Patterns and Drivers of Wildlife Offenses in Nagarhole Tiger Reserve: A Socio-Spatial Assessment

Venkata Naidu, Satish B Narayanappa[1], Anusha Sanjay Revankar[1*], Syed Ali[2], Sushma C. Meti[1] and Mahadev Murthy

University of Agricultural Sciences, GKVK, Bengaluru-560 065, India
[1]*College of Forestry (Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga),*
Ponnampet, Kodagu-571 216, India
[2]*College of Forestry (University of Agricultural Sciences, Dharwad), Sirsi, Uttara Kannada-581 401, India*
*E-mail: anurevankar19@gmail.com

Abstract: Nagarhole Tiger Reserve, a key component of the Nilgiri Biosphere Reserve in Karnataka, India, is a vital stronghold for wildlife, including tigers, elephants and several herbivore and carnivore species. However, the park faces persistent threats from wildlife and other forest-related crimes. This study investigates the patterns, trends and drivers of such offenses in Nagarhole between 2008–09 and 2017–18, based on Forest Offense Case (FOC) records maintained by the Karnataka Forest Department. A total of 617 such cases were reported during this period and it comprises 148 wildlife crimes and 469 other offenses. The analysis reveals a declining trend in crime numbers, although specific years showed spikes in wildlife crimes, indicating episodic surges possibly linked to poaching networks or enforcement drives. Spatial analysis showed significant variation across forest ranges, with DB Kuppe and Metikuppe reporting the highest number of cases. Temporal analysis highlighted increased crime incidence during monsoon months, though statistical tests showed no significant monthly or seasonal variation. Species most frequently targeted included spotted deer, elephants and tigers, along with 47 cases of illegal fishing. Demographic profiling of offenders revealed that most were male, in the 30–60 age group, poorly educated and economically vulnerable, primarily working as wage labourers. Nearly 94 per cent of crimes were intentional, suggesting organized or semi-organized involvement. The study emphasizes the need for improved legal processing, strengthened patrolling, community engagement and alternative livelihood opportunities to mitigate forest crimes. Targeted conservation interventions, informed by spatial and socio-economic data, can enhance the effectiveness of wildlife protection efforts in Nagarhole.

Keywords: Biodiversity protection, Forest offense case, Temporal trends, Wildlife crime

India possesses an exceptional variety of flora and animals, a significant portion of which is safeguarded under its system of national parks, wildlife sanctuaries and conservation reserves. (Singh and Kushwaha 2008). Among these protected areas, Nagarhole National Park (Nagarhole hereafter) is also known as Rajiv Gandhi National Park stands out as a critical component of the Nilgiri Biosphere Reserve, located in the Western Ghats region of Karnataka. Nagarhole is characterized by moist deciduous and dry tropical forests and supports a wide array of wildlife species, including the Bengal tiger (*Panthera tigris*), Asian elephant (*Elephas maximus*), Indian leopard (*Panthera pardus*) and supporting a wild herbivore biomass density of 14,744 kg km^{-2} (Karanth and Sunquist 1992). While the Nagarhole serves as a vital habitat for wildlife and plays a key role in the conservation of range of threatened flora and fauna, however, Nagarhole is facing an increase in anthropogenic activities, particularly in the form of wildlife crimes and other forest-related offenses (Madhusudan and Karanth 2002).

These crimes include poaching of endangered species, illegal fishing, trapping of animals using snares, unauthorized collection of forest produce and other forms of environmental violations (Madhusudan and Karanth 2002, Rana and Kumar 2023, Haq 2023). Such activities not only threaten the

survival of vulnerable and endangered species but also erode the integrity of ecosystems and undermine conservation efforts. Given the ecological and legal importance of wildlife protection, there is a pressing need to examine the nature, extent and patterns of such offenses. This study is based on the analysis of crime records reported in Nagarhole between 2008–09 and 2017–18 and focuses on developing a comprehensive profile of both wildlife and other crimes in the park by examining reported case data, including the number of cases, types of offenses, affected species and legal outcomes. Additionally, the study attempts to identify temporal trends in crime occurrences across different months and seasons. Understanding when crimes are most frequent can help managers allocate resources more effectively and plan surveillance accordingly.

Moreover, information on the species most frequently targeted by illegal activities has been compiled to highlight those at greatest risk. An overview of the demographic characteristics of individuals associated with reported crimes, such as age, gender, education level and occupation, offers additional context for understanding the socio-economic background of offenders. By systematically documenting these elements, the study lays the groundwork for more informed conservation strategies and policy planning.

MATERIAL AND METHODS

The present study was conducted in the Nagarhole Tiger Reserve, one of the five major reserves selected to understand the patterns and causes of wildlife crimes in Karnataka. Covering an area of approximately 643 km², Nagarhole is known for its diverse ecosystems and significant wildlife populations, including tigers, elephants and several herbivore and carnivore species. Data on wildlife and other forest-related crimes from 2008–09 to 2017–18 were collected from official Forest Offence Case (FOC) records maintained by the Karnataka Forest Department. This included details of the type of crime, affected species, location of the incident, legal status and seasonal occurrence.

In order to evaluate both temporal and spatial trends, reported cases were grouped by month (Table 3) and range (Table 2). The Kruskal-Wallis test and other statistical analysis were used to decide whether crime rates differed significantly between ranges and months. Also, structured interviews were used to gather demographic data about those who commit wildlife crimes, and the data was analysed to determine the socioeconomic characteristics that influence these kinds of crimes. The study's ability to document trends, pinpoint hotspots and evaluate the dynamics of wildlife crime at the local level in Nagarhole was made possible by its integrated approach.

RESULTS AND DISCUSSION

A total of 617 cases were recorded in Nagarhole over a ten-year span, comprising 148 wildlife crimes and 469 other forest-related offenses (Table 1). The data show a declining trend in both categories, with wildlife crimes dropping from 13 in 2008–09 to just 7 by 2017–18. A similar decline was observed in other forest offenses. However, two major spikes in wildlife crimes during 2012–13 (26 cases) and 2013–14 (25 cases) suggest episodic surges, possibly driven by increased enforcement or poaching pressure. These temporal variations align with findings from other protected areas in India, where local socio-economic changes and enforcement intensity influence wildlife crime trends (Rao et al 2010, Sharma et al 2019). The overall reduction may indicate successful interventions, though the persistently high baseline highlights ongoing challenges.

The distribution of crimes varied significantly across the eight ranges, with DB Kuppe (43 cases) and Metikuppe (38 cases) reporting the highest numbers (Table 2). In contrast, Hunsur and Kallahalla recorded the fewest cases (4 and 5, respectively). The Kruskal–Wallis test (H = 38.58, p<0.001) confirmed significant variation across ranges, suggesting unequal enforcement or differing access to forest areas.

Such spatial heterogeneity is commonly influenced by proximity to human settlements, forest roads and resource abundance (Karanth et al., 2013). These findings emphasize the need for range-specific enforcement strategies and monitoring systems. Further, monthly analysis showed peak crime incidences in June and July (12.16% each), followed by September. The lowest incidences were noted in January (4.73%) and October (5.41%). The variation in wildlife crimes across months was not statistically significant, indicating relative uniformity across time. Nevertheless, higher crimes in the monsoon months may be linked to limited patrolling during rains or increased animal movement (Gubbi et al 2014). Seasonality in wildlife crime remains a critical consideration in resource planning and deployment (Table 3).

Seasonal comparison revealed that the majority of wildlife crimes occurred during the monsoon (64 cases, 43.2%), followed by post-monsoon (32), summer (30) and winter (17) (Table 4). Although the Kruskal–Wallis test did not show a statistically significant difference between seasons, the trend

Table 1. Profile of wildlife and other crimes reported in Nagarahole Tiger Reserve

Year	Wildlife	Others	Total cases
2008-09	13	100	113
2009-10	16	94	110
2010-11	12	61	73
2011-12	8	66	74
2012-13	26	40	66
2013-14	25	30	55
2014-15	17	20	37
2015-16	15	22	37
2016-17	9	18	27
2017-18	7	18	25
Total	148	469	617

Table 2. Comparison of different ranges across Nagarahole Tiger Reserve

Forest ranges	Cases
Hunsur	04
Veernahosahalli	14
Anechowkur	24
Nagarahole	09
Kallahalla	05
Metikuppe	38
Antharasanthe	11
DB Kuppe	43

Kruskal-Wallis test value H= 38.58, p<0.001

suggests there was a heightened risk during the monsoon, possibly due to lush vegetation cover aiding concealment of illegal activities. Studies in other reserves have reported similar trends, where monsoons enable easier snare setting and reduced detection (Madhusudan and Shankar Raman 2003).

The temporal analysis of wildlife crime in Nagarhole Tiger Reserve between 2008–09 and 2017–18 (Fig. 1) reveals notable monthly variations, with the highest incidences recorded in June and July (12.16% each), followed by September and August , while the lowest were observed in January (4.73%) and October (5.41%). This concentration of offences during the monsoon months suggests that dense vegetation cover may facilitate concealment of illegal activities, while reduced patrolling due to harsh weather conditions could further exacerbate the risk (Gubbi et al., 2014). The pattern aligns with findings from other Indian reserves where monsoon seasons see a surge in poaching and illegal forest use due to both ecological conditions and limited enforcement presence (Madhusudan and Shankar Raman 2003). Although the Kruskal–Wallis test indicated that these monthly differences were not statistically

significant, the practical implications remain critical, necessitating enhanced surveillance and strategic deployment of forest staff during high-risk periods. These insights underscore the importance of integrating temporal risk factors into anti-poaching planning and wildlife protection strategies. The temporal dynamics of wildlife crimes across forest ranges in Nagarhole Tiger Reserve reveal varied patterns of monthly occurrence, influenced by range-specific factors such as terrain, accessibility, and enforcement presence (Table 5). Among the eight ranges analyzed, DB Kuppe (43 cases) and Metikuppe (38 cases) reported the highest number of wildlife crimes. In DB Kuppe, peak incidences occurred in January, June and July, while Metikuppe recorded the highest numbers during June, November and December, coinciding with monsoon and post-monsoon months. These patterns may be linked to thick vegetation during the rainy season, which facilitates concealment and limits patrolling efforts (Gubbi et al., 2014). In contrast, ranges like Hunsur (4 cases) and Kallahalla (5 cases) reported minimal activity, possibly due to stronger enforcement or lower accessibility for offenders.

The May, July and September recorded simultaneous spikes in multiple ranges, suggesting periods of increased vulnerability across the reserve. For example, May month was notably active in Veernahosahalli and Anechowkur, while July saw incidents in seven of the eight ranges. These simultaneous surges highlight the need for synchronized and intensive patrolling efforts during specific months. The presence of offenses even during winter months, although fewer, indicates that illegal activities are not entirely seasonal

Table 3. Temporal patterns in Wildlife Crime across months in Nagarahole Tiger Reserve

Month	Number	Per cent
January	7	4.73
February	10	6.76
March	8	5.41
April	11	7.43
May	11	7.43
June	18	12.16
July	18	12.16
August	13	8.78
September	15	10.14
October	8	5.41
November	12	8.11
December	12	8.11
Data NA	5	3.38

Kruskal-Wallis test value (H): 34.2, p<0.001 [Between Reserves comparison]

Table 4. Seasonal distribution of Wildlife Crimes

Season/Reserves	Nagarahole
Winter	17
Summer	30
Monsoon	64
Post Monsoon	32

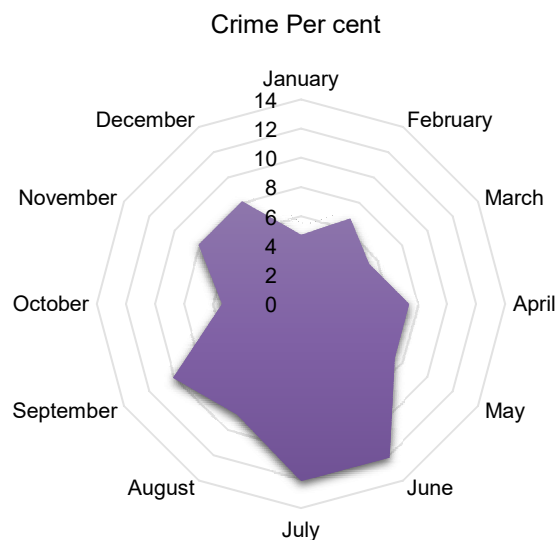Kruskal Wallis test value is H= 4.52, p=0.24 (Non-significant)

Fig. 1. Temporal dynamics of wildlife crime reported in Nagarahole Tiger Reserve

Table 5. Temporal dynamics of wildlife crime reported across forest ranges in Nagarahole Tiger Reserve

Month	HNS		VHH		ANK		NGH		KLH		MKP		ATS		DBK		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
January	0	0.0	0	0.00	0	0.00	0	0.00	1	20.00	1	2.63	0	0.00	5	11.63	7	4.73
February	1	25.0	1	7.14	0	0.00	1	11.11	0	0.00	3	7.89	1	9.09	3	6.98	10	6.76
March	0	0.0	0	0.00	1	4.17	1	11.11	0	0.00	2	5.26	1	9.09	3	6.98	8	5.41
April	0	0.0	0	0.00	1	4.17	0	0.00	0	0.00	5	13.16	1	9.09	4	9.30	11	7.43
May	0	0.0	2	14.29	5	20.83	0	0.00	0	0.00	0	0.00	1	9.09	3	6.98	11	7.43
June	0	0.0	1	7.14	1	4.17	0	0.00	0	0.00	8	21.05	0	0.00	8	18.60	18	12.16
July	1	25.0	2	14.29	4	16.67	1	11.11	0	0.00	2	5.26	1	9.09	7	16.28	18	12.16
August	0	0.0	2	14.29	2	8.33	1	11.11	1	20.00	3	7.89	2	18.18	2	4.65	13	8.78
September	1	25.0	3	21.43	4	16.67	2	22.22	0	0.00	4	10.53	0	0.00	1	2.33	15	10.14
October	0	0.0	0	0.00	3	12.50	0	0.00	1	20.00	3	7.89	1	9.09	0	0.00	8	5.41
November	0	0.0	0	0.00	1	4.17	3	33.33	0	0.00	4	10.53	1	9.09	3	6.98	12	8.11
December	1	25.0	0	0.00	1	4.17	0	0.00	2	40.00	3	7.89	2	18.18	3	6.98	12	8.11
Data NA	0	0.0	3	21.43	1	4.17	0	0.00	0	0.00	0	0.00	0	0.00	1	2.33	5	3.38
Total	4	100.0	14	100.00	24	100.00	9	100.00	5	100.00	38	100.00	11	100.00	43	100.00	148	100.00

Forest Ranges of NTR = HNS=Hunsur; VHH=Veernahosahalli; ANK=Anechowkur; NGH=Nagarahole; KLH=Kallahalla; MKP=Metikuppe; ATS=Antharasanthe; DBK=DB Kuppe

and can occur year-round when opportunities arise. Similar spatial-temporal crime clustering has been reported in other protected areas, where landscape structure, community proximity and resource availability shape criminal behaviour (Karanth et al., 2013, Raza et al., 2012, Madhusudan and Shankar Raman 2003). Thus, localized intelligence, community surveillance, and adaptive patrolling schedules based on seasonal risk can enhance conservation outcomes across forest ranges.

The most frequently targeted species were spotted deer (*Axis*, 26 cases), elephants (*Elephas maximus*, 18) and tigers (*Panthera tigris*, 8). Additionally, 47 cases of illegal fishing were recorded (Table 6). Lesser-known species such as monitor lizards, langurs, foxes and dholes were also affected. This wide taxonomic impact reflects diverse motivations behind poaching, ranging from commercial gain (Ivory, Skins) to subsistence and cultural use (Meijaard et al., 2011). The species profile underscores the need for awareness campaigns and strict enforcement even for non-charismatic species.

The majority of wildlife crimes (93.9%) were intentional, with only 6.1 per cent deemed unintentional (Table 7). About half the offenders were identified (74 out of 148 cases), while the rest remained unidentified. This finding is consistent with patterns reported in wildlife crime literature where intentionality is often linked to organized or semi-organized efforts (Anonymous 2020). Improving intelligence networks and community informant systems can aid in increasing offender identification rates. Of the 30 respondents from Nagarhole, 83.3 per cent were male and they mostly fell in the 30–60 age group. The majority were wage labourers (80%) with low education levels, 50 per cent illiterate and 40 per cent educated only up to primary school (Table 8). Most respondents belonged to nuclear families. These socio-demographic factors suggest a link between economic vulnerability and involvement in forest crimes (Karanth 2008, Dutta 2020, Nikhil et al., 2023). Interventions aimed at livelihood generation, environmental education and local participation in conservation may reduce future crime incidence.

CONCLUSION

The comprehensive analysis of wildlife and other forest-related crimes in Nagarhole Tiger Reserve from 2008–09 to 2017–18 reveals critical insights into the spatial, temporal and socio-economic dynamics, which influence the illegal activities in the region. Despite an overall declining trend in reported offenses, episodic spikes and persistent hotspots particularly in DB Kuppe and Metikuppe ranges, highlight the need for sustained and range-specific enforcement strategies. Temporal patterns show elevated crime incidence during monsoon months, though these variations are not statistically significant across months or seasons. The high proportion of intentional crimes and the predominance of cases involving economically vulnerable individuals underscore the complex interplay between poverty,

Table 6. Profile of species affected by wildlife crime in the study area

Species	Scientific name	Numbers
Tiger	*Panthera tigris*	8
Leopard	*Panthera pardus*	7
Elephant	*Elephas maximus*	18
Wild boar	*Sus Scrofa*	4
Spotted deer	*Axis*	26
Sambar deer	*Rusa unicolor*	4
Barking deer	*Muntiacus muntjack*	2
Indian gaur	*Bos gaurus*	3
Hare	*Lepus nigricollis*	1
Fishing	-	47
Langur	*Semnopithecus entellus*	2
Jackal	*Canis aureus*	0
Tortoise	*Geochelone elegans*	0
Pangolin	*Manis crassicaudata*	0
Monkey	*Macaca radiata*	1
Birds	-	1
Snake case	-	1
Teasing	-	0
Honey	-	1
Mouse deer	*Moschiola indica*	0
Civet cat	*Viverricula indica*	0
Monitor lizard	*Varanus bengalensis*	2
Bat	*Pteropus giganteus*	0
Otter	*Lutrogale perspicillata*	0
Porcupine	*Hystrix indica*	0
Gaint squirrel	*Ratufa indica*	1
Fox	*Vulpes bengalensis*	2
Dhole	*Cuon alpinus*	1
Snare and hunting intension	-	16
Data NA	-	0
Total	133	148

Table 7. Classification and intentionality of Wildlife crimes in Nagarhole Tiger reserve

Particulars	Number
Identified	74
Unidentified	69
NA	5
Total	148
Intentional	139
Un-intentional	9
Data NA	0
Total	148

Table 8. Demographic characteristics of respondents in Nagarhole Tiger reserve

Particular	Categories	Frequency	Per cent
Gender	Male	25	83.3
	Female	5	16.7
Age	<30	5	16.7
	30-45	11	36.7
	45-60	11	36.7
	>60	3	10.0
Family Type	Nuclear	22	73.3
	Joint	8	26.7
Education	Illiterates	15	50.0
	Primary	12	40.0
	High School	3	10.0
	Plus 2	0	0.0
	Graduation and Above	0	0.0
Occupation	Farmer	1	3.3
	Private	2	6.7
	Wage Labour	24	80.0
	Dependent	3	10.0
	Others	0	0.0
Working days/Month	Low	7	23.3
	Average	18	60.0
	High	5	16.7
Total Number of cases Recorded		148	

awareness and opportunity in driving such offenses. The targeting of both charismatic megafauna and lesser-known species indicates the breadth of threats facing the reserve's biodiversity. In response, there is a pressing need to enhance patrolling, invest in community engagement and promote alternative livelihoods for forest-dependent populations. Strengthening institutional mechanisms, combined with local participation and environmental education, will be key to ensuring long-term conservation success in Nagarhole and similar protected landscapes across India.

REFERENCES

Anonymous 2020. *Assessment of Wildlife Crime and Illegal Wildlife Trade in India: Trends and Insights.* TRAFFIC India, New Delhi.

Anonymous 2023. *Status of Tigers, Co-predators and Prey in India, 2022 – Final Report*. National Tiger Conservation Authority (NTCA), Wildlife Institute of India (WII). Government of India, MoEFCC, New Delhi.

Dutta A 2020. Understanding poaching and illegal wildlife trade in India: A socio-economic perspective. *Wildlife Society Bulletin* **44**(2): 325-335.

Gubbi S, Linkie M and Leader-Williams N 2014. Evaluating the legacy of conservation: The protected area system of Karnataka, India. *Environment Conservation* **41**(1): 45-53.

Haq S M, Sircar D, Louies J, Sinha SK and Menon V 2023. Tracking

snares to mitigate the threat to wildlife: Quantification of hunting methods along the fringes of Valmiki Tiger Reserve, India. *Biological Conservation* **284**, p.110196.

Karanth K 2008. Wildlife in the midst of battles: Understanding human–wildlife conflict in India. *Current Science* **94**(7): 882-883.

Karanth K, Nichols JD, Hines JE, Karanth KU and Christensen NL 2013. Patterns and determinants of mammal species occurrence in India. *Journal of Applied Ecology* **50**(1): 109-118.

Karanth KU and Sunquist ME 1992. Population structure, density and biomass of large herbivores in the tropical forests of Nagarahole, India. *Journal of Tropical Ecology* **8**(1): 21-35.

Madhusudan MD and Karanth KU 2002. Local hunting and the conservation of large mammals in India. *Ambio* **31**(1): 49-54.

Madhusudan MD and Shankar Raman TR 2003. Conservation as if biological diversity matters: Preservation versus sustainable use in India. *Conservation Society* **1**(1): 49-59.

Meijaard E, Sheil D, Nasi R and Augeri DM 2011. People, forests and trees in Indonesia: When conservation means killing. *Biodiversity Conservation* **20**(6): 1117-1134.

Rana A K and Kumar N 2023. Current wildlife crime (Indian scenario):

Major challenges and prevention approaches. *Biodiversity and conservation* **32**(5): 1473-1491.

Rao M, Rabinowitz A and Khaing ST 2010. *Status review of the tiger, its habitat and prey base in Myanmar.* WWF and Wildlife Conservation Society.

Raza RH, Chauhan DS and Pasha MKS 2012. Evidence-based strategies to combat poaching in India. In: Menon, V. (ed.) *Conservation in Crisis: India's Forests, Wildlife and Biodiversity*, 99-112.

Sharma RK, Jhala YV, Qureshi Q and Vattakaven J 2019. *All India Tiger Estimation Report 2018.* National Tiger Conservation Authority and Wildlife Institute of India.

Singh JS and Kushwaha SPS 2008. Forest biodiversity and its conservation in India. *International Forestry Review* **10**(2): 292-304.

Nikhil PV, Muhammed Iqbal A, Aneesh KS and Gopakumar S 2023. Attitude of local communities towards human-wildlife interactions and wildlife conservation in the Peechi-Vazhani Wildlife Sanctuary, Thrissur, Kerala. *Indian Journal of Ecology* **50**(2): 546-548.