18(1) 156-164, Spring 2026

Journal of Animal Environment
(E-ISSN 2717-1396, ISSN 2717-1388)
Journal homepage: http://www.aejournal.ir

Original Research Paper

Habitat Fragmentation and Its Role in Territorial Behavior, Movement Patterns and Reproductive Outcomes of Medium-Sized Carnivores

Dr. Shinki Katyayani Pandey[1*], Mariyam Ahmed[2]

[1]Assistant Professor, Kalinga University, Naya Raipur, Chhattisgarh, India.*
Email: ku.shinkikatyayanipandey@kalingauniversity.ac.in, ORCID: https://orcid.org/0009-0009-9316-5093
[2]Assistant Professor, Kalinga University, Naya Raipur, Chhattisgarh, India.
Email: ku.mariyamahmed@kalingauniversity.ac.in, ORCID: https://orcid.org/0009-0006-7541-3557

Key Words

Habitat fragmentation, Medium-sized carnivores, Territorial behaviour, Movement ecology, Reproductive success.

Abstract

Habitat fragmentation is a common effect of urbanization, deforestation, agriculture, and infrastructural changes that cause habitat isolation and changed behavior among the animal kingdom. Large carnivores are most affected by their dependence on territory for survival and reproduction, the availability of food sources, and safe corridors for dispersal. The purpose of this study is to assess the effect of habitat fragmentation on the behavior and reproduction of medium-sized carnivores. This research was performed in continuous forests, moderately fragmented areas, and highly fragmented regions using habitat analysis based on Geographic Information System (GIS), GPS telemetry, camera trapping, and reproductive studies. Parameters of spatial ecology, such as home-range size, territorial overlap, displacement rate, and corridor use, were considered. At the same time, reproductive success was assessed by measuring litter size, juvenile survival rates, breeding frequency, and hormonal levels. This work revealed significant variations in ecological characteristics depending on the type of the habitat. Home ranges in continuous forests were larger on average (18.4 km²), there were smaller overlaps (12.3%), and the daily displacements were shorter (9.6 km/day) in comparison to those carnivores residing in highly fragmented habitats (average home range size - 8.7 km²; territorial overlap - 41.5%; displacements - 16.2 km/day). Moreover, reproduction success in highly fragmented areas was significantly lower because litters were smaller (4.2 in continuous forests; 2.3 in highly fragmented regions), juveniles had lower survival rates (81.5% in continuous forests; 62.7% in fragmented habitats), and the frequency of breeding was reduced (78.4% and 46.3%, respectively). Stress hormone level in carnivores inhabiting fragmented environments increased as well.

* Corresponding Author's email: ku.shinkikatyayanipandey@kalingauniversity.ac.in
Received: 02 December 2025; Reviewed: 09 January 2026; Revised: 28 January 2026; Accepted: 03 April 2026
(DOI): 10.70102/AEJ.2026.18.1.13

Introduction

One of the major environmental impacts that arise from urbanization, agricultural development, road building, and deforestation is the effect of habitat fragmentation on ecosystems (Giuntini & Pedruzzi, 2023; Patil, 2018). Habitat fragmentation refers to the splitting up of an ecosystem into smaller patches of land due to reduced resources and disruption of connectivity within the fragmented habitats. Fragmentation impacts medium-sized terrestrial carnivores including foxes, jackals, civets, raccoons, and wild cats due to the requirement of these animals to have large home territories, prey, and freedom of movement (Soto & Palomares, 2015). Fragmentation affects the territorial behavior of animals by increasing competition for resources, thereby necessitating changes in their social behavior. Fragmentation of the landscape also affects the movements of animals by limiting the dispersal, road crossing frequency, and increased human disturbances for the carnivores (Smith et al., 2025).

The main purpose of this research work is to determine the impact of habitat fragmentation on the territorial behavior, movement patterns, and reproduction in medium sized carnivores. It attempts to find out how the landscape modification influences the use of space by animals, their dispersal patterns, mating, and successful reproduction.

While numerous scientific studies have addressed the ecological implications of habitat destruction, there have been few scientific studies that have concurrently analyzed behaviour ecology, movement ecology, and reproductive outcomes of medium-sized carnivores. Most of these scientific studies usually address issues of a particular species or an ecological issue without considering the interaction of fragmentation impacts on territoriality and population sustainability. Moreover, there is very little data available from rapidly transforming human-modified landscapes especially in underdeveloped parts of the world.

The research proposes that increased fragmentation would lead to enhanced territoriality problems, disturbance in normal movement behavior, reduced chances for dispersal, and decreased breeding success for medium-sized carnivores. Carnivores living in highly fragmented environments would suffer from inefficient reproduction and behavioral stress compared with those in contiguous landscapes.

The research provides an integrative perspective on ecological studies related to habitat fragmentation, behavioral adaptations, and reproduction among medium-sized carnivores. The results of the study would be useful in formulating effective wildlife corridors for the betterment of carnivore survival in fragmented landscapes.

Literature survey

Fragmentation of habitats has become a prominent issue that impacts animals' movements, territoriality, and reproduction in different ecosystems. Habitat fragmentation as a result of urban development, farming, road constructions, and deforestation modifies the

distribution of habitats and resources, which consequently affects the behaviour of carnivoran mammals (Giuntini & Pedruzzi, 2023; Patil, 2018). It has been noted that fragmentation of the habitat of terrestrial vertebrates has great impacts on their mating behavior, territoriality, and dispersal due to resource competition (Giuntini & Pedruzzi, 2023).

Through the use of GPS telemetry and spatial ecology, it has been found that habitat specialists living in fragmented habitats experience reduced efficiency in movement, changes in dispersal behavior, and greater reliance on habitat corridors (Bista et al., 2022). Likewise, it has been observed that barriers such as fences and roads impact the natural pathway of animals and cause energy expenditure for carnivores, which ultimately affects the home ranges and habitat use of carnivores (Naha et al., 2023). Furthermore, territoriality in carnivoran mammals has been largely affected by habitat fragmentation because the limited resources available in such habitats lead to overlapping territories and aggression (Facka & Powell, 2021).

Some ecological studies have pointed out the significance of habitat segregation at a fine spatial scale to facilitate co-existence of sympatric carnivores in fragmented ecosystems (Soto & Palomares, 2015). Fragmentation has other impacts like constraining gene flow and lowering population connectivity due to its effect on natal dispersal and social organization in wildlife species (Cousseau et al., 2020). Man-made disturbances have also led to changes in habitat use and activity patterns in medium- and small-size felids, resulting in higher nocturnal activities and behavior responses to stressors (Cruz et al., 2018).

Researches on carnivore ecology have helped reveal gender differences in resource selection and adaptation strategies to habitat fragmentation, suggesting that the consequences of environmental disruptions on the reproductive habits and territories of male and female species are distinct (Smith et al., 2025). In conservation-related literature, the necessity of sustainable rehabilitation of ecosystems and landscape management to ensure the survival of wildlife in fragmented habitats has been emphasized (Dixit & Raje, 2024; Mishra, 2025; Ziwei & Han, 2023).

On the whole, from the literature review, it can be observed that fragmentation has negative consequences on territory, movement patterns, dispersal success, and reproductive functions of medium carnivores. Nevertheless, there is no study available which links all these factors together.

Methodology

Study Area Selection

The experiment will be carried out on different types of landscapes depending on the extent of habitat fragmentation, such as contiguous forest landscapes, moderately fragmented habitats, and highly fragmented man-made habitats. This will involve choosing landscapes from areas that are well protected, agroecological transitional zones, peri-urban landscapes, and isolated landscapes. The GIS land use classification and satellite images will

help measure the degree of habitat fragmentation, patch size, edges, and corridors.

Target Species Identification

In terms of the species to be studied, the focus will be on mid-sized predators that are regularly found in fragmented landscapes, and these may include foxes, jackals, civets, raccoons, or even small wild cats, according to their availability within the area of study. The choice of the species for study will be based on several considerations, including ecology, territoriality, adaptability, and conservation value.

Behavioral and Movement Data Collection

The movement pattern and territorial behavior of animals will be studied through GPS tracking collars as well as camera traps. The home range size, dispersal pathway, habitat use, resting areas, and corridor movement will be tracked through the use of GPS tracking technology. The camera traps will be placed at locations where there are trail systems, habitat borders, and corridors to study territorial behavior, daily routines, and interspecific competition.

Reproductive Outcome Assessment

Measurement of reproductive success is going to take into consideration den sites observations, number of offspring, frequency of breeding, and juvenile survival rates. Hormonal levels reflecting stress response can also be measured through non-invasive fecal hormone sampling. The reproductive success rate of fragmented habitat versus continuous habitat will be statistically compared.

Spatial and Statistical Analysis

Fragmentation indices for landscape ecology will be combined with the behavioral and reproduction data using GIS tools. The statistical techniques to be used include regression analysis, multivariate analysis, and habitat suitability modeling. This will help establish the link between fragmentation and the ecological response of carnivores.

Results

Habitat Fragmentation Characteristics

Analysis of the selected landscapes based on spatial data showed significant variation in the parameters of habitat continuity, patch density, and corridor connectivity between the different landscapes. Fragmented landscapes had smaller patches with high levels of edge effect in comparison with continuous forest ecosystems. Fragmentation was significantly high in urban and agricultural interfaces, which had an impact on the habitat accessibility of medium-sized carnivores.

Changes in Territorial Behavior

Territorial behavior of the carnivore community living in fragmented ecosystems showed changes. Carnivores from severely affected areas had lower stability of home range and higher levels of overlap in territories than those living in intact forest areas. From camera trap studies, there was a record of more fights in territorial behavior and territorial marking around habitat boundaries and in nutrient-deprived habitats. Nocturnal behavior increased among carnivores in fragmented areas.

Table 1: Territorial and Movement Characteristics of Medium-Sized Carnivores Across Different Habitat Types

Habitat Type	Mean Home Range (km²)	Territorial Overlap (%)	Daily Movement Distance (km/day)	Corridor Utilization Frequency
Continuous Forest	18.4	12.3	9.6	High
Moderately Fragmented Habitat	13.1	26.8	12.4	Moderate
Highly Fragmented Habitat	8.7	41.5	16.2	Low

As shown in table 1, the effects of habitat fragmentation can be observed in the territorial and movement ecology of medium-sized carnivores. The species in the undisturbed forest had large territories, little territory overlap, and frequent utilization of ecological corridors. However, the fragmented environment had small territories, territory overlap, high movements in a day, and low utilization of ecological corridors. This suggests that fragmentation plays an important role in altering the spatial behavior and movements of species.

Alteration of Movement Patterns

Telemetry data collected by GPS confirmed that habitat fragmentation had a great impact on movement ecology. Carnivores living in a fragmented habitat had to cover long distances each day through narrower movement corridors with higher unpredictability. Dispersal limitations were visible in isolated fragments of a habitat as the number of road-crossing instances and contacts with humans increased.

Reproductive Outcomes and Physiological Stress

The reproductive performance of animals varied widely among the different habitats. Animals living in uninterrupted forests showed higher reproductive success, larger litter sizes, and higher offspring survival rates. On the other hand, animals that lived in fragmented habitats had poor reproductive success and high levels of physiological stress. The level of glucocorticoids in feces was found to be higher in carnivores.

Figure 1 presents the relationship between the reproduction performance of medium-sized predators and habitat fragmentation. The continuous forest provided for increased reproduction rate, number of offspring, and survival rate as opposed to highly fragmented forests that led to reduced reproduction performances and increased stress hormones.

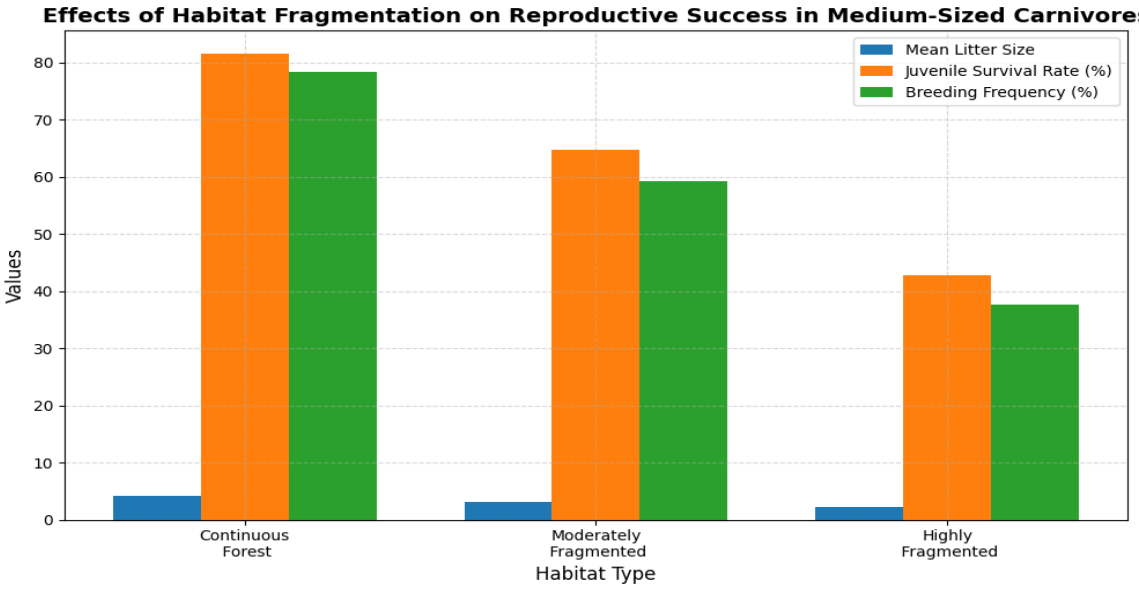

Figure 1: Effects of Habitat Fragmentation on Reproductive Success and Physiological Stress in Medium-Sized Carnivores

Relationship Between Fragmentation and Ecological Responses

Modeling statistics showed a strong negative correlation between fragmentation levels and reproductive success, while there was a positive correlation between fragmentation levels and territorial fighting frequency. Increased edge levels and low levels of connectivity of corridors resulted in behavioral changes as well as stress levels. This suggests that fragmentation can affect not only spatial ecology but also the population stability of medium-sized carnivores.

Discussion

In the current research, it is established that habitat fragmentation affects territorial behavior, locomotion, and reproduction in medium-sized carnivores. Medium-sized carnivores that lived in continuous forest cover had much larger territories (18.4 km²), less territorial overlap (12.3%), and lower movement distances per day (9.6 km) than the animals living in a highly fragmented habitat, where they had smaller territories (8.7 km²), more territorial overlaps (41.5%) and higher movement distances (16.2 km/day). Moreover, reproductive results were poorer with an increase in habitat fragmentation since continuous forests allowed medium-sized carnivores to give birth to more cubs (4.2), have higher juvenile survivorship rates (81.5%), and higher frequency of mating (78.4%). The results show that habitat fragmentation has a direct negative effect on the natural distribution and availability of resources among carnivores. Increased movement distances in fragmented environments might be an indication of animals having to move greater distances to find food, mates, or places to live. Poor reproduction and increased stress hormones also support the conclusion that habitat disturbances have negative effects on the condition of the organisms, as well as their ability to reproduce successfully. This conclusion highlights the importance of maintaining connectivity between

patches of habitat and creating corridors for medium-sized carnivores. Apart from affecting the behavioural ecology of such animals, fragmentation of habitats can affect their viability over the long run due to their poor reproductive success and increased energy expenditures. These conclusions can be useful in managing and planning the protection of the carnivores' habitats at the level of entire landscapes. The study is somewhat limited because it has taken place during a limited period of time, and because of differences in ecologies of certain animals and their species. Seasonal changes, prey availability, and the intensity of anthropogenic pressure have not been considered in the research. Furthermore, evaluation of the carnivores' stress levels was mainly done using indirect methods.

Conclusion

The current research focused on the effects of habitat fragmentation on spatial organization, movement ecology, and reproduction in medium-sized carnivores. Fragmentation due to urban expansion, deforestation, and land use is a phenomenon that results in a patchy landscape that negatively impacts the ability of organisms to move and reproduce effectively. This study sought to investigate the effects of fragmentation on the above factors. The research found distinct differences between habitat types. Organisms that lived in continuous forests had greater home range size (18.4km2), less overlap (12.3%), and smaller movement distances per day (9.6km/day). Reproduction was significantly affected by fragmentation. The litter sizes were higher in continuous forests (4.2), juvenile survivorship rate was high (81.5%), and breeding rate was high (78.4%). Reproductive success decreased significantly in highly fragmented forests. Furthermore, physiological stress levels were elevatedIn conclusion, the research provides evidence that habitat fragmentation exerts detrimental impacts on both behavioral ecology and the reproductive fitness of middle-sized carnivores. What one should understand here is that it is crucial to preserve connectivity within the habitat and create ecological corridors to alleviate territory disputes and the natural migration of the species.

Author contribution

Conflict of interest

The authors declare no conflict of interest.

Funding

This research received no external funding.

Ethical consideration

All wildlife handling and monitoring procedures will follow established ethical guidelines for animal research. GPS collaring and field sampling will be conducted under appropriate wildlife permits while minimizing stress and disturbance to the animals and their habitats.

References

[1] Bista, Damber, Greg S. Baxter, Nicholas J. Hudson, Sonam Tashi Lama, and Peter John Murray. "Effect of disturbances and habitat fragmentation on an arboreal habitat specialist mammal using GPS telemetry: A case of the red panda." *Landscape Ecology* 37, no. 3 (2022): 795-809.

https://doi.org/10.1007/s10980-021-01357-w

[2] Cousseau, Laurence, Martijn Hammers, Dries Van de Loock, Beate Apfelbeck, Mwangi Githiru, Erik Matthysen, and Luc Lens. "Habitat fragmentation shapes natal dispersal and sociality in an Afrotropical cooperative breeder." *Proceedings of the Royal Society B: Biological Sciences* 287, no. 1941 (2020). https://doi.org/10.1098/rspb.2020.2428

[3] Cruz, Paula, María Eugenia Iezzi, Carlos De Angelo, Diego Varela, Mario S. Di Bitetti, and Agustin Paviolo. "Effects of human impacts on habitat use, activity patterns and ecological relationships among medium and small felids of the Atlantic Forest." *PloS one* 13, no. 8 (2018): e0200806. https://doi.org/10.1371/journal.pone.0200806

[4] Dixit, A., & Raje, N. (2024). Using Multiple Objective Impact Analysis to Track Sustainable Rehabilitation of Ecosystems. *International Academic Journal of Science and Engineering, 11*(3), 31–34. https://doi.org/10.71086/IAJSE/V11I3/IAJSE1158

[5] Facka, Aaron N., and Roger A. Powell. "Intraspecific competition, habitat quality, niche partitioning, and causes of intrasexual territoriality for a reintroduced carnivoran." *Frontiers in Ecology and Evolution* 9 (2021): 734155. https://doi.org/10.3389/fevo.2021.734155

[6] Giuntini, Silvia, and Luca Pedruzzi. "Sex and the patch: the influence of habitat fragmentation on terrestrial vertebrates' mating strategies." *Ethology Ecology & Evolution* 35, no. 3 (2023): 269-298. https://doi.org/10.1080/03949370.2022.2059787

[7] Mishra, Nidhi. "Forest–Landscape Connectivity under Climate Change: Modelling Species Dispersal, Genetic Flow, and Adaptive Capacity." *National Journal of Forest Sustainability and Climate Change* (2025): 31-37.

[8] Naha, Dipanjan, Stéphanie Périquet, J. Werner Kilian, Caitlin A. Kupferman, Tammy Hoth-Hanssen, and James C. Beasley. "Fencing affects movement patterns of two large carnivores in Southern Africa." *Frontiers in Ecology and Evolution* 11 (2023): 1031321.

[9] https://doi.org/10.3389/fevo.2023.1031321

[10] Patil, P. J. (2018). An Ecological Analysis of Forest Accounting. *International Academic Journal of Innovative Research, 5*(1), 109–127.

[11] Smith, Matthew M., Amanda M. Veals Dutt, Jason V. Lombardi, Aidan B. Branney, Ashley M. Reeves, Daniel G. Scognamillo, Maksim Sergeyev, Zachary M. Wardle, Michael E. Tewes, and Lisanne S. Petracca. "Sex-specific resource strategies mediate home range sizes of an endangered carnivore across multiple scales." *Scientific Reports* 15, no. 1 (2025): 34190.

https://doi.org/10.1038/s41598-025-15493-9

[12] Soto, Carolina, and Francisco Palomares. "Coexistence of sympatric carnivores in relatively homogeneous Mediterranean landscapes: functional importance of habitat segregation at the fine-scale level." *Oecologia* 179, no. 1 (2015): 223-235. https://doi.org/10.1007/s00442-015-3311-9

[13] Ziwei, Meng, and Ling Li Han. "Scientometric review of sustainable land use and management research." *Aquatic Ecosystems and Environmental Frontiers* 1, no. 1 (2023): 21-24. https://doi.org/10.70102/AEEF/V1I1/5