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## Livestock depredation by leopard (*Panthera pardus fusca*) in Vansda Taluka, South Gujarat

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### Abstract

Human-wildlife conflict is of growing concern because it threatens the survival of many wildlife species. This is especially true in case of large felids, most of which are threatened primarily due to anthropogenic causes, with conflict accounting for the highest mortality. Due to the increase in number of leopard and reduction of land area, the human-leopard conflict has increased, though the direct human interference with leopard is not seen but indirect use of the land and reduction of the natural prey to leopard and decreased prey base drastically have increased the indirect conflict with humans in many forms and the major one is the livestock depredation. In this study, we attempt to elucidate the ecological and social factors that drive such conflict in agricultural landscape in Vansda taluka of South Gujarat. We report an average 21.8 incidents of livestock depredation a year by the leopard. The depredation of Goats 43.12%, poultry 27.06 and Cow 19.72% formed the frequently attacked livestock and amongst the regions, the highest number of attacks (n=62) were in North zone followed by the Central zone (n=26) of Vansda taluka. Leopard's highest attack on livestock near sugarcane field was recorded during early morning (49.59%) followed by late evening (28.46%). The study revealed that a total of 50.46% attacks were in the evening, 80.20% infants of livestock were attacked and 75.63% attacks were when livestock is tied in the shed. The useful recommendations were concluded out of the study for forest department, local NGOs and farmers/villagers of the study area.

**Keywords:** leopard, livestock, depredation, Vansda taluka

### Introduction

Leopard is one of the most common animals in human-animal conflict (Khorozyan *et al* 2015; Karanth *et al.*, 2017; Naha *et al* 2018; Puri *et al* 2019) [39]. Reasons for high human-leopard conflict are due to the greater adaptability of leopard's diet- from mammals, arthropods, rodents, amphibians to rotting carcasses (Daniel 1996; Karanth 2013; Athreya *et al* 2014; Odden *et al* 2014; Majgaonkar *et al* 2019) [6, 55], as well as easier access to left out cattle and dogs in neighborhoods of Indian villages and towns (Athreya *et al.*, 2007) [5]. Openly available cattle are huge temptation to wandering leopards (Karanth *et al.*, 2017) [41]. Food scarcity, depletion of the natural prey base, degradation and fragmentation of leopard habitat, and human modified landscape same as the leopard habitat are also responsible factors for leopard's intrusion in human dominated landscapes and creating conflict. Scarcity of site-specific detailed study on this most occurring problem in many parts of India disables us to scientifically comprehend the exact process behind increasing rates of human-leopard conflict (Bhatia *et al* 2012; Kalle *et al* 2014; Kshetry *et al* 2018) [42]. One common assumption is that rainfall regions are getting lesser and forests density is getting scarce day by day, and that is why this wild cat is entering in human territories where negative interaction with people is experienced. (Karanth *et al.*, 2019).

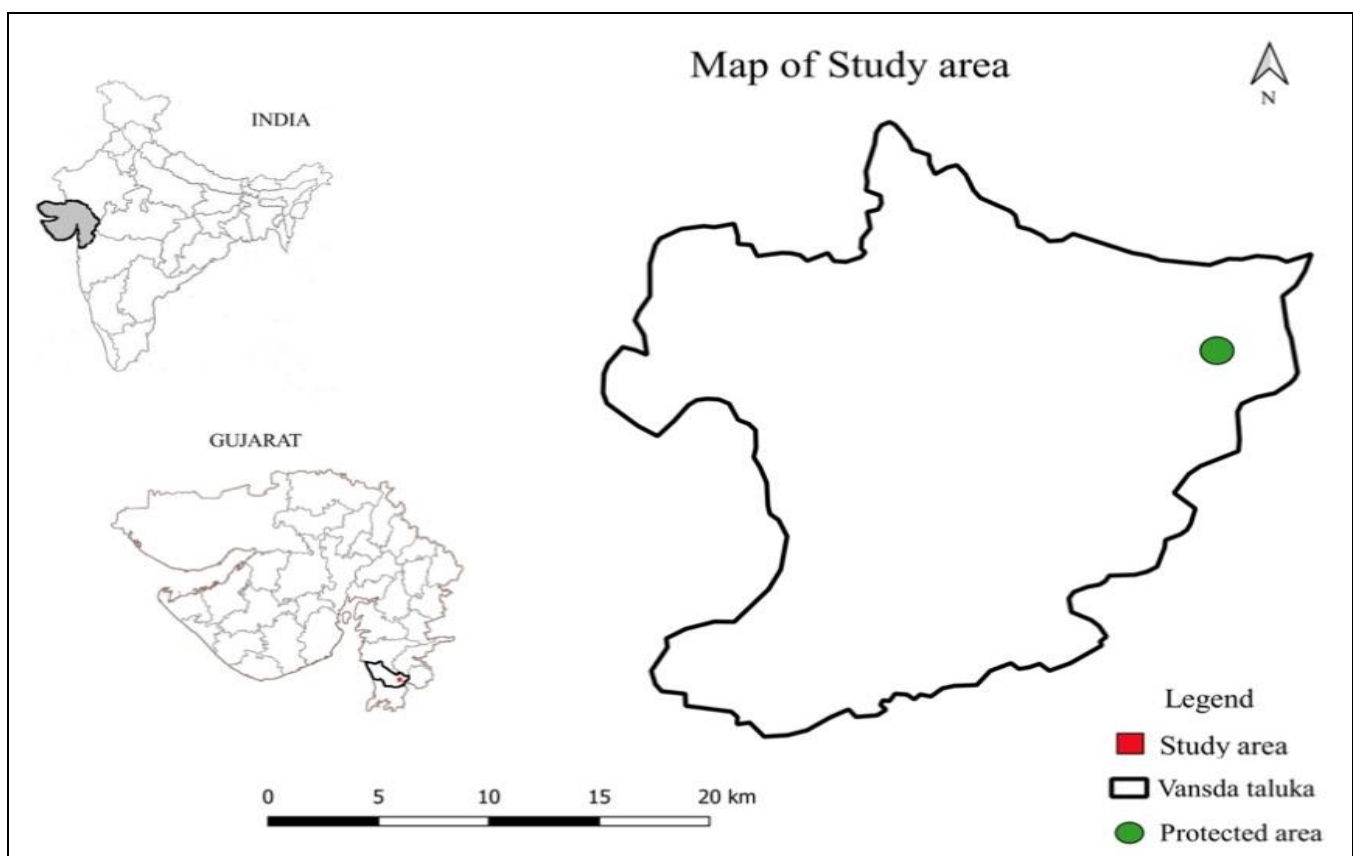
Leopards, like other felids have a well-defined land tenure system- where the basic layer of land used in the territory of other females, and this layer is superimposed with the territories of males which are much larger, and can either contain or overlap with many female territories (again no tolerance is accepted towards other males). The final layer is of the transients, usually sub-adults in search of new or vacant territories. Female sub-adults settle close to their mother whereas males are driven out to search for new territories, a strategy that prevents reproduction among close relatives. This large and constant pool of transients and their habit of ranging far make the species difficult to manage when some individuals come into conflict with humans (Athreya & Belsare, 2007) [5].

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In most part of India, government grants ex-gratia for livestock damage, crop raid or human injury by any wild species including leopards; however, a large sum of rural population is unaware about these compensatory schemes (Madhusudan *et al.*, 2003). Sometimes villagers indulge in retaliatory killings because of high panic or aggravated anger (Malviya and Ramesh 2015) [46]. Attacks on livestock are tolerated to a large extent due to the inherent non-violent attitude of the people and also due to the ex-gratia paid by the government, but human-leopard conflict turns uncontrollable once human injury or deaths are experienced. One of the most important factors, that allow leopards to survive close to human habitation, is large number of stray animals. India is agriculture-based country and livestock is a subsidiary vocation. Most of the cattle are grazed around village lands, kept near homes and similarly large numbers of stray dogs can be seen in the cities. Moreover, population control of stray animals is not routinely carried out and cows are not killed because of religious sentiments (Athreya *et al.*, 2007,

2014) [5,6]. This has lured leopards from forests to villages and towns. Sugarcane field, tea plantation and other tall crop like jowar and bajra have provided ideal habitat, and thereby imposing to live close to humans and consequently a conflict situation. In Gujarat too, the same reasons are guessed as possible causes for the increasing in human-leopard conflict. So, how do we deal with the issue? The conflict is not only of leopards, it lies with 75% world's felid species (Inskip & Zimmermann, 2009). Most common method in India is "rescue and release". But the effectiveness of translocations as a management strategy to reduce conflict is minimal due to high morality involved with translocations and large-scale homing behavior of leopards in the absence of soft release. Leopards leave the area of release immediately, increase intra specific aggression and infanticide if a resident territory is lost to the newcomer (Athreya *et al.*, 2017).

## Materials and Methods



**Map 1:** Map of the Vansda Taluka

The Vansda Taluka of Navsari district is selected for the present study as frequent human-leopard conflict has been reported in the area for 10 years of time. The Vansda Taluka lies between 20.45° N to 73.22° E. With an area of 557 km<sup>2</sup>, the Taluka is situated in Sahyadri region of Western Ghats and is entirely hilly except some part fertile valley.

As per land utilization survey carried out in 2014-15, the land pattern comprises of Vansda Taluka Forest - 20,270 ha, barren and uncultivated land - 20,270 ha, permanent pastures and other grazing land - 2,216 ha, land under miscellaneous tree crops and grooves - 41,280 ha, fallow land - 105 ha and agricultural area - 59,972 ha.

The rural population of the area is economically poor. Source of income is agriculture along with livestock rearing. Every

house invariably has a few cows or buffalos, goats and poultry. Some shepherds have large number of sheep and goats. In order to meet their daily needs, they depend on the forests and forest produce. The total population of livestock was 1,46,279; including 96,631 cattle, 19,097 goats, 36 sheep and 30,083 buffalos. Other livestock includes horse, mule etc. Vansda National Park (VNP) is the smallest national park of the state, comprising 23.99 sq km.. The national park has over 450 species of flowering plants. 12 species of Mammals, 30 species of Reptiles are found in the park & 121 species of spiders and 45 species of butterflies found in the National Park. (Vansda National Park Management plan 2016-2025). Among all, Leopard rules the bio diversity pyramid.

### Data Collection

This study aimed to investigate the nature and extent of human injuries, livestock killing by leopard and also leopard deaths by human beings, spatial and temporal patterns of conflict between humans and the leopard. To study the human-leopard conflict, a reconnaissance survey was done in the Vansda Taluka. We examined predation activity of leopard on humans and a variety of livestock for the period 2010 to 2020. Field data were collected using a combination of qualitative methods (unstructured interviews, participatory observation and focus group discussions) and quantitative methods (structured interviews). Information on the human casualties, livestock killing and circumstances was collected in specially designed questionnaire formats and by interviewing the affected villages. Information on the number of injured and killed persons; time of incidence, age and sex of the victims, place of attack, activity of the victims, mode of attack and nature of injuries etc. was collected from all the affected villages and survey sites in pre-designed questionnaire formats.

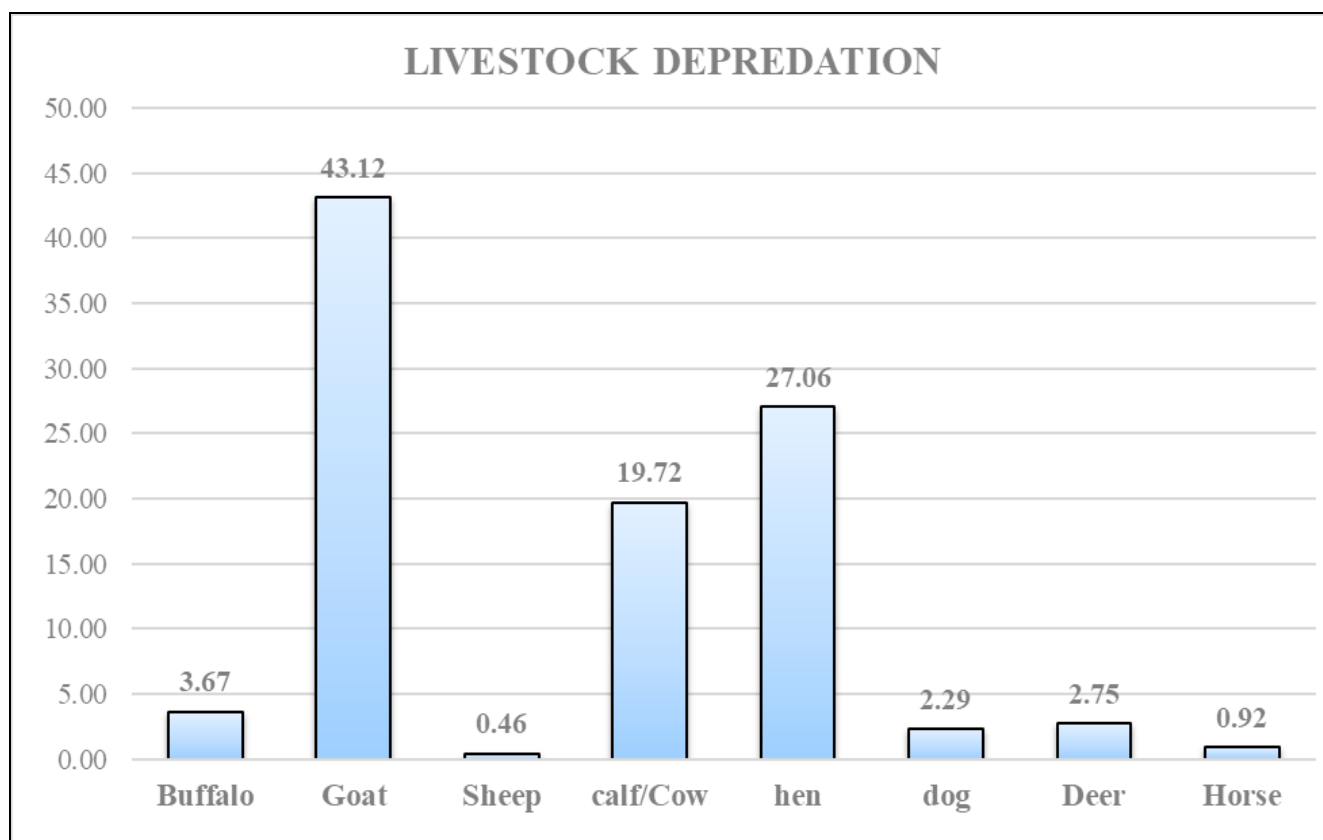
Similarly, the information on the livestock killing by the leopard, time and place of incidence and age class was collected. A zone map showing man-leopard conflict in relation to distribution and abundance of domestic livestock has also been developed. According to villager's opinion

where the Leopard were roosting in their areas, farms like sugarcane fields and vegetation fields or near the place they leave camera traps were set to trap the leopard in the cameras so that leopard's presence can be noticed in the study area. After studying and collecting all the data, area is divided into five zones: (1) Central Zone, (2) North Zone, (3) South Zone, (4) East Zone and (5) West Zone for the analyzing of the data.

### Results and Discussion

#### Livestock Depredation

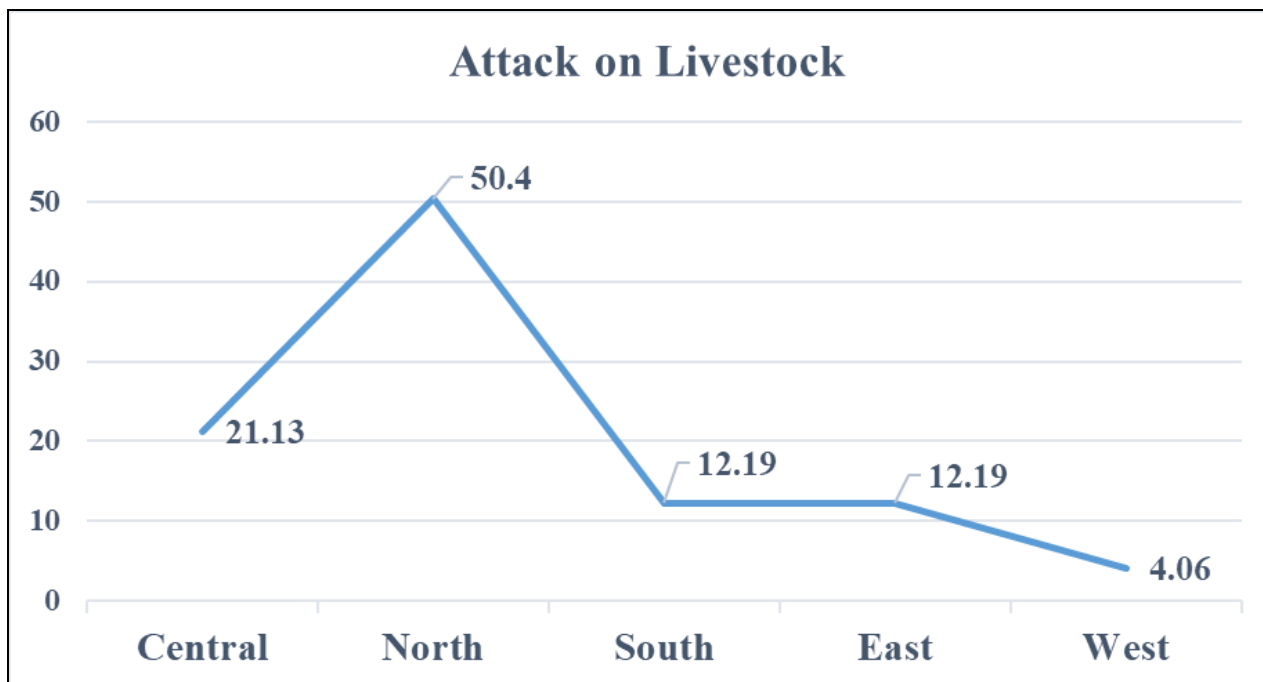
Over a 10 year period (2010-2020), almost all forms of livestock were reported to be predated by Leopard. In total, there were 218 livestock attacks in the study year, and among these 123 attacks were noticed by the forest department and the rest were recorded by the villagers. With an average 21.8 incident in the year. There might be large number of cattle-lifting cases in Vansda Taluka, from which many of the cases might have not been reported to forest department on time perhaps many cases have not been recorded by forest department (Fig-1). Amongst livestock, Buffalos (3.67%), Goats (43.12%), Sheep (0.46%), Calf & Cow (19.72%), Dogs (2.29%), Hen (27.06%), Deer (2.75%) and Horse (0.92%) were predated by the leopard in the study area in a decadal time of study.



**Fig 1:** Livestock attack by leopard in Vansda Taluka

The highest number of attacks in the North zone, with the number of 62 (50.40%), followed by the Central zone with 26 (21.13%) attacks; whereas, in south and east zone remain with

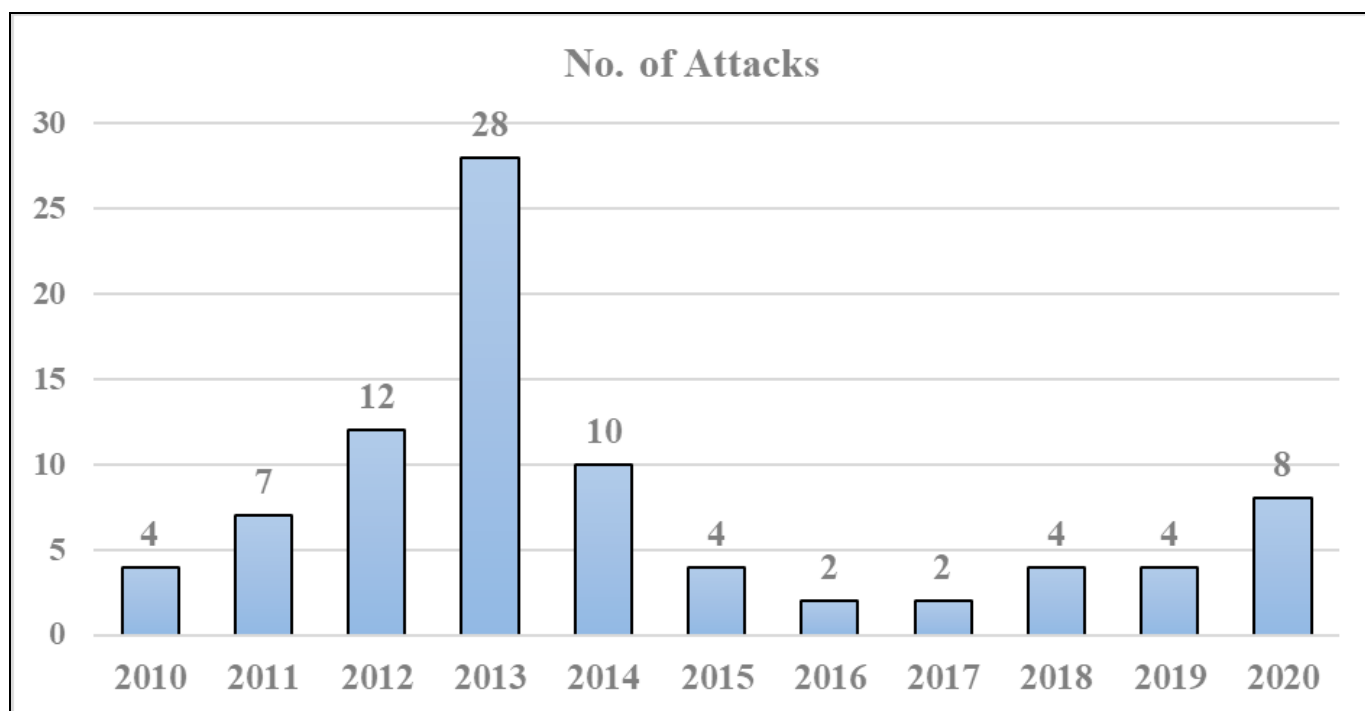
the same number of attacks- 15 (12.19%), and with 5 (4.06%) attacks, the West zone had the least number of attacks (Fig - 2).



**Fig 2:** Livestock attack by leopard in Vandsa taluka

Leopard, being the apex predator of the region, was responsible for killing all forms of livestock in this area. Number of incidents of livestock killing differs in each year of decade. According to the data collected from forest department and leading newspapers, the highest incident

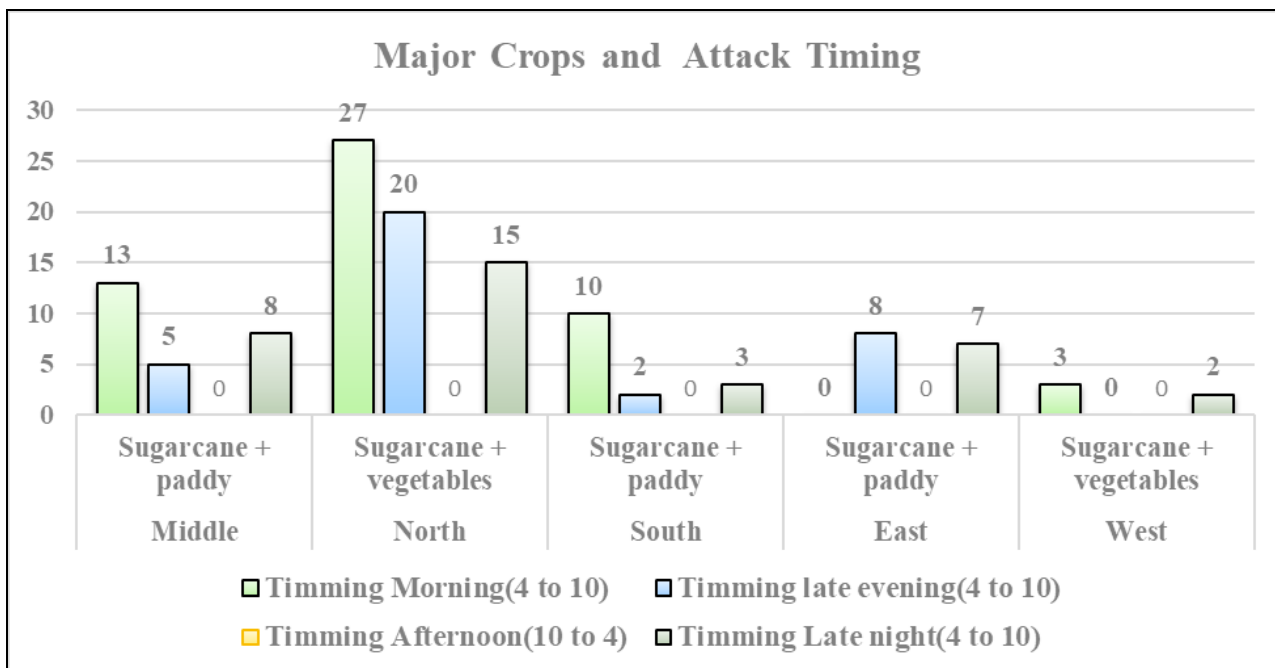
occurred in the year 2013 with 28 cases, followed by 2012 and 2014 with 12 and 10 cases, respectively whereas 2016 and 2017 recorded as less as 2 cases per year (Fig-3).



**Fig 3:** Year wise recorded livestock attack in Vandsa taluka

During the study period we found that Goat, Hen and Calf/Cow suffered the maximum. Out of 218 total attacks, there were 94, 59 and 43 (43.11%, 27.06% and 19.72) on Goat, Hen and Cow, respectively, followed by Buffalo, Deer and Dog 8, 6 and 5 (3.66%, 2.75% and 2.29%) attacks, respectively. Different crop present in the study area such as Sugarcane, Paddy and Vegetables were grown maximum and

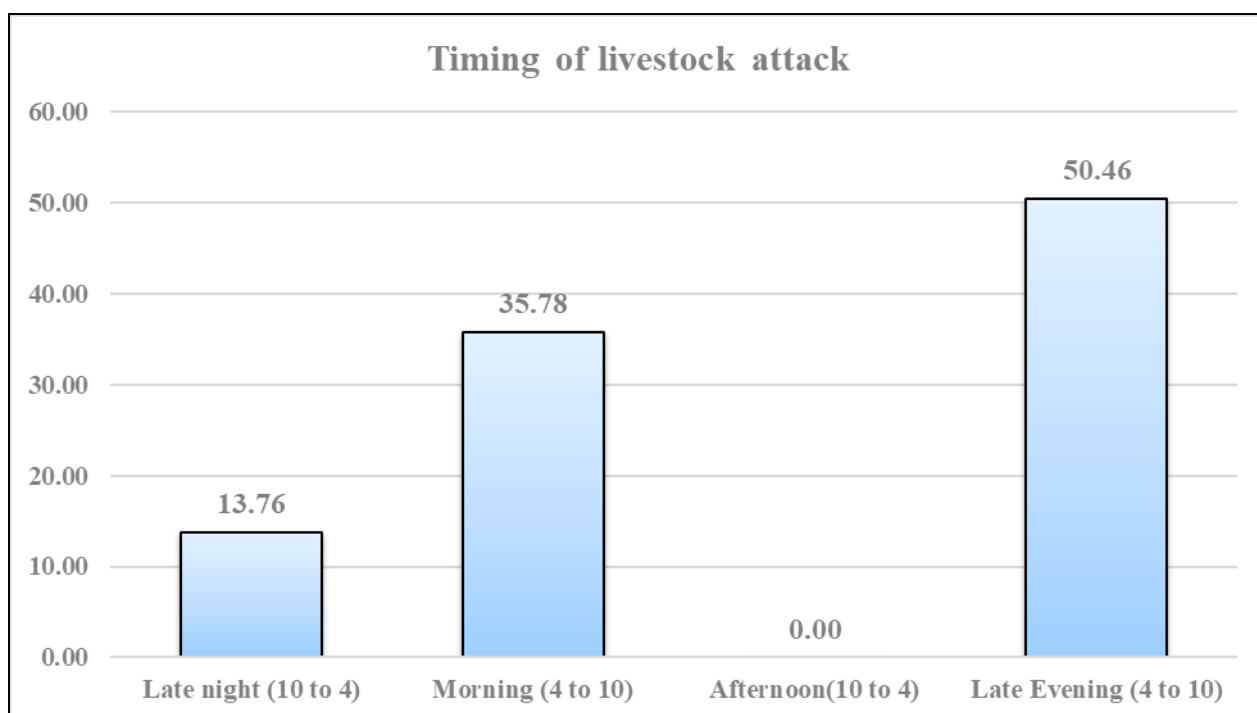
that correlates with the presence and absence of leopard. The primary data analysis revealed that the majority of Leopard attacks were noticed in North zone of wherein large sugarcane fields are in abundance. Furthermore, leopard’s highest attack on livestock near sugarcane field was recorded in early morning time (49.59%) followed by late evening (28.46%).



**Fig 4:** Attack on livestock in various crop fields with varied timings

Studying the overall attack pattern of leopard, evening attack was the highest by 50.46%, followed by early morning 35.78% and the late night 13.76% is been recorded. In

addition, no record of attacks has been noted during afternoon (Fig-5).



**Fig 5:** Attack time on livestock in Vansda Taluka

Leopard was responsible for killing livestock of different age groups in the study area. The record shows the maximum attack on the adult animals. There was visible variation in the age group below 3 years of livestock infants of Buffalo, Goat, Sheep, Cow, Dog, Donkey and Horse, which has been eaten and attacked the highest with the total number of 158

(80.20%) attacks. Then the age group above 3-5 years were recorded with the number of 32 in total (16.24%). Lastly, the age groups of 5-8 years and above had the least record of 7 cases (3.55%). Thus, in total 197 cases were recorded in ten years (Fig-6).

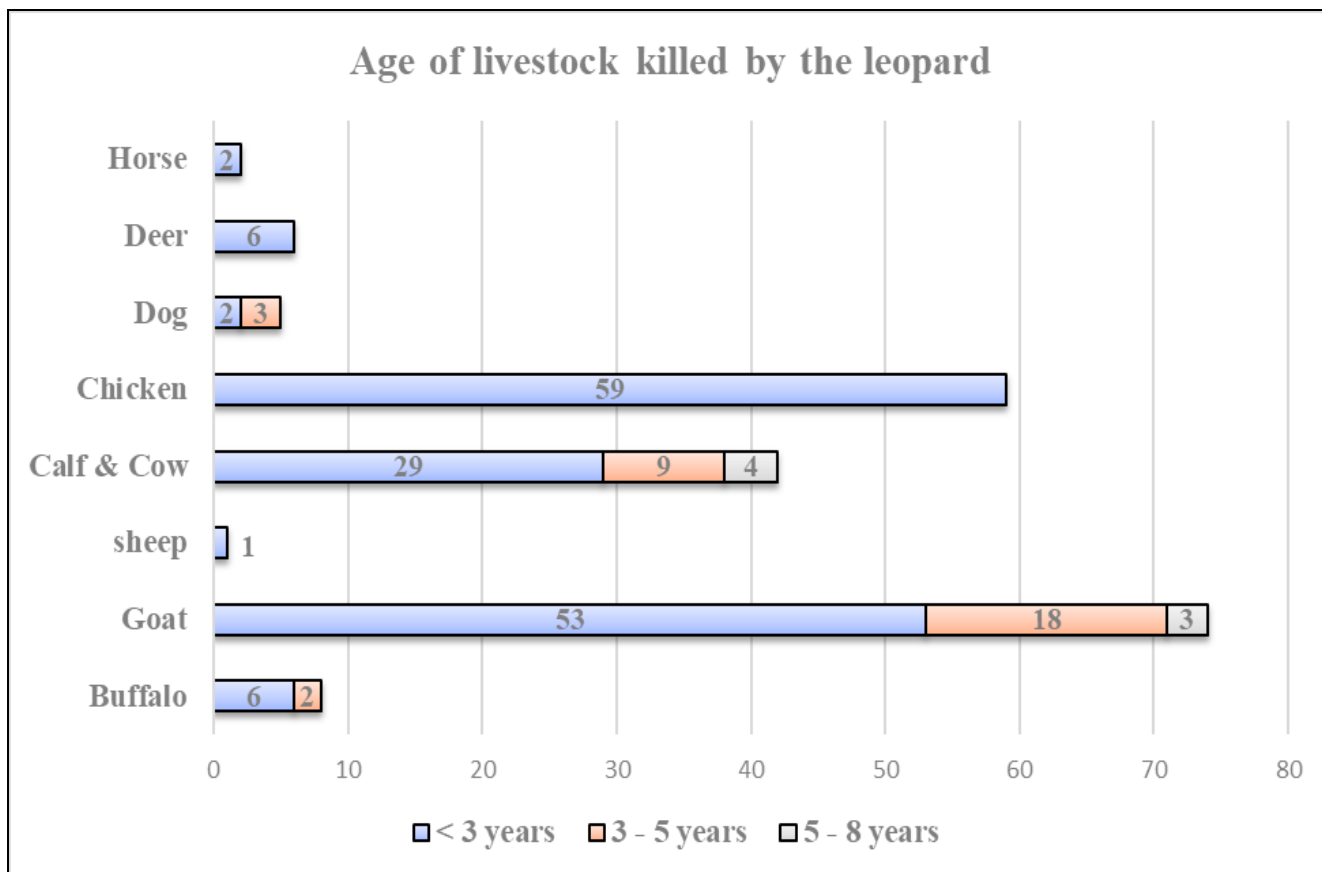


Fig 6: Age wise livestock attacked by leopard in Vansda taluka

Various livestock attacks and fatalities took place in different places viz. tied in sheds, running in crop field or forest area, and covered with basket by the owner. Out of total 110 recorded cases, the highest occurred while the prey was tied in the cattle shade with a count of 75.63% followed by roaming livestock with a count of 24.37% (Fig-7).

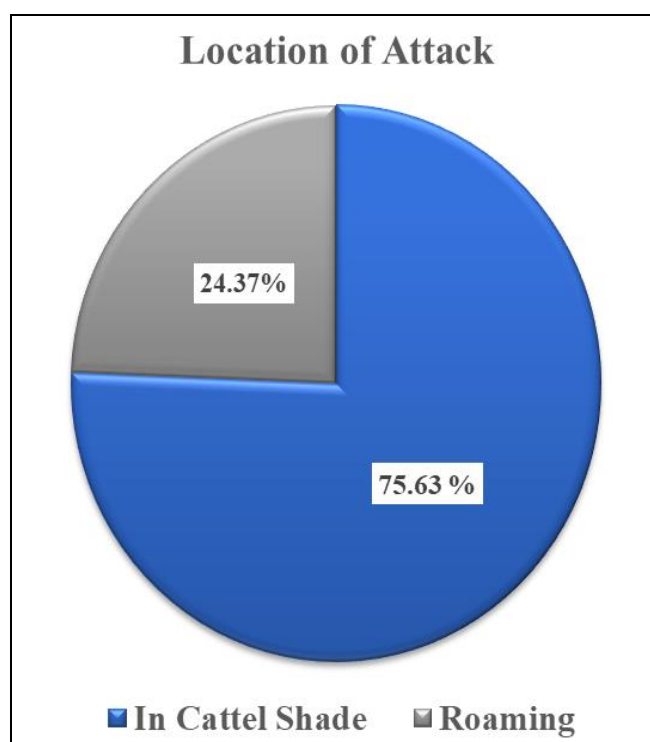


Fig 7: Pattern of livestock attack by Leopard

**Statistical Analysis**

Table 1: Correlation coefficient for Livestock depredation analysis

| Model     | Coefficients | Standard Error | t-test | P-value |
|-----------|--------------|----------------|--------|---------|
| Intercept | 0.304        | 0.757          | 1.722  | 0.594   |
| (x1)      | 0.121        | 0.286          | 0.485  | 0.573   |
| (x2)      | 0.182        | 0.233          | 0.783  | 0.439   |
| (x3)      | 0.182        | 0.319          | 0.502  | 0.570   |
| (x4)      | 0.121        | 0.286          | 0.505  | 0.573   |
| (x5)      | 0.060        | 0.357          | 0.170  | 0.865   |

x1 - Livestock attack by leopard, x2 - Age of Livestock, x3 - Time of attack, x4 - Crop type, x5 - Location

It was decided to utilize the correlation between surveyed collected data to that of method of correlation regression for analyzing the data. By this analysis, summary models were produced. Three predictive variables were significant at the 0.5 level [(x1) 0.42, (x3) 0.50, (x4) 0.50] All the models showed significance level of p = 0.5, except the value of (x2), (x5).

Table 2: Regression Statistics

| Multiple R | R Square | Adjusted R Square | Standard Error | Observations |
|------------|----------|-------------------|----------------|--------------|
| 0.201      | 0.890    | 0.849             | 0.206082       | 5            |

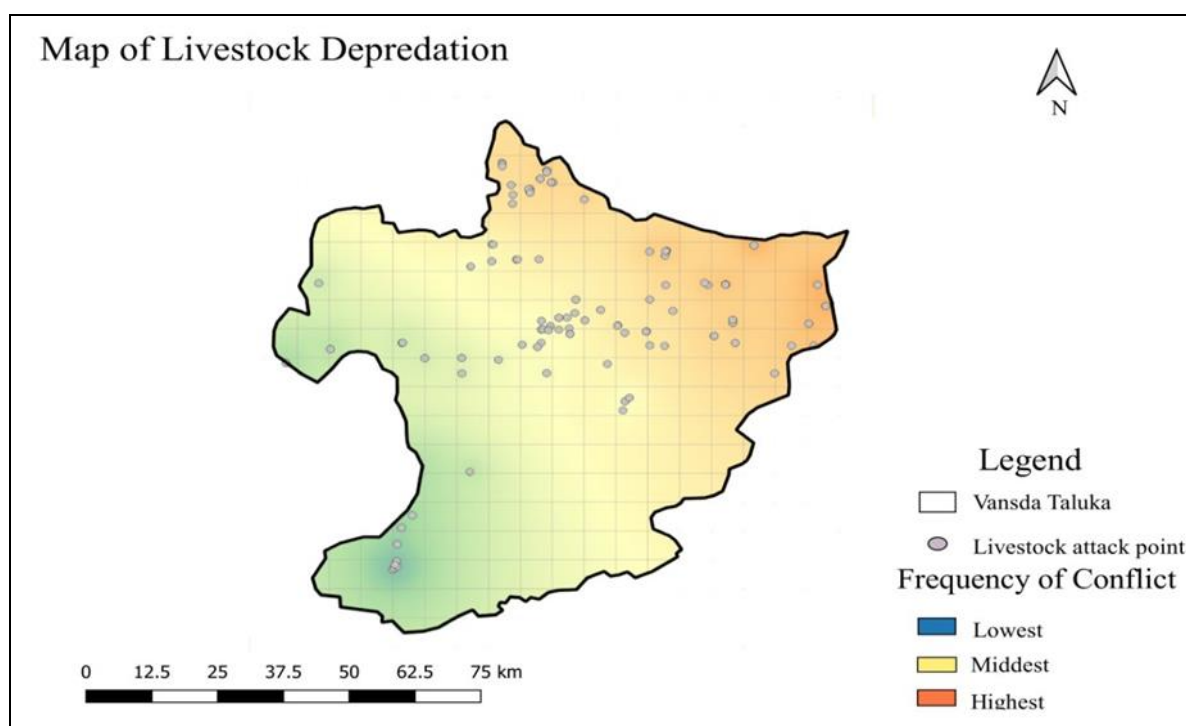
Table - 2 shows the result of the predictive variables in the simultaneous manner towards multiple correlation regression analysis is 0.849 percent of the variance as explained in the predictor of the variable (R square .849 x 100 = 84.9; 84.9 + 15.1 = 100%). The predictive variable of the Livestock Depredation is number of attack, crop, age, position and time are stated in this model. The R square in a multiple regression

represents the explained variation that can be contributed in the predictor and correlation. The R square gives explanatory power, in Table - 2 the model summary shows the value of R squared of .890 (.890 x 100 = 89.0%) or 89.0. The variance in the dependable variable (Human-Leopard Conflict). The percentage shows Livestock depredation in surveyed data.

### GIS Mapping of Livestock depredation of Vansda Taluka

Vansda Taluka of Navsari District covers 556 sq km area. A base map of this study area was prepared by removing all the divisional boundaries, settlement area, drainages, roads and survey was carried out by using 0.79 cm scale. The vegetation and other landscape features survey was carried out in 2019-20. After the survey, a grid of 2 × 2km was generated for entire study area to get accurate information about human leopard conflicts. Vegetation and other habitat types were

classified using GPS system and number of human leopard conflicts for each grid was done during the study period. The survey of conflicts was estimated on the basis of numbers of leopard attack on human and livestock depredation. Primary data was collected on presence of leopard's pugmarks and scat which was noted in the study area. Secondary data was collected from the Forest Department, local survey through interview and questionnaire and the literature of last 10 years was also considered to get related information. Primary and secondary data of human leopard conflicts was collected and graphical representation was done in the form of map. According to the data collected from primary and secondary sources, all grids were classified and coded into different conflicts categories i.e., low, medium and high. Finally categorized grids were overlaid on the map with the help of QGIS (3.12) & (2.8) and IDW plugin.



**Map 2:** Gradient of livestock depredation in Vansda taluka

### Conclusion

Based on the records of the forest department, village survey, and interview with the local people and assessing leading print media's coverage of ten years in this study, recommendations are made to effort to minimize human-leopard conflict in the study area. The forests of Vansda are patchy and fragmented. Sugarcane, Paddy and Vegetables are being grown in abundance around the villages. Leopard increasingly use the Sugarcane farm for hiding, ambush and attacking livestock. Villages are scattered but most of them are located in the close vicinity of forests. The pariah dogs are the delicacy of leopard, villagers should keep dogs in their houses. In the late evening and night, dogs can be kept inside rooms or in safe pet house. This will greatly help in keeping leopard away and attacks can be minimized. Livestock especially young ones should be kept in secure shed and movement during evening time should be reduced or taken care. To further minimize human-leopard conflict in Vansda, education and awareness programmers related to ecology and behavior of leopard, genesis of leopard menace, possible mitigation strategies need to be devised. For conducting

systematic research study, we recommend a detailed study on population ecology including habitat use, movement, activity and dietary pattern of leopard. A site specific human-leopard conflict mitigation plan is recommended for long term solution.

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