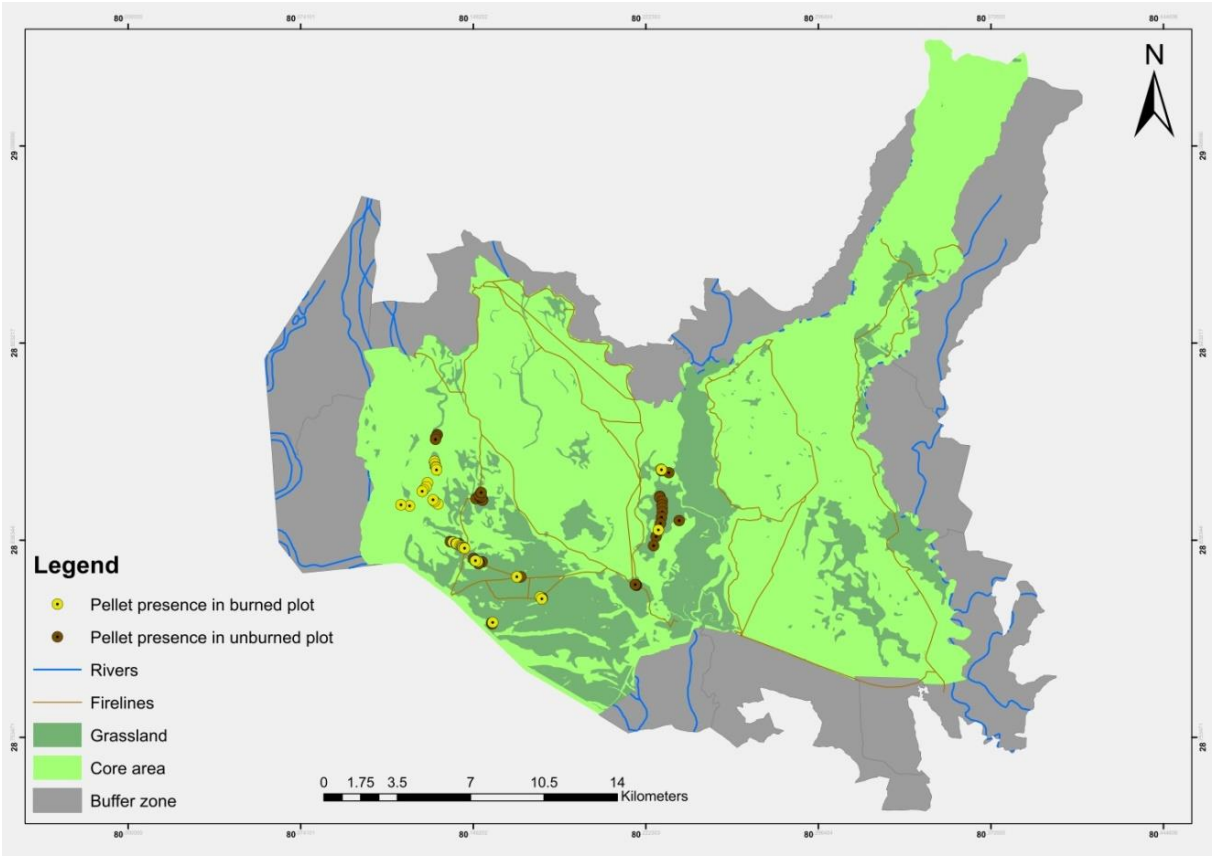

Figure 4: Hispid hare distribution in the burned plot and unburned plot with two different symbols i.e. yellow for pellet presence in burned plot and brown for pellet presence in unburned plot.

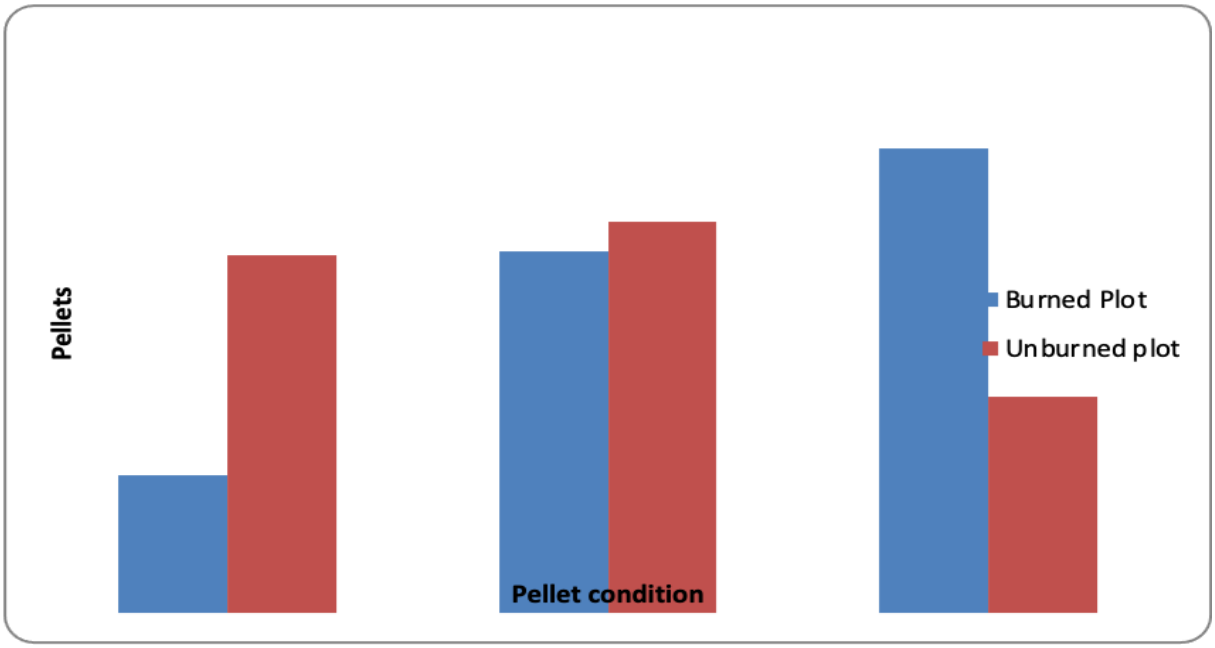

Figure 5: Pellet condition with respect to fire management practices.

The species pellet density of the post-burning season was also more than twice than that of before burning. They concluded that availability of preferred plant species composition in the hispid hare habitat

influences more for the selection of hispid hare, which outweighs the effects of burning practices for their distribution. Similarly, it was found that they preferred varieties of grassland habitats including tall grassland to short as well as recently burnt patches (Maheswaran, 2002). However, we did not record the available plant species and their influences in the selection of hispid hare habitat within our study area. A study conducted by Aryal et al. (2012) in SNP has also concluded that there were no significant differences in the use of burned and unburned habitat patches by hispid hare. They observed that though the hispid hare is benefited by increasing their ranges away from water sources due to new growths after burning habitat patches, but the burning practices overlapped with the breeding season of hispid hare has potential negative impacts on the survival of the species in the study area, which further supported the conclusion of previous studies (Yadav et al., 2008; Aryal, 2010). Yadav et al. (2008) further mentioned that such unsuitable timing (months) of burning practices not only increase the possibilities of higher casualties of leverets (young hares) but also destroy their habitats by reducing regeneration of preferred grass species mostly in the drier areas, which might lead to the population decline of the hispid hare.

Similarly, Chand et al. (2017) has mentioned that in SNP, though the overall population density of hispid hare was greater in the patches after burning rather than patches before burning; but in the areas far from water sources, more signs were found in the patches with new growths after burning in comparison to unburned patches. This implies that the selection of burned or unburned habitat patches depends on other habitat parameters too such as distance from water sources. Nevertheless, we did not record the distances of our sample plots from the nearest water sources for our study.

We found significant differences in the pellet condition between burned and unburned plots with more fresh pellets in unburned plots while more old pellets in burned plots. This might be due to the presence of tall grasses in unburned plots as tall grasses provide suitable cover to the hispid hare in order to perform its ecological behavior being safe from predators (Maheswaran, 2002). In contrast to our finding, Nath et al. (2010) found old pellets in 123 transects out of 146 in a study conducted in Manas National Park, India. However, we did not find other supporting literature on the condition of pellets with respect to burning practices. Thus, further studies are essential to obtain more information on the frequency of habitat use of hispid hare in different habitat management practices.

Conclusion

Although the pellet distribution of hispid hare is found to be clumped in both unburned and burned plots, its populations seem to be affected by grassland burning practices followed differently in different areas. Thus, it is recommended that alternate burning be practiced in all areas with respect to the breeding seasons of endangered species, such as the hispid hare. Further research is needed for updating action plans for hispid hare across different seasons.

Acknowledgments

We would like to thank WWF-Hariyoban Program Nepal and Dr. Achyut Aryal for the research grant. The first author would like to express sincere gratitude to Mr. Suman Bhattarai, Assistant Professor, Institute of Forestry, Pokhara Campus, Pokhara for his continuous support and guidance. We would like to thank Associate Professor Dr. Mark Morgan, College of Agriculture, Food and Natural Resources, University of Missouri, USA for his valuable comments and language editing on the manuscript. We also like to thank Shuklaphanta National Park Staff especially Puran Dev Mishra and Yam Rawat and National Trust for Nature Conservation staffs for the field support. And last but not the least we would also like to acknowledge the valuable time and efforts of three anonymous reviewers to improve the quality of this research article, and Professor Theodore J. Papenfuss for his help with final native English editing.

Conflict of interest

The authors declare that there are no conflicting issues related to this research article.

References

Aryal, A. (2010). First cameras trap sighting of critically endangered hispid hare (*Caprolagus hispidus*) in Shuklaphanta Wildlife Reserve Nepal. *World Applied Science Journal*, 9: 367–371.

Aryal, A., Brunton, D., Ji, W., Yadav, H. K., Adhikari, B. and Raubenheimer, D. (2012). Diet and habitat use of hispid hare (*Caprolagus hispidus*) in Shuklaphanta Wildlife Reserve, Nepal. *Mammal Study*, 37 (2): 147–154. https://doi.org/10.3106/041.037.0205

Aryal, A. and Yadav, B. (2019). *Caprolagus hispidus*. The IUCN Red List of Threatened Species 2019: e.T3833A45176688. https://dx.doi.org/10.2305/IUCN.UK.20191.RLTS.T3833A45176688.en. Downloaded on 07 August 2021.

Bell, D.(1986). A study of the hispid hare (*Caprolagus hispidus*) in Royal Suklaphanta Wildlife Reserve, Western Nepal: a summary report. *Dodo, Journal of the Jersey Wildlife Preservation Trust*, 23: 24–31.

Bell, D. J. (1987). Study of the biology and conservation problems of the hispid hare. Final Report University East Anglia, England. pp 38.

Brown, K. (1997). Plain tales from the grasslands: extraction, value and utilization of biomass in Royal Bardia National Park, Nepal. *Biodiversity and Conser*vation, 6:59–74. https://doi.org/10.1023/A:1018323631889

Buckland, S. T., Anderson, D. R., Burnham, K. P., Laake, J. L., Borchers, D. L. and Thomas, L. (2001). *Introduction to distance sampling: estimating abundance of biological populations*. Oxford University Press, Oxford, UK. 448 pp.

Burnham, K. P., Anderson, D. R., and Laake, J. L. (1980). Estimation of density from line transect sampling of biological populations. *Wildlife Monographs*, 72: 3–202.

Chand, D. B., Khanal, L., and Chalise, M. K. (2017). Distribution and habitat preference of Hispid hare (*Caprolagus hispidus*) In Shuklaphanta National Park, Nepal. *Tribhuvan University Journal*, 31 (1–2): 1–16. https://doi.org/10.3126/tuj.v31i1-2.25326

Chapman, J. A., and Flux, J. E. C. (1990). *Rabbits, hares and pikas: status survey and conservation action plan. Internation Union for Conservation of Nature*. Information Press, Oxford, UK. 168 pp.

CITES. (2021). CITES Appendices I, II and III (28/08/2020). 74 pp.

DNPWC. (2017). Site specific grassland management guideline for Shuklaphanta National Park. Department of National Parks and Wildlife Conservation, Nepal. 18 pp.

IUCN. (2017). The IUCN Red List of Threatened Species. Version 2016-3. www.iucnredlist.org Downloaded on 15 March 2017.

Jnawali, S. R., Baral, H. S., Lee, S., Acharya, K. P., Upadhyay, G. P., Pandey, M., Shrestha, R., Joshi, D., Lamichhane, B. R., Griffiths, J., Khatiwada, A. P., Subedi, N. and Amin, R (2011). *The Status of Nepal's Mammals: The National Red List Series-IUCN*. Department of National Parks and Wildlife Conservation, Kathmandu, Nepal. 276 pp.

Khadka, B. B., Yadav, B. P., Aryal, N., and Aryal, A. (2017). Rediscovery of the hispid hare (*Caprolagus hispidus*) in Chitwan National Park, Nepal after three decades. *Conservation Science*, 5: 10–12. https://doi.org/10.3126/cs.v5i1.18560

Lamichhane, S., Khanal, G., Karki, J. B., Aryal, C. and Acharya, S. (2020). Natural and anthropogenic correlates of habitat use by wild ungulates in Shuklaphanta National Park, Nepal. *Global Ecology and Conservation*, 24: e01338. https://doi.org/10.1016/j.gecco.2020.e01338

Maheswaran, G. (2002). Status and ecology of endangered Hispid hares in Jaldapara Wildlife Sanctuary, West Bengal, India. Final Report submitted to Wildlife Conservation Society, New York and Bombay Natural History Society, India. 45 pp.

Maheswaran, G. (2006). Ecology and conservation of the endangered Hispid hare (*Caprolagus hispidus*) in Jaldapra Wildlife Sanctuary, West Bengal, India. *Journal of the Bombay Natural History Society*, 102 (2/3): 191–201.

Mishra, H. R. (1982). The ecology and behaviour of chital (*Axis axis*) in the Royal Chitwan National Park, Nepal: with comparative studies of hog deer (*Axis porcinus*), sambar (*Cervus unicolor*) and barking deer (*Muntiacus muntjak*). Ph.D. thesis. University of Edinburgh. 282 pp.

Nath, N. K., Sarkar, P. P. and Machary, K. (2010). Ecological assessment of Hispid Hare in Manas National Park, India. Final Report on Conservation Leadership Programme, Aaranyak, Assam. 42 pp.

Nath, N. K. and Machary, K. (2015). An ecological assessment of Hispid Hare *Caprolagus hispidus* (Mammalia: Lagomorpha: Leporidae) in Manas National Park, Assam, India. *Journal of Threatened Taxa*, 7 (15): 8195–8204. https://doi.org/10.11609/jott.2461.7.15.8195-8204

Odum, E. P. (1971). *Fundamentals of ecology*. Third Edition. W. B. Saunders Company, Philadepnia. 574 pp.

Oliver, W. L. R. (1985). The distribution and status of the Hispid Hare, *Caprolagus hispidus*, with some additional notes on the Pigmy Hog, *Sus salvinius*: a report based on the Pigmy Hog and Hispid Hare field/status survey in northern Bangladesh, southern Nepal and northern India, January to April 1984. Jersey Wildlife Preservation Trust, Jersey. 94 pp.

Oliver, W. L. R. (1980). The pygmy hog. The biology and conservation of the pygmy hog, *Sus* (*Porcula*) *salvanius*, and the hispid hare. Caprolagus hispidus Jersey Wildlife Preservation Trust Special Scientific Report. 1: 1–80.

Takahata, C., Amin, R., Sarma, P., Banerjee, G., Oliver, W. and Fa, J. E. (2010). Remotely-sensed active fire data for protected area management: Eight-year patterns in the Manas National Park, India. *Environmental Management*, 45 (2): 414–423. https://doi.org/10.1007/s00267-009-9411-8

Tandan, P. and Dhakal, B. (2013). Population status, habitat utilization, distribution and conservation threats of hispid hare (*Caprolagus hispidus*, Pearson, 1839) in Bardia Natonal Park of western Nepal. *Tigerpaper*, 40 (4): 7–13.

Tandan, P., Dhakal, B., Karki, K. and Aryal, A. (2013). Tropical grasslands supporting the endangered hispid hare (*Caprolagus hispidus*) population in the Bardia National Park, Nepal. *Current Science*, 105, 5(10): 691–694.

Thapa, P., Khatiwada, A. P., Nepali, S. C. and Paudel, S. (2014). Distribution and conservation status of Chinese pangolin (*Manis pentadactyla*) in Nangkholyang VDC, Taplejung, Eastern Nepal. *American Journal of Zoological Research*, 2 (1): 16–21.

Yadav, B. (2006). Status, distribution and habitat use of hispid hare (*Caprolagus hispidus*) in Royal Suklaphanta Wildlife Reserve, Nepal. B.Sc. thesis,. Institute of Forestry, Tribhuvan University.

Yadav, B. P., Sathyakumar, S., Koirala, R. K., and Pokharel, C. (2008). Status, distribution and habitat use of hispid hare (*Caprolagus hispidus*) in Royal Suklaphanta Wildlife Reserve, Nepal. *Tiger paper*, 35 (3): 8–14.