Final Draft

Spatial analysis of livestock predation by lions in the Greater Gir Landscape

Project: Reconciling development with conservation: Delineating habitat patches and corridors for Gir lions

1st year Technical Report 2018

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Front cover photograph –Keshab Gogoi

Summary:

Data on livestock kill by carnivores (lion and leopard) were collected from the districts of Junagadh, Amreli, Gir Somnath and Bhavnagar, accounting for 914 villages between 2012-13 to 2016-17. These data were further translated into English, digitized and spatially mapped in GIS. We obtained remotely sensed as well as spatial covariate layers of forest cover, lion refuge patches, drainages and nigh-light intensity. We conducted a fixed Kernel analysis of spatially explicit livestock predation events at the village resolution to obtain a consolidate "predation risk map" of the landscape on a relative scale and used it for subsequent analysis.

The tehsils of Jafrabad, Gir gadhada, Amreli, Dhari, Khambha and Rajula recorded highest livestock predation by lions. A temporal increasing trend was observed for number of lion-predation events as well as in the spatial extent of predations. More importantly the intensity (number of livestock kills/village/year) of livestock predation showed an increasing trend (R^2= 0.73, P= 0.06, slope = 15 % (SE 0.05))**,** this suggests not only an increase in the spatial extent of the conflict but also a substantial increase in the magnitude of conflcit within the same spatial extent. A logistic regression, given by: Ln Odds Ratio (occurrence of lion predation) = -0.16 + 0.76 * distance to forest + 0.54* distance to lion habitat; (Wald's $p < 0.05$).

The increasing trend in the extant and intensity of livestock predation by lion was indicative of an increasing lion population but of concern in maintaining the tolerance of local communities towards lions co-existing with them. A significant deficit between the market rate and compensated amount for lion predation ($R^2 = 0.74$, p=0.06) was observed with an increasing trend. As a management strategy we recommend a revision of compensation rates to match the market price and an efficient system to pay compensation promptly. Improved husbandary practices and, as well as managing lion density below social carrying capacity is recommended. This would help maintaining tolerance towards lion under an increasingly conflict scenario.

Introduction:

Currently, managing successful recoveries of carnivore populations exceeding the carrying capacity of protected areas is one of the biggest global conservation challenges (Hayward *et al.* 2007). Although large carnivore populations thriving outside of protected areas are rare but also existing in Europe (Chapron *et al.* 2014), North America (Bangs *et al.* 2001) and Asia (Singh & Gibson 2011)). The concomitant rise in human appropriation of natural resources with increasing human population around carnivore habitats inevitably intensifies negative interactions amongst human and large carnivores (Graham et al. 2005). For lions (*Panthera leo*), in particular, high profile debate surrounds the issue of whether they can be conserved effectively outside protected areas (Packer et al. 2013, Stephens 2015). Whereas, in India, the Asiatic lion population is on a rise (Bauer et al, 2015, Singh 2017), presently estimated over 500 individuals (Gujarat Forest Department 2015) spanning over more than 20,000 km^2 outside protected areas (Singh 2017). Concurrent with a 19.17 % rate of human population growth (Human census report 2011) in Gujarat state there has also been a 126% increase in the population of Asiatic lions outside the protected area in the last 5 years (Gujarat Forest Department 2015). About 30% of the total population is known to be located outside the protected area (Gujarat Forest Dept. 2015). Due to the natural paucity of wild prey in such landscapes, lions often predate upon livestock (Inskip and Zimmermann, 2009). Moreover, outside the protected areas Asiatic lions are also dependent on scavenging dead livestock (Banerjee 2012). Large carnivores habituated to anthropogenic food sources are known to modify their daily behaviour (Ayres et al. 1986, Matthews et al. 2006) and lose fear of human beings (Masse et al 2014). This change in behaviour escalates the conflicts with humans (Herrero et al. 2011). Such negative interactions with humans not only results in loss of property and live but also creates anti conservation sentiment amongst the locals (Woodroffe et al.

2005). Religious beliefs and cultural importance have undoubtedly played a significant role in India towards losses to wildlife conflicts but such values are changing fast and wildlife managers need innovative mechanisms for conflict resolution (Sukumar, 1994). In this report we analyses livestock predation by lions between 2012-13 to 2016-17 to understand spatial and temporal patterns and potential explanatory factors in an attempt to guide management of lion-human conflict.

Fig 1: Lioness feeding on a cattle in Savarkundla, the Greater Gir Conservation Area

Methods:

Field method:

Data on lion livestock predation from 2012-13 to 2016-17 were collected from the respective forest divisions and ranges across the Asiatic Lion Landscape. Often sites were visited to validate actual locations of conflicts and other relevant information if such were not available on the records. Data were collated from 914 villages, of which 250 villages were ground validated. The villages come under the forest divisions of Junagadh, Gir West, Gir Somnath, Dhari, Amreli and Bhavnagar in the districts of Junagadh, Gir Somnath, Amreli and Bhavnagar.

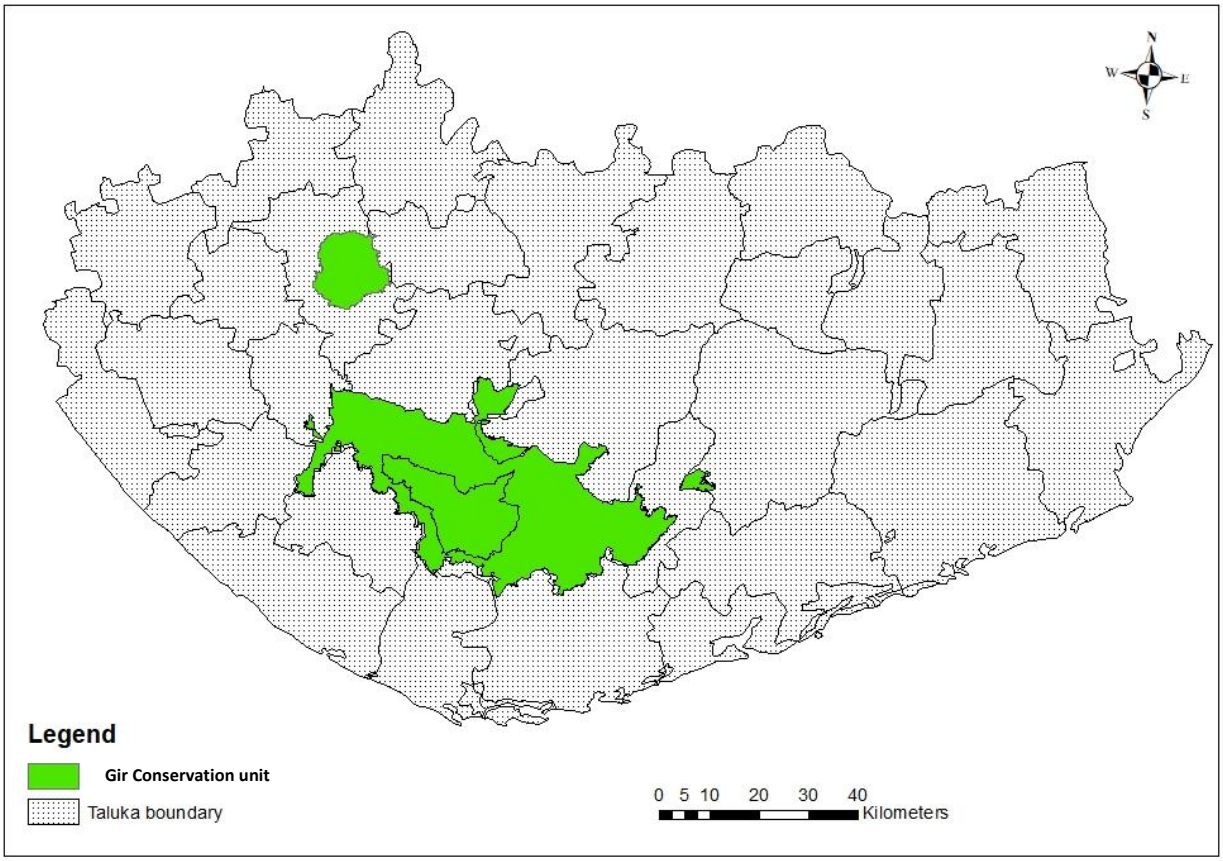

Fig 2: Map showing the study area of Saurashtra with talukas and Gir Protected area representing the Greater Gir Ecosystem.

Analytical methods:

We translated all the information from local language Gujarati into English and subsequently geo-referenced each data point into an analyzable format using excel spread sheet (Microsoft Inc 2016) and Arc Gis 10.2 (ESRI). Village shapefiles were obtained from Survey of India. The magnitude of livestock predation at every village was attached to the centroid of that village. These point locations were then used to map the predation hotspots by using Kernel density estimator (KDE) (Silverman 1986; Brunsdon 1995). KDE is a fundamental data smoothing technique where inferences about the populations are made based on finite data samples. In its usual form, kernel density estimation is a spatial method of estimating the probability density function of some variable x from a data set of observed values of **x (**in this case lion predation events in villages). The shape of the kernel depends on the smoothening parameter (h). When h is too small, kernel becomes very 'spiky' and when h is too large, f **( )** is oversmoothened. We used a value of h=5 km to obtain a realistic smoothing of our data based on lion movement. The information on the values of the utilization distribution function of the fixed kernel estimator were subsequently extracted for every 5 km^2 grid and used for spatial analysis.

We used the following remotely sensed and derived spatial variables to analyze livestock predation by lions.

Night light (NL): Surrogating for human habitation areas and urbanization. Acquired from United States Air Force Defense Meteorological Satellite Program (DMSP) and National Oceanic and Atmospheric Administration's (NOAA) Operational Linescan System (OLS) with a pixel size of 2.7 km X 2.7 km. (http://www.ngdc.noaa.gov/dmsp/sensors/ols.html; accessed 30 May 2015) (Elvidge *et al*. 1997). We computed the intensity of the nightlight by averaging the pixel values of

nigh-light within the grids. We also computed the distance of a grid from night-light above the threshold intensity of 10 using ArcMap 10.2 (ESRI) as Euclidean distances.

Forest patches: The locations of the forest patches, generated by unsupervised classification (Basu et al 2013) including National Parks and Sanctuaries were {obtained from the Wildlife Database cell of the Wildlife Institute of India (http://www2.wii.gov.in/nwdc/index.html)}. Area under forest cover and euclidean distances from such forest patches for each grids were generated using Arc GIS 10.2 (ESRI).

Lion habitat: Ecological Niche Factor Analysis (ENFA) with GPS fixes from radio collared lions, lion signs (scats, predation events etc.) and historical ad-libitum lion sightings presence data were used in the program Biomapper to model lion habitat in this landscape (Basu et al. 2013). The area of lion habitat in each grid and distance of a grid from lion habitat were computed and used a covariate to explain livestock predation by lions.

Drainage: Lion and leopards often use drainages as corridors and cover for movement. The major drainage maps of the digital chart of the world (ESRI 1992) for the landscape at a scale of 1: 1000,000 were used. Total length of drainage in each of the grids was quantified using Hawth's tool in ArcMap 10.2 (ESRI). This drainage density for each grid along with **e**uclidean distance from drainage calculated using ArcMap 10.2 (ESRI) were used as covariates of lion predation.

We analysed temporal pattern in livestock predation of lions by exploratory analysis and logistic regression. To explore the relationship of different factors that could potentially influence the occurrence of predation in a grid, we categorized the grid cells into presence or absence of predation events and box-whisker plots were plotted for each of the explanatory variables in NCSS

(Fig 13 – Fig 22). Subsequently, to explore how the magnitude of conflict is influenced by different covariates, we categorized the predation events into No predation, Low, Medium and High predation magnitude and box-whisker plots were plotted against each of the variables in NCSS.

The Gujarat Forest Department pays compensation for damage caused by lion and leopard. Though it is one of the finest schemes in the country the compensation is a measure of reducing the impact of predation and does not fully cover the actual market price loss. We compiled the number of livestock killed by lions in the Greater Gir Landscape annually and computed the compensation amount that would have been paid by the Gir Forest Department as per the official rates. We compare this amount with the actual loss as computed from current market price of each livestock to estimate the actual monetary loss incurred by local community due to lion predation despite being compensated. A temporal trend would provide an index of resentment by community and potential for reducing tolerance.

Results:

The extent of livestock predation by lion across the Greater Gir Landscape of Saurastra was found to be skewed. The eastern side of the landscape had higher extent of livestock predation which towards the western side was abruptly truncated a few kilometers from the protected area boundary (Fig 3). This map also depicts the eastward dispersion of the lions and current extant of their distribution in the landscape, indicative of non-extant habitat patches and connectivity towards the western part.

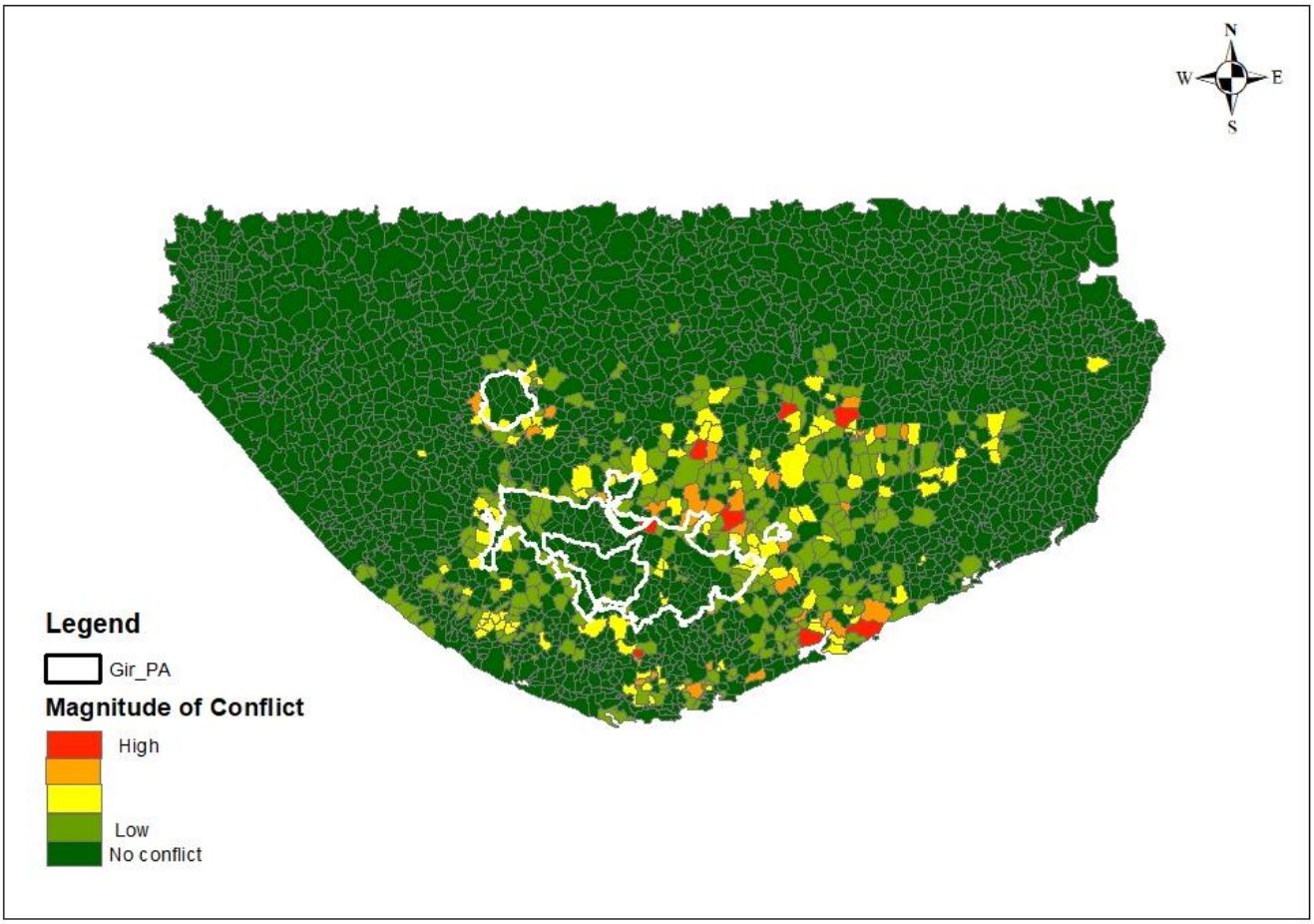

Fig 3: Village level magnitude of livestock predation by lion in last 5 years (2012-13 to 2016-17) within the Greater Gir Landscape of Saurashtra

High predation was recorded from villages bordering the protected areas and in the eastern landscape along the Shetrunji basin and coastal regions (Fig 4). There seems to be no spatial relation between intensity of nightlight and predation magnitude. This shows that lions killed livestock across the landscape irrespective of the size of human and livestock population at a site.

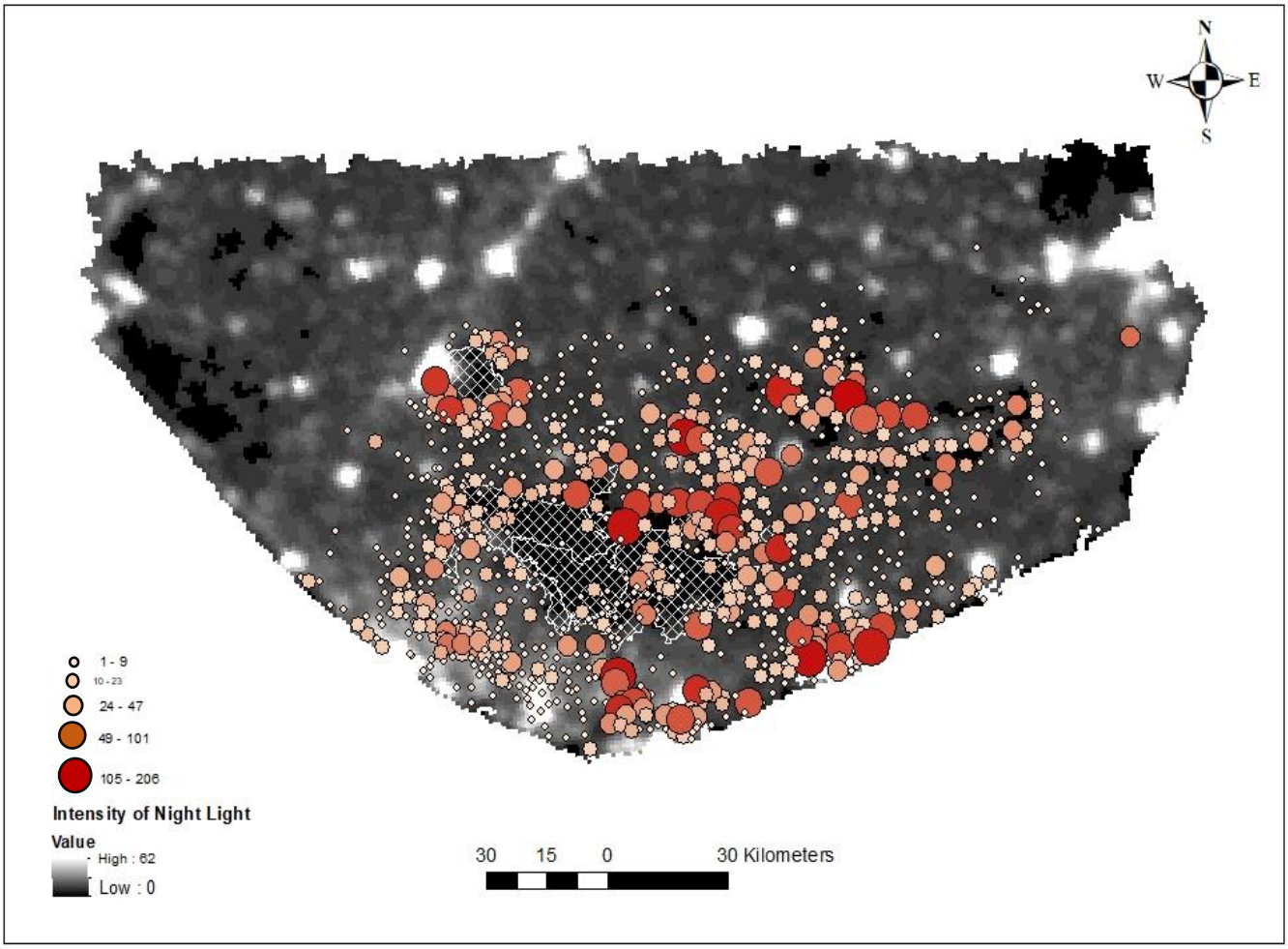

Fig 4: Distribution and intensity of livestock predation by lion between the years 2012-13 to 2016-17 overlaid on nigh-light intensity within the Saurashtra landscape.

The kernel utilization distribution (Fig 5) shows a clear pattern of livestock predation with high intensity recorded along Girnar Sanctuary, Shetrunji basin, Amreli, coastal regions and Khambha-Mitiala belt (Fig 5). Temporal patterns of livestock predations across years were suggestive that the intensity of livestock predation was on the rise in the areas of Ambaradi of Dhari Taluka from 2014-15 onwards. A similar trend was observed in Savarkundla (Amreli) and in the coastal areas of Mahua and Jafrabad where new predation hotspots were found to emerge (Fig S1, S2, S3, S4, S5).

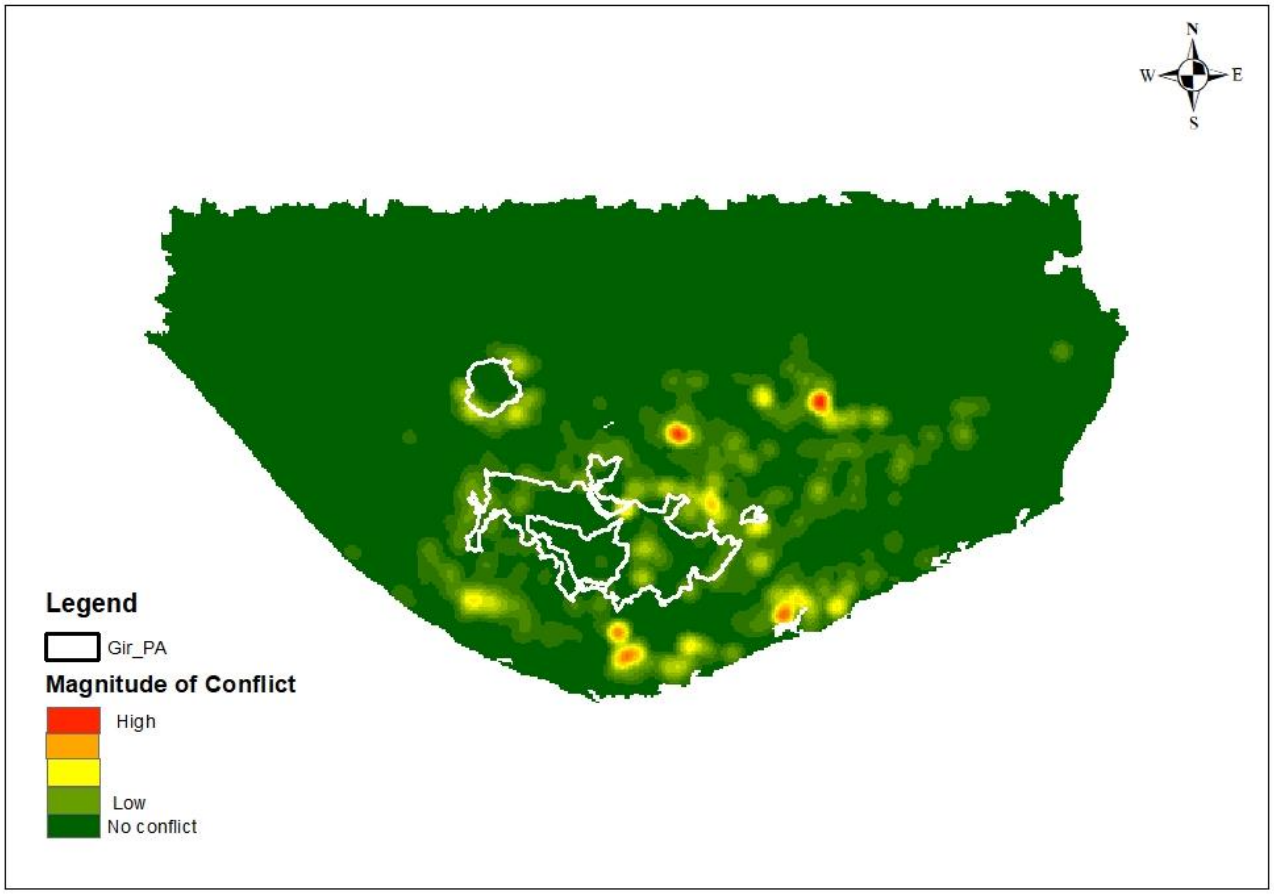

Fig 5: Kernel density of livestock kill intensity by lions within the Greater Gir Landscape between 2012-13 to 2016-17

Lions were observed to predate maximum on cattle followed by buffalo inside the protected area (Fig 6), whereas lion predation was more on female cattle, followed by males and juveniles outside the protected area (Fig 7). There was a greater array of livestock species killed by lions outside the protected area (Fig 6 and Fig 7). Seventy percent of the lions resids inside the protected area (Gujarat Forest Department 2015) and were responsible for **10%** of total livestock predation, whereas the thirty percent of the lions resids outside the protected area (Gujarat Forest Department 2015) but were responsible for **90%** of the total livestock predation in the landscape between 2012-2016. An increasing trend was observed in the number of cattle killed by lions while predation on buffalo, goat, sheep and other livestock did not show a temporal trend (Fig 8).

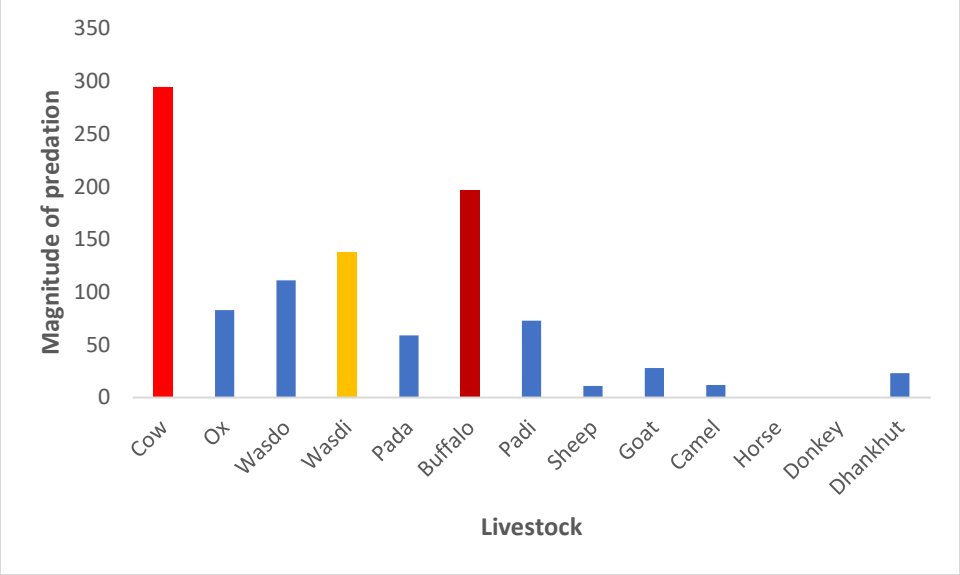

Fig 6: Graph showing the number of depredated livestock by lions inside the protected area.

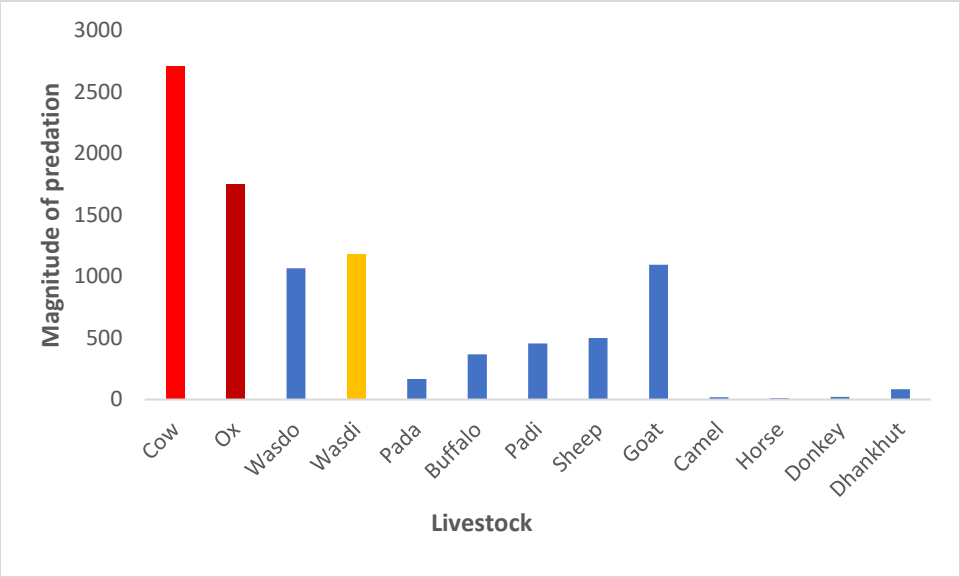

Fig 7: Graph showing the number of depredated livestock by lions outside the protected area.

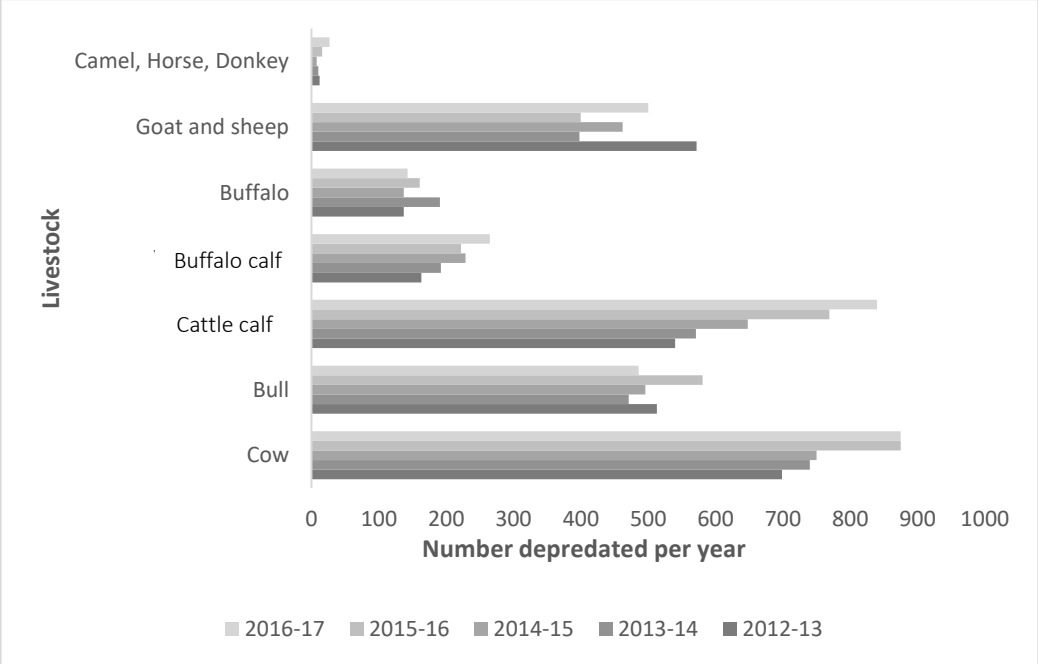

Fig 8: Number of different livestock predated by lions between 2012-13 to 2016-17.

There is an increase in the number of villages that registered predation on livestock by lions, with a spurt between 2015 to 2017 (Fig 9). The cumulative number of villages that reported lion kills of livestock also increased linearly (R^2 = 0.97), with an addition of over 100 new villages each year. This is indicative of an expanding lion population across the landscape (Fig 10).

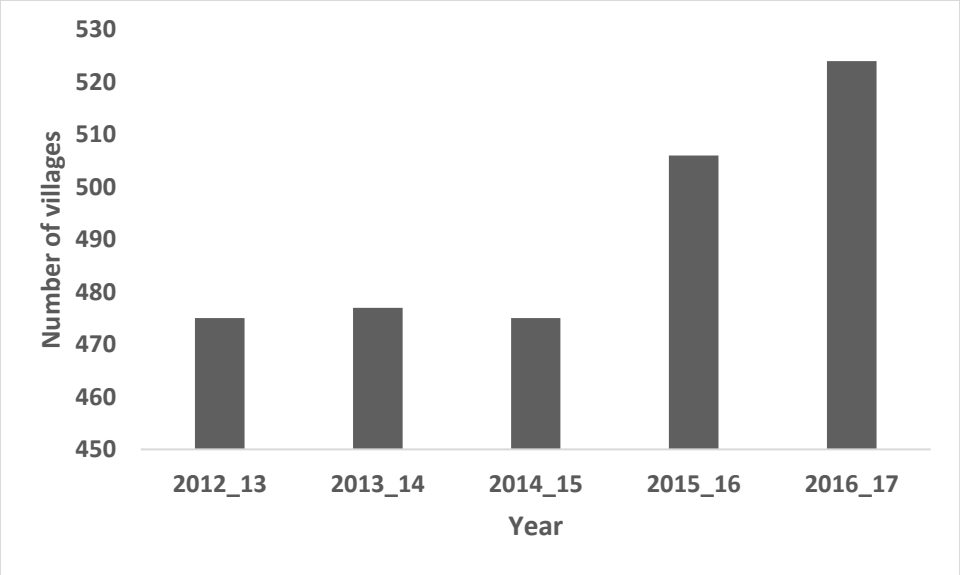

Fig 9: Graph showing the total number of villages under predation by lions in last 5 years from 2012 to 2016.

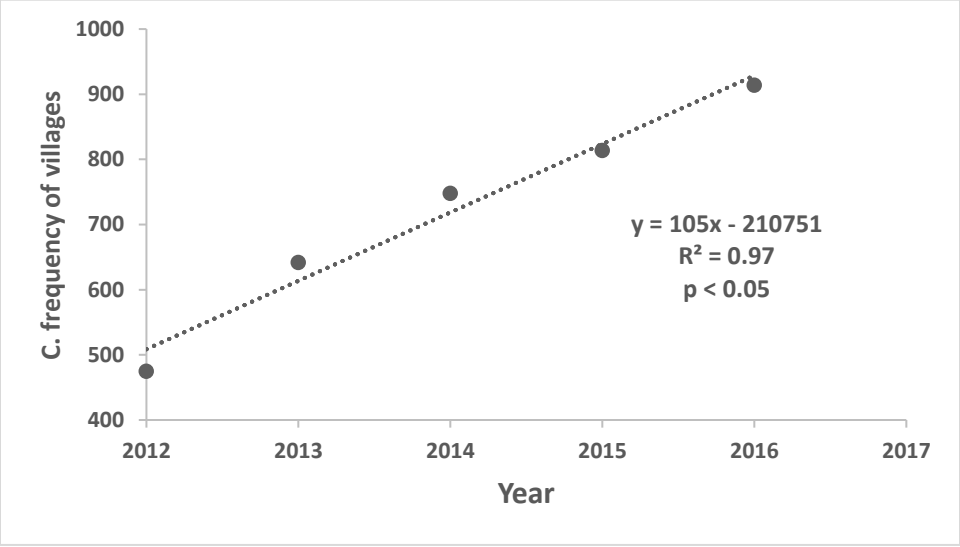

Fig 10: Cumulative number of villages where lions depredated livestock in the last 5 years (2012-2016).

The number of livestock killed by lions showed an increasing trend between 2012-2016, with an predation increament of more than 140 livestock per year in the landscape (R^2= 0.86, p= 0.01) (Fig 11). Intensity of conflict, indexed through number of conflicts/number of villages showed an increasing trend (P = 0.02, R^2= 0.84) with an annual increase of 9% (Fig 12). This shows that with passing years with an increasing and expanding lion and human population, the magnitude of conflict is rising. This can be a major cause of concern for the management, since with increase in lion density (numerical response) or lions learning to hunt livestock more effectively (behavioural response) the conflict scenario and subsequent resentment towards lions is likely to aggravate in the Greater Gir Landscape. This aspect needs immediate attention and implementation of amiliorative practices so as to buffer the rising conflict. This step would be essential to continue to foster amicable co-existance between lions and local communities, crucial for sustaining a feasible lion population outside the formal boundaries of protected areas.

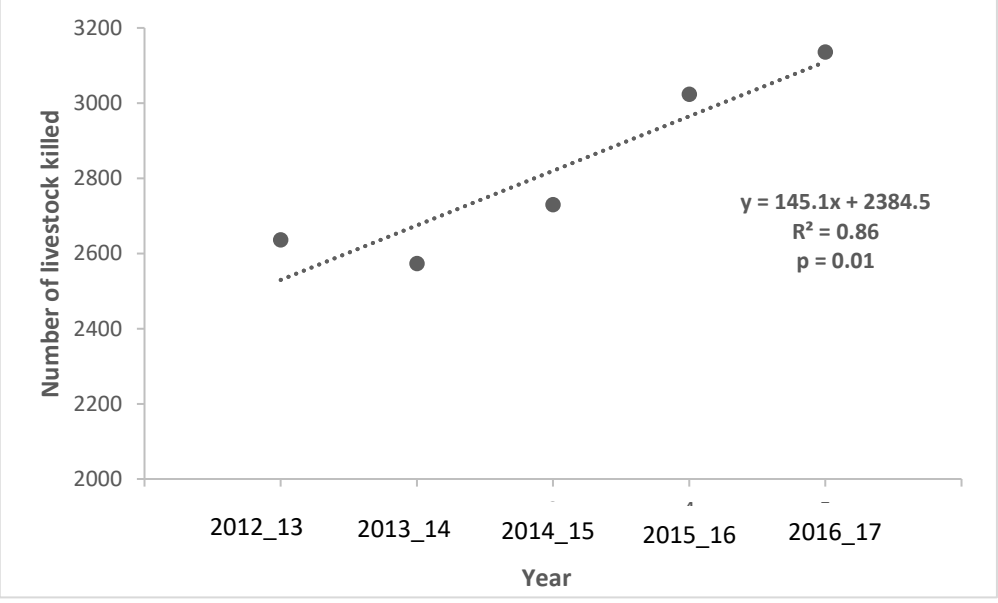

Fig 11: Graph showing the trend of livestock killed by lions in the last 5 years (2012-2016) within the Greater Gir Landscape.

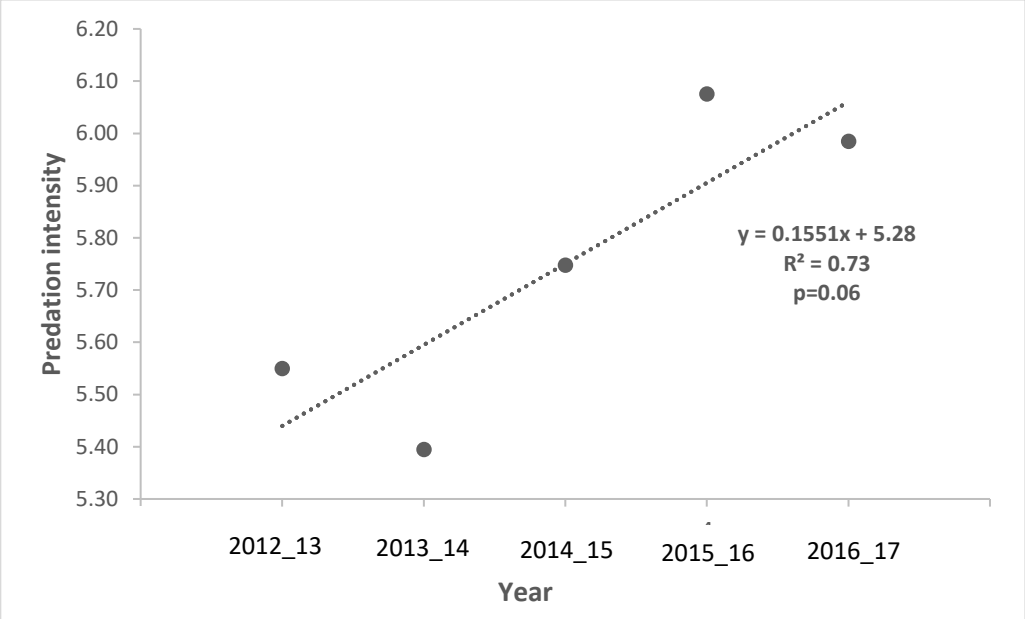

Fig 12: Graph showing the intensity of livestock predation (number of predation events / number of villages with predation per year) by lions in the last 5 years (2012-2016) within the Greater Gir Landscape.

The Gujarat Forest Department has one of the finest livestock compensation schemes and mechanisms for payment in India. Yet, an analysis of the magnitude of market rate economic loss incurred by lion predation with potential and actual compensation paid showed a significant deficit, especially in the years 2014-15 and 2015-16 (Fig 13). Such an increasing deficit is likely to result in increasing resentment by local communities towards lions living in their backyards.

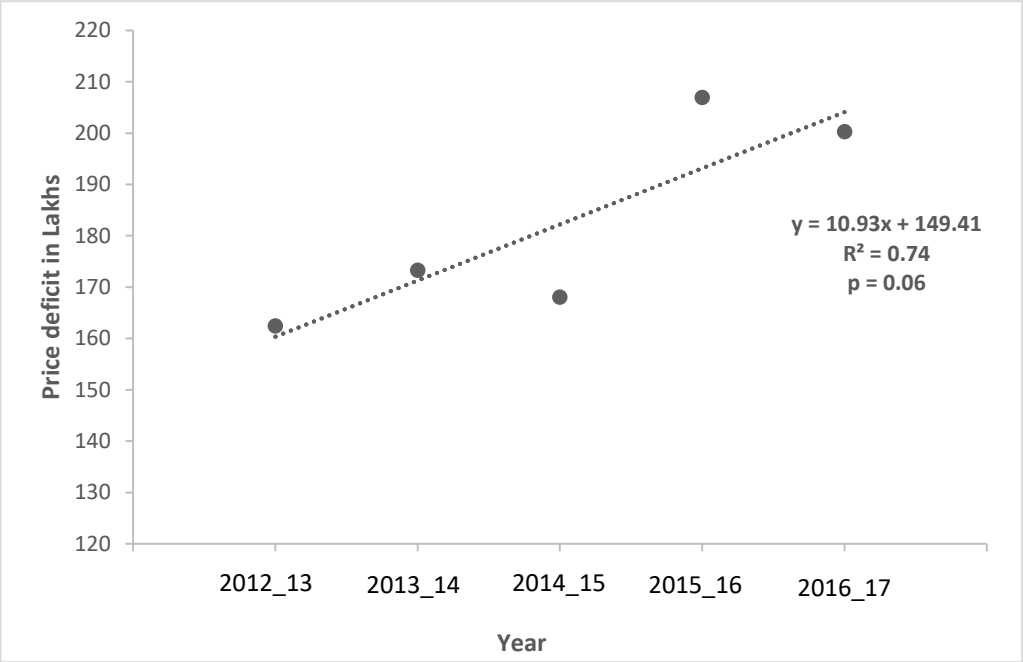

Fig 13: Graph showing the yearly differences in compensation paid by the Forest Department and actual market value of the livestock. This shows economic loss to the locals to predation by lions in last five years (2012-2016) despite claiming of compensation.

It was found that grids where livestock predation has occurred was associated with high lion suitable habitats within it (Fig 14). Similarly grids with livestock predation were also found to be close to forest patches and high lion suitable habitats (Fig 15, & Fig 16). We also found that areas with higher drainages had a greater chance of predation by lions (Fig 17). Drainages act as natural movement corridors for lions wherein our long-term information from radio telemetry have shown that individuals use such broken terrain to move from one refuge patch to another, in search of resources. Our results show that lion attacks on livestock had no relation with size of human settlement and affected small hamlets and urban areas equally (Fig 18).

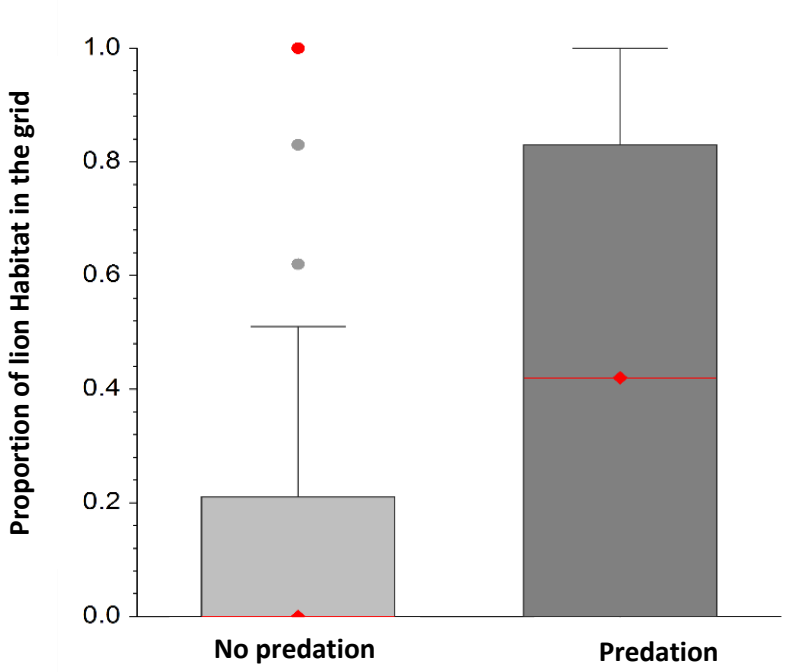

Fig 14: Box-whisker plot showing distribution of livestock predation with proportion of lion habitat present in the respective grids. This shows that presence of livestock predation was high in grids with high lion habitats.

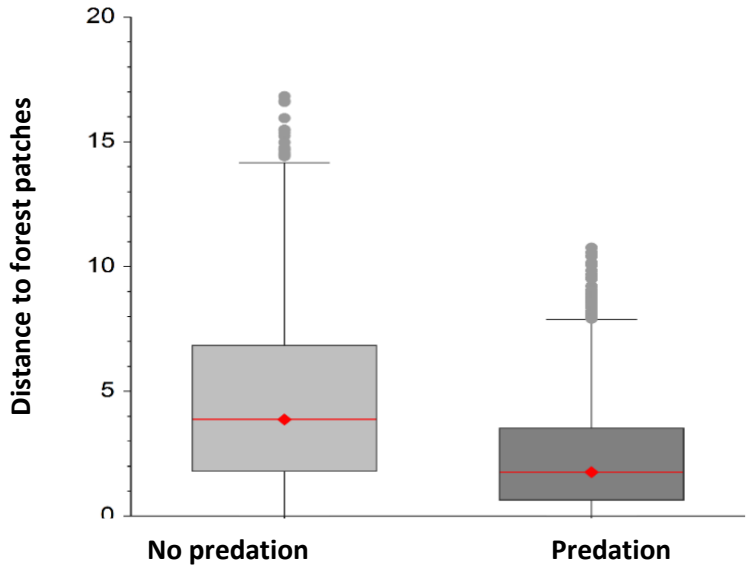

Fig 15: Box-whisker plot showing distribution of livestock predation with distance to forest patches from respective grids. This shows that presence of livestock predation was high in grids which were closer to forest patches.

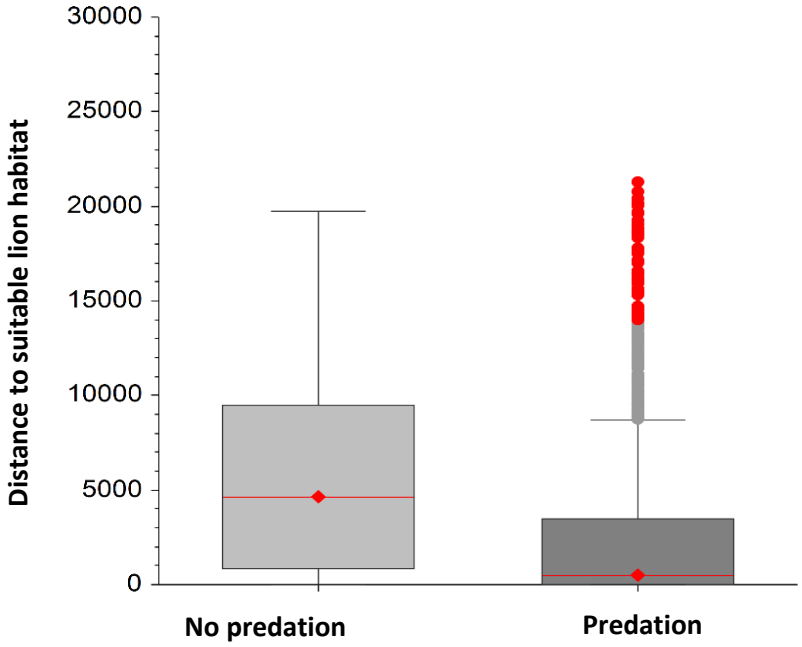

Fig 16: Box-whisker plot showing distribution of livestock predation (categorized into presence (1) and absence (0)) with distance of the respective grids from lion suitable habitats which were mapped through a habitat suitability analysis using long-term information of lion locations in the landscape. Presence of livestock predation was higher in grids near to lion suitable habitats.

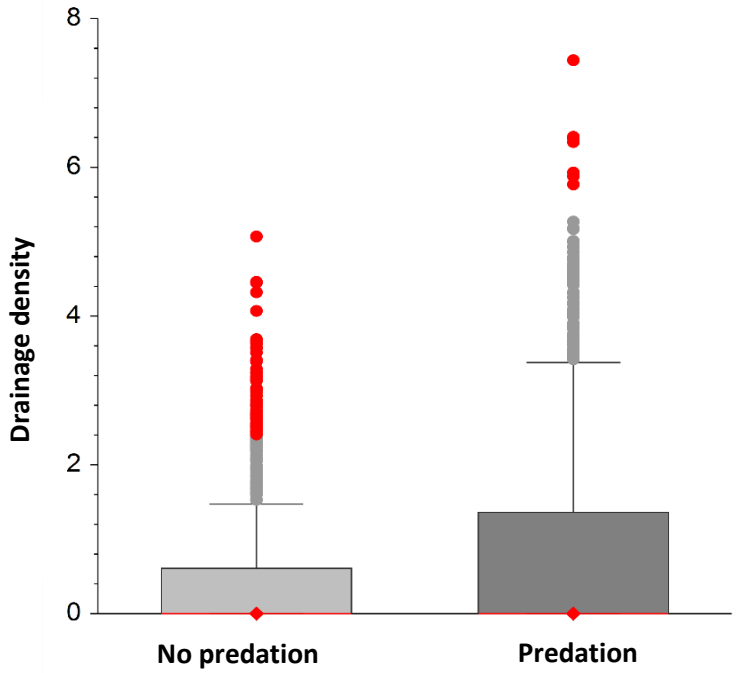

Fig 17: Box-whisker plot showing distribution of livestock predation (categorized into presence (1) and absence (0)) with the total length of drainages present in the grids. Presence of livestock predation was higher in grids with greater lengths of drainages.

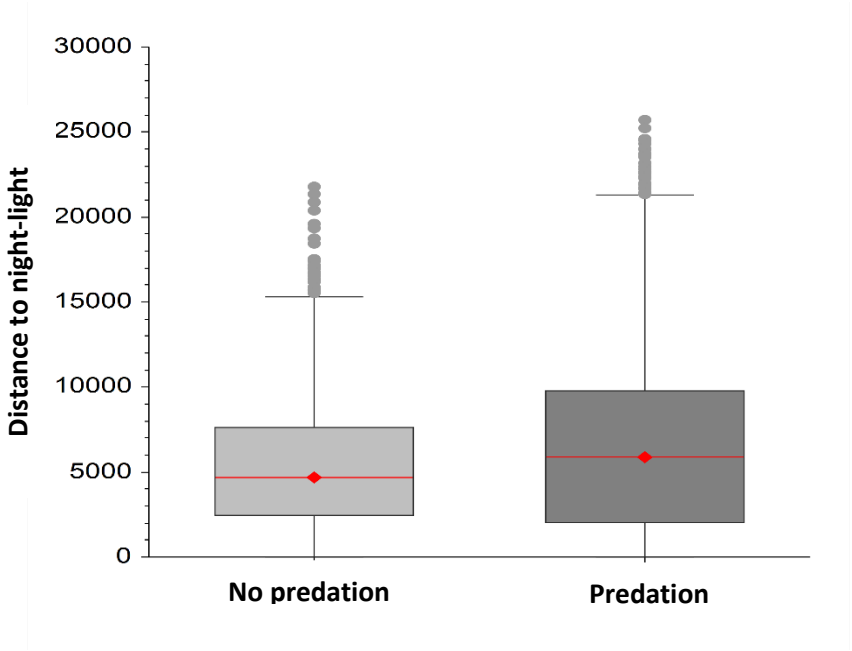

Fig 18: Box-whisker plot showing distribution of livestock predation (categorized into presence (1) and absence (0)) with the distance to built-up areas, surrogated by the intensity of nightlights. Livestock predation was found to be present both in areas near and far from such built-up areas.

Categorization of magnitudes of livestock predation further indicated that areas which are closer to lion suitable habitats incurred higher predation, and lion conflict progressively declined with increasing distance from such habitats (Fig 19). A similar trend was observed for areas and distance to nearest forest patches (Fig 20). Presence of lion suitable habitat in an area did not have any significant effect on the magnitude of predation, however, areas with high proportion of lion suitable habitats were found to have higher predation (Fig 21). A weak to no relationship existed between magnitude of livestock predation in an area and distance of the site from built-up areas (Fig 22). Urbanization surrogated by intensity of nightlight had no effect on the livestock predation by lions (Fig 23).

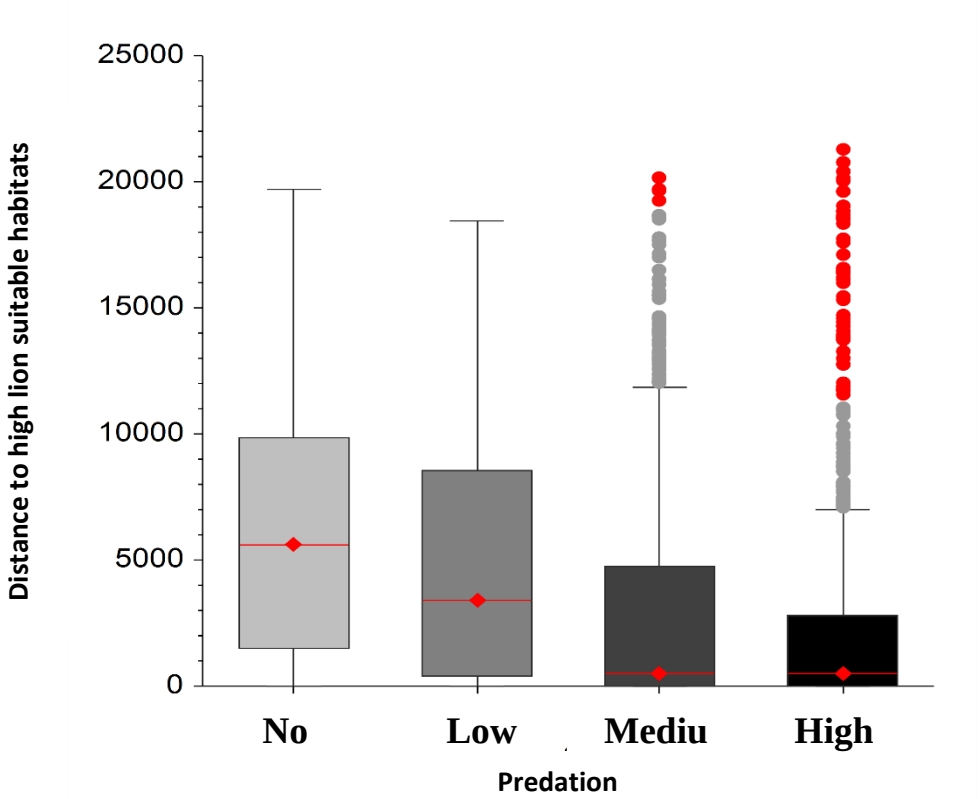

Fig 19: Box-whisker plot showing distribution of livestock predation (categorized into four classes of no (1), low (2), medium (3) and high (4)) with the distance to high lion suitable areas. This shows that high livestock predation was found in areas closed to such suitable lion habitats which progressively decline with increasing distance from such habitats.

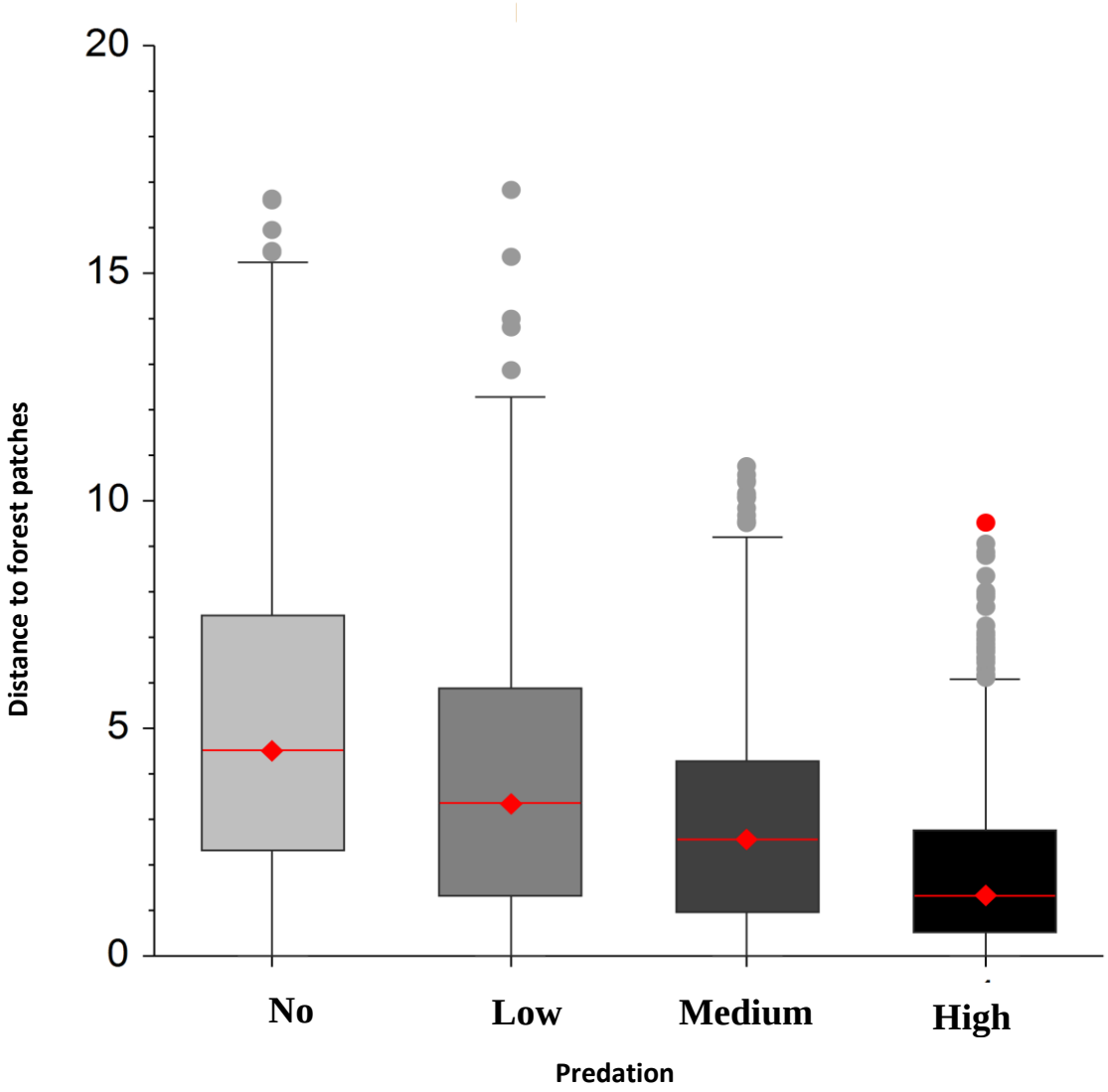

Fig 20: Box-whisker plot showing distribution of livestock predation (categorized into four classes of no (1), low (2), medium (3) and high (4)) with the distance to forest areas. This shows that high livestock predation was found in areas closed to forest patches which progressively decline with increasing distance from such patches.

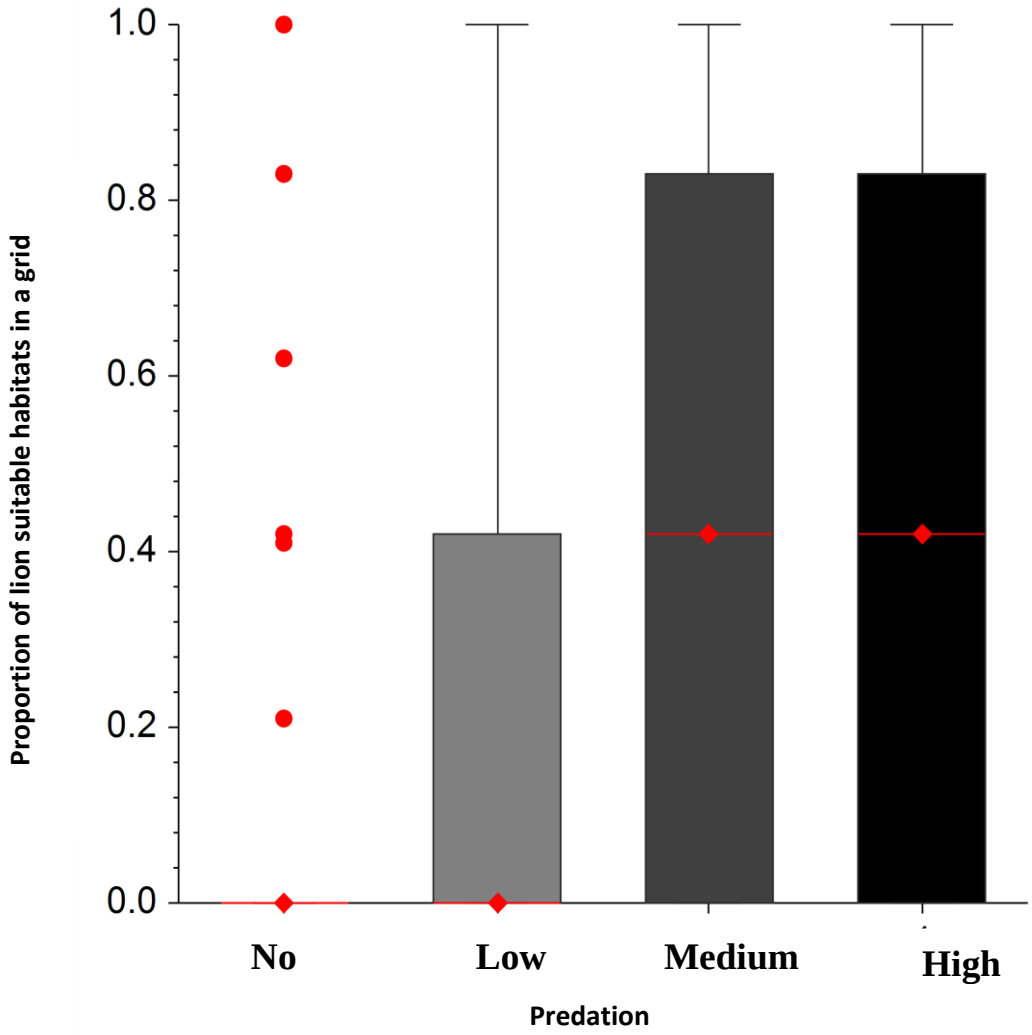

Fig 21: Box-whisker plot showing distribution of livestock predation (categorized into four classes of no (1), low (2), medium (3) and high (4)) with the proportion of high lion suitable areas in the respective grids. This shows that high livestock predation was found in grids with greater proportion of lion habits, which decline with decrease in such habitats in a grid.

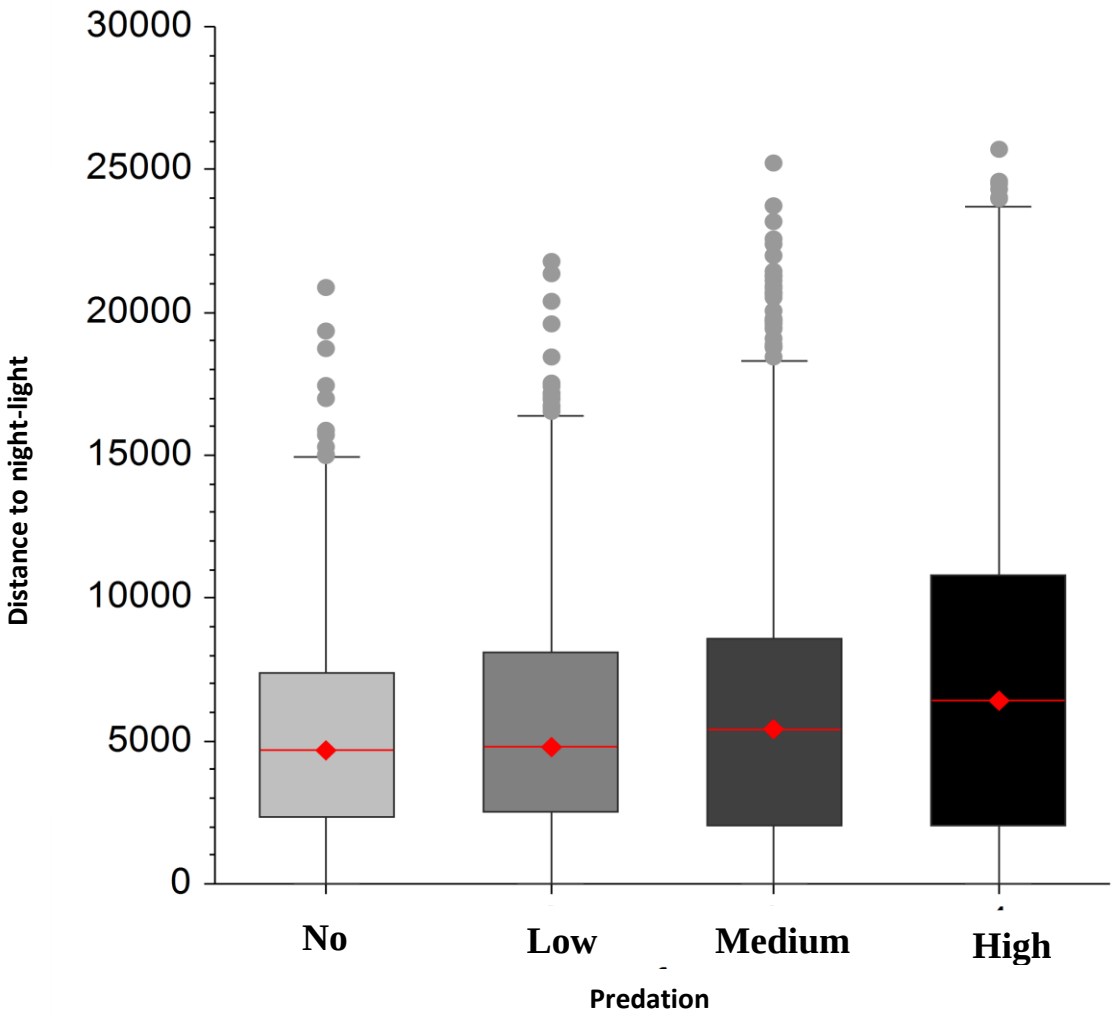

Fig 22: Box-whisker plot showing distribution of livestock predation (Categorized into four classes of no (1), low (2), medium (3) and high (4)) with the distance from night-light, surrogates the built-up area and urbanization. This shows that high livestock predation was found in grids which area away from such areas.

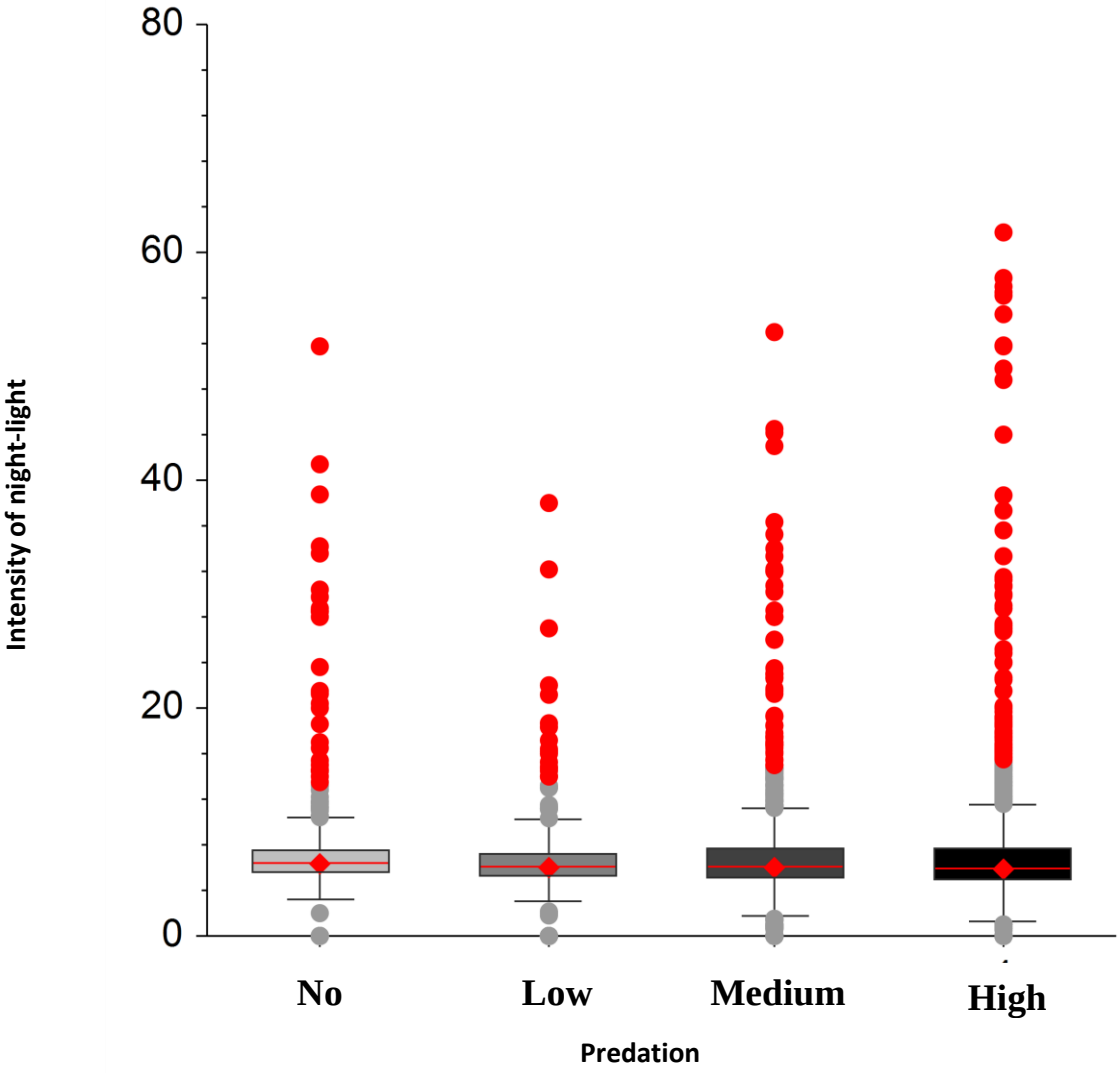

Fig 23: Box-whisker plot showing distribution of livestock predation (Categorized into four classes of no (1), low (2), medium (3) and high (4)) with the intensity of nigh-light surrogating urban and built-up areas in a grid. This shows that lions were predating livestock all across the landscape irrespective of built-up and non-built-up areas.

The magnitude of conflict at any given village in the study area was best explained by a model having the additive effect of proximity to forest patches (Dis_forest), and distance to high lion suitable areas (Dist_lhab) (Table 1) given by:

$$\text{Model: } \log\left(\frac{\text{conflict grids}}{\text{no conflict grids}}\right) = -0.16 + 0.76 * \text{Distance to forest} + 0.54 * \text{Distance to lion habitat}$$

For the above model we used the predictor variables mentioned in the method section, which explains that villages or townships those are closer to forest patches as well as high lion suitable areas are prone to high cattle predation by lions.

Table 1: Logistic regression table

Independent Variable	Regression Coefficient	Standard Error	Wald Z-Value	Wald
Intercept	-0.16	0.02	-7.35	< 0.001
Distance to forest	0.76	0.04	16.46	< 0.001
Distance to lion habitat	0.54	0.04	13.14	< 0.001

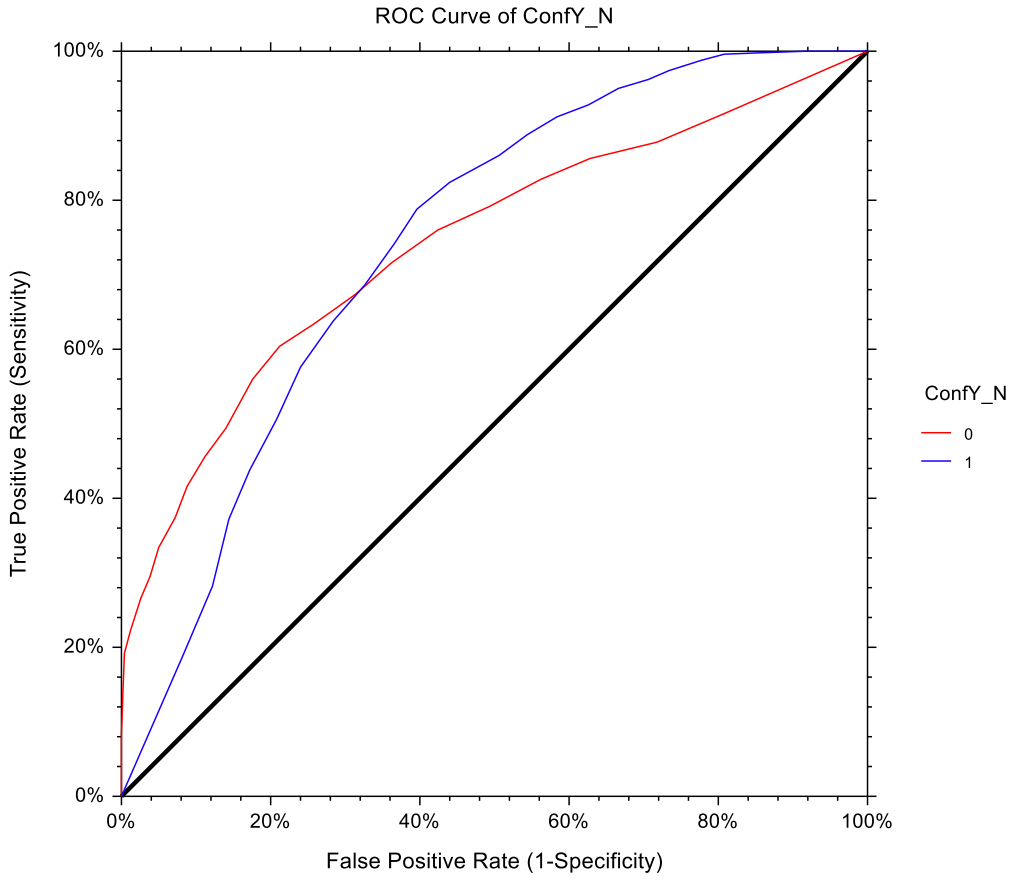

Fig 24: Model fit of the logistic regression as assessed by Receiver Operator Curve

Villages with high livestock predation:

Based on the magnitude of livestock predation by lions a list of villages which are of utmost priority for mitigation measures are listed below. Villages with magnitude of conflict more than 50 incidents in the last 5 years are listed in table 2. Other villages with magnitude of 20-50 livestock predation in the last 5 years are categorized as moderate priority villages (Table A1) and villages with magnitude of >20 predations were listed as low priority villages (Table A2).

Table 2: Villages with magnitude of conflict more than 50 between 2012-2016.

Village name	Taluka	District	Total predation
Krankach	Amreli	Amreli	206
Ambaradi	Dhari	Amreli	181
Nageshri	Jafrabad	Amreli	174
Shemardi	Dhari	Amreli	130
Asundrali nes	Gir Gadhada	Gir Somnath	118
Gadhiya	dhari	Amreli	111
Rampara No-2	Rajula	Amreli	110
Chandgadh	Amreli	Amreli	105
Dadhiyali	Khambha	Amreli	101
Khilavad	Gir Gadhada	Gir Somnath	81
Mota Mindha	Gir Gadhada	Amreli	80
Dedan	Khambha	Amreli	74
Virpur	dhari	Amreli	71
Dhari Nani	Khambha	Amreli	71
Dungarpur	Junagadh	Junagadh_ N	70
Junagadh	Junagadh	Junagadh_ N	70
Sarasiya	dhari	Amreli	69
Lunsapur	Jafrabad	Amreli	69
Dalkhaniya	dhari	Amreli	68
Bilkha	Junagadh	Junagadh_ N	67
Kagvadar	Jafrabad	Amreli	67
Bherai	Rajula	Amreli	64
Ghodavadi	Gir Gadhada	Gir Somnath	64
Jira	dhari	Amreli	62
Piparadi	Savarkundala	Amreli	62
Fifad	Savarkundala	Amreli	60
Barman Nana	Khambha	Amreli	59
Rajpara	Visavadar	Junagadh	59
Manavav	dhari	Amreli	58
Khadsali	Savar Kundala	Amreli	58
Una	Una	Gir Somnath	58
Kodiya	Gir Gadhada	Gir Somnath	53
Hathasani	Savarkundala	Amreli	52

Discussion:

Recovery of Asiatic lions from ~50 individuals to the present over 500 is a conservation success and typifies India's commitments to wildlife conservation. However, this steady increase in lion population has caused their spillover outside the formal boundaries of Gir PA. Presently about one-third of the lion population live in ~22,000 km^2 of agro-pastoral landscape of Saurashtra, an area full of people and livestock. Lions now occupy areas where they were not present for the last 200 years (Divyabhanisinh 2005). This has caused lions and humans to share space often without a cultural background of co-existence, enhancing the interface and conflict between them.

Our results indicate that the chances of livestock predation occurring in an area was positively affected by the proximity to high lion suitable habits and distance to forest patches. This shows that potential high lion densities and proximity to forest patches enhanced the probability of predation in a village.

However, the conflict information presented here represents data that has been reported to the forest department. Thus, such information represents two important facets:

1. **Ownership of livestock:** The kill data comes from livestock that are owned. The landscape also comprises of a high density of feral livestock which are significantly cropped by lions (Banerjee 2012). However, such livestock losses are not reported for compensation claim. However, such losses are unlikely to cause resentment in local communities as feral livestock are a serious problem for crop damage.
2. **Compensation claim:** Also, the information comes from only those cases which have been reported to the department for a compensation claim. Many cases are not reported. Thus, the data presented here also signify the level of awareness people have towards a

government policy of compensating losses of livestock to lions. However, since payment of compensation foe lion predation dates back to pre-independent era and was practiced by the Nawabs of Junagadh. Therefore, most communities were aware of this scheme.

The pattern of lion-human conflict arising from livestock predation seems to be influenced by the shifting of *gaushalas or panjrapoles* at places like Savarkundla and Dhari. Such gaushalas provide free food to lions in terms of cattle carcasses dumped outside their premises, with lions using this bounty frequently (Banerjee 2012). Lions are site-fidel and mostly stay put in their territories, expanding and contracting them based on resource needs (Schaller 1972). With removal of such cattle-camps, resident lion groups miss out on their free food-sources and have to switch over to killing livestock, evident from the pattern of predation-hotspots in Savarkundla and Dhari in the last 2-3 years (Fig S1, S2, S3, S4 S5). Also, the livestock-predation kernel in and around Ambardi in the last 3-4 years represent the fencing-off of Ambardi for the Safari park, which have displaced the resident lions from a prime habitat. This seems to have heightened the predation levels in areas close to Ambardi and the lower-part of Dhari, where displaced lions have probably switched over to killing of livestock. Based on our results and long-term understanding of lions and the landscape, we propose the following mitigation strategies:

1. Removal or shifting of traditional *gaushalas/panjrapoles* might be detrimental for lion persistence in the landscape. Such shifting of free food sources would increase lion-livestock conflict.
2. In areas with recent colonization by lions, pastoral community should be educated about husbandry practices that minimize lion-livestock interaction. An approach could be to make them visit Maldhari ness in Gir and exchange information on husbandry practices.

3. Compensation for livestock losses should be continued. A prompt and fair compensation would ameliorate the losses and build up the social carrying capacity for lions in the landscape. Also, the compensation paid by the forest department should be revised as per the market rates and should cover the lost opportunity cost of the livestock killed (Banerjee et al. 2013).
4. Lion-based ecotourism should be promoted outside the landscape and managed by the forest department. This would incentivize people to live with lions and also prevent conversion of refuge patches (privately owned) to other land-use that are not lion friendly.
5. Prompt action is required in the priority villages (Table 2) to mitigate high livestock kills either by providing pulsating electric fencing to livestock pens, promote stall feeding in place of free grazing of Gauchars and encourage trained guard dogs. Dogs have been effectively used against livestock predation by carnivores in several parts of the world (Andelt and Hopper 2000).

Fig 25: Lion scavenging on dead livestock in a cattle dumping site in the human dominated landscape. These dumping sites acting as free food resources for the lions.

Conclusion:

Our report analyses information on livestock predation by lions between 2012-2016 and provides insight into spatial and non-spatial pattern that would be useful for management.

We show that the extent and intensity of Lion-livestock conflict is on the increase and can reach a tipping point if not addressed with innovative, proactive management interventions. Villages with heightened conflict have been identified for priority investments in mitigation measures. Drives of lion-livestock conflict were (a) Proximity to forests, (b) proportion of lion habitat within an area, (c) density of drainage system (cover for lions). There seemed to be no relation to the size of villages and livestock holding with lion predation. We propose a revised compensation scheme that reflects market reality and lost opportunity cost, as well as better husbandry practices to reduce livestock-lion conflict. A policy decision may soon be required on the social carrying capacity of lions in the Greater Gir Landscape. Discussion and policy on how lion population should be managed below this carrying capacity so as to continue to foster the co-existence between lions and humans in this unique landscape is urgently required.

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Appendix

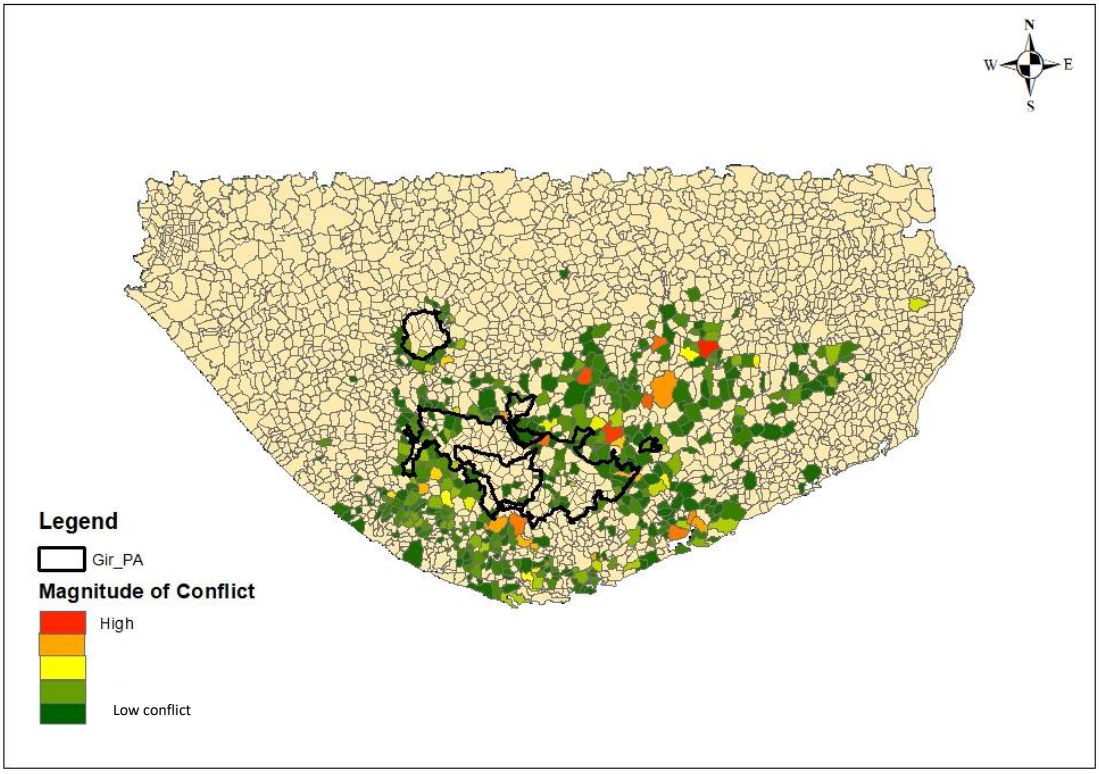

Fig S1: Map showing the villages with livestock predation by lions in the year 2012-13

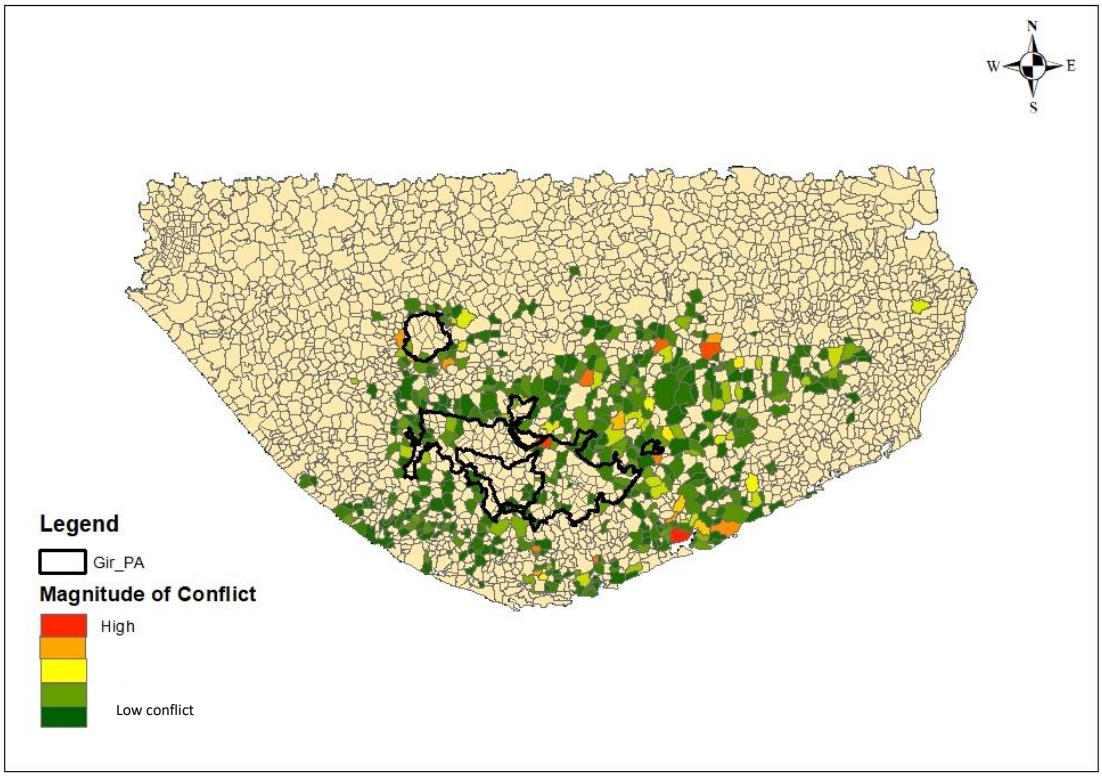

Fig S2: Map showing the villages with livestock predation by lions in the year 2013-14

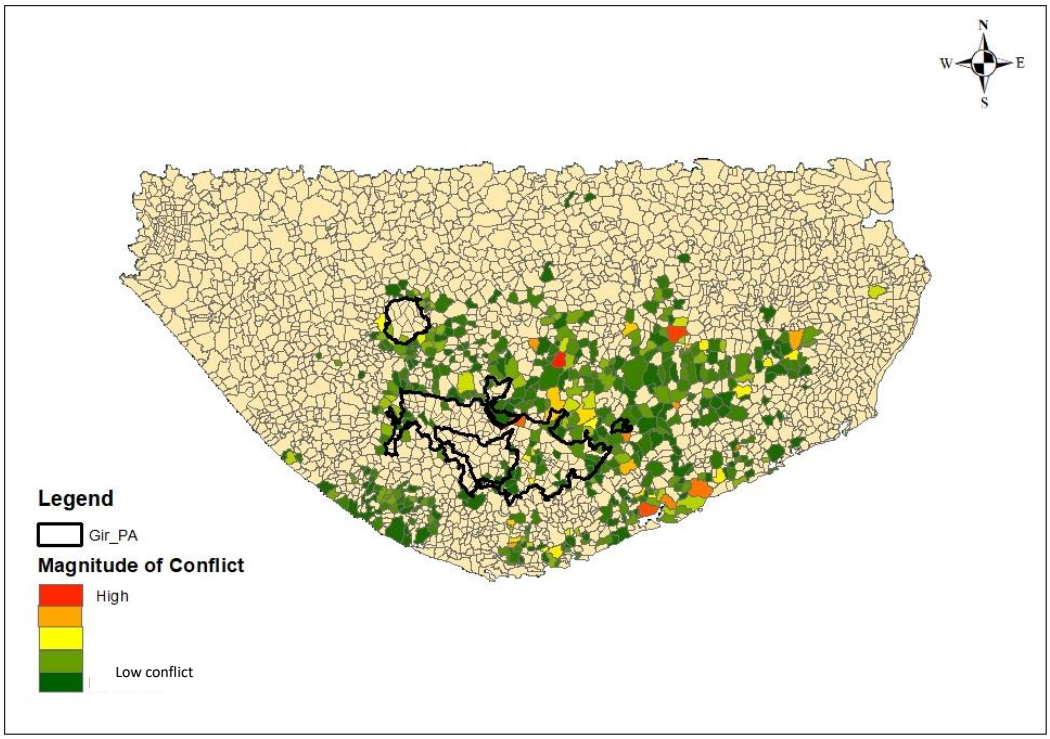

Fig S3: Map showing the villages with livestock predation by lions in the year 2014-15

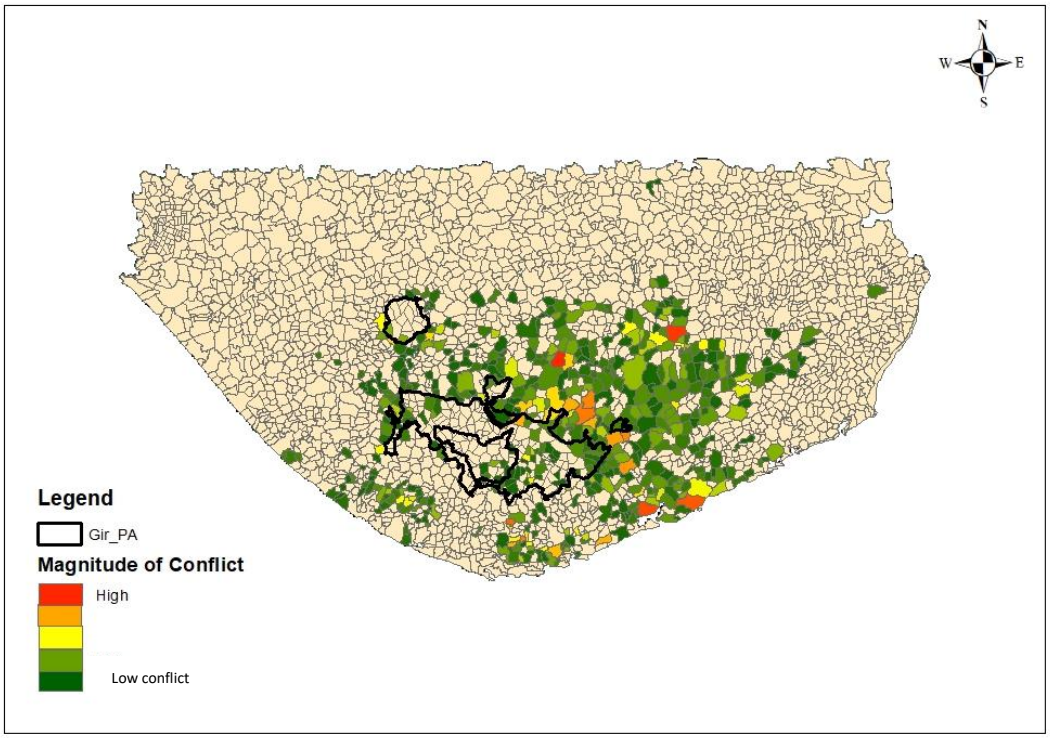

Fig S4: Map showing the villages with livestock predation by lions in the year 2015-16

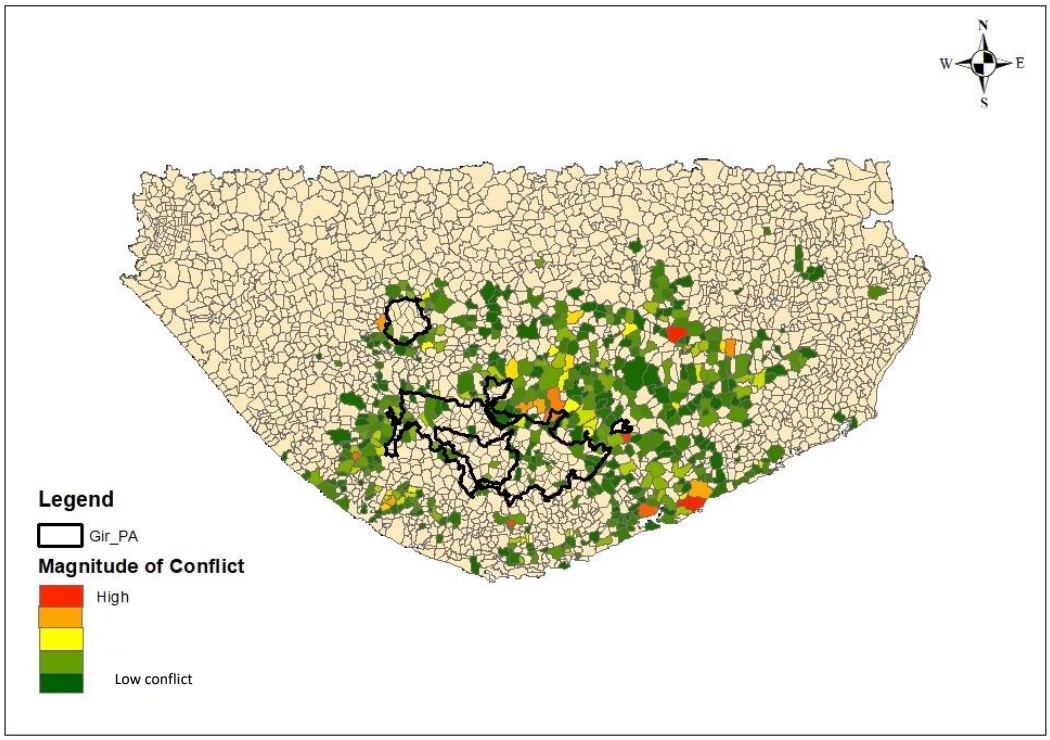

Fig S5: Map showing the villages with livestock predation by lions in the year 2016-17

Table A1: Villages with magnitude of conflict in the range of 20 – 50 incidents in last 5 years.

Village name	Taluka	District	Total
Hadala	Gir Gadhada	Gir Somnath	50
Dodhi	Gir Gadhada	Gir Somnath	50
Nava Pipadiya	Junagadh	Junagadh_N	49
Ankolada	Savar Kundala	Amreli	49
Bhoringda	(blank)	Amreli	47
Mandavi	Gir Gadhada	Gir Somnath	45
Kanek	Una	Gir Somnath	44
Bhandariya	(blank)	Bhavnagar	42
Govindpur	dhari	Amreli	41
Indroi	Veraval	Junagadh_ N	41
Chhapariyali	(blank)	Bhavnagar	40
Umej	Una	Gir Somnath	40
Balanivav	Jafrabad	Amreli	39
Tantaniya	(blank)	Bhavnagar	39
Monvel	dhari	Amreli	38
Khambha	Khambha	Amreli	38
Mandor	Veraval	Junagadh_ N	38
Kukras	Veraval	Junagadh_N	38
Vedva	Kodinar	Junagadh	38
Savarkundla	Savarkundala	Amreli	38
Padargadh	dhari	Amreli	37
Lasa	Khambha	Amreli	37
Malanka	Mendarada	Junagadh	37

Village name	Taluka	District	Total
Vadal	(blank)	Bhavnagar	37
Kariya	Bhesan	Junagadh_ N	36
Harmadiya	Kodinar	Junagadh	35
Jalondhar	Maliyahatina	Junagadh	35
Bhadiyadar	Una	Gir Somnath	35
Lalpur	Visavadar	Junagadh	35
Babapur	Amreli	Amreli	34
Jira	Savarkundala	Amreli	34
Padariya	Junagadh	Junagadh_N	33
Mithapur	(blank)	Amreli	33
Vaghaniya	Liliya	Amreli	33
Vangar	(blank)	Bhavnagar	33
Ladudi	Maliyahatina	Junagadh	33
Fatsar	Gir Gadhada	Gir Somnath	33
Khambha Gir	Visavadar	Junagadh	33
Mendpara	Bhesan	Junagadh_ N	32
Bandhala	Junagadh	Junagadh_N	32
Katar	(blank)	Amreli	32
Navagam	Junagadh	Junagadh_ N	31
Dhokadva	Gir Gadhada	Gir Somnath	31
Khisari	dhari	Amreli	30
Ghantvad	Visavadar	Junagadh	30
Lilia (CT)	Amreli	Amreli	30
Kathivadar	(blank)	Amreli	30
Juna Savar	Liliya	Amreli	30
Vekariya	Visavadar	Junagadh	30

Village name	Taluka	District	Total
Babarkot	Jafrabad	Amreli	29
Rampara	Veraval	Junagadh_ N	29
Abhrampara	Savarkundala	Amreli	29
Haripur	Mendarada	Junagadh	29
Khajuri	Gir Gadhada	Gir Somnath	29
Itvaya	Gir Gadhada	Gir Somnath	29
Ingorala(Dungri)	Liliya	Amreli	28
Palsava	Junagadh	Junagadh_ N	28
Alidar	Kodinar	Junagadh	28
Pandava	Veraval	Junagadh_ N	28
Umarala	Junagadh	Junagadh_N	27
Dhundhavana	Khambha	Amreli	27
Raningpara	Khambha	Amreli	27
Ambala	Mendarada	Junagadh	27
Shevadivadar	(blank)	Bhavnagar	27
Uchaiya	Rajula	Amreli	27
Nava Ugla	Gir Gadhada	Gir Somnath	27
Nagadhra	dhari	Amreli	26
Bhuva	Savarkundala	Amreli	26
Khalpar	dhari	Amreli	26
Nani Vadal	dhari	Amreli	26
Anandapara	Sutrapada	Junagadh_N	26
Pransli	Sutrapada	Junagadh_ N	26
Gir Gadhada	Gir Gadhada	Gir Somnath	26
Bavadi	Liliya	Amreli	25
Khadadhar	Khambha	Amreli	25

Village name	Taluka	District	Total
Rampara No-1	Rajula	Amreli	25
Jabal	Savarkundala	Amreli	25
Samdhiyala	(blank)	Amreli	24
Dhargani	Chalala	Amreli	24
Bhalgam	Bilkha	Junagadh_N	24
Pankuva	Maniya Hatina	Junagadh_N	24
Ukadiya	Veraval	Junagadh_ N	24
Thavi	Savar Kundala	Amreli	24
Kandhi	Una	Gir Somnath	24
Visavadar	Visavadar	Junagadh	24
Sarambhda	Amreli	Amreli	23
Malida	Bhesan	Junagadh_ N	23
Trambakpur	dhari	Amreli	23
Raydi	Khambha	Amreli	23
Umariya	Khambha	Amreli	23
Navadra	Veraval	Junagadh_ N	23
Vad	Rajula	Amreli	23
Mekda	Savarkundala	Amreli	23
Halariya	Bagasara	Amreli	22
Gopalgram	dhari	Amreli	22
Kodidra	Veraval	Junagadh_ N	22
Ishvariya	Veraval	Junagadh_ N	22
Karla	(blank)	Bhavnagar	22
Beda	(blank)	Bhavnagar	22
Kalmodar	(blank)	Bhavnagar	22
Detad	Savarkundala	Amreli	22

Village name	Taluka	District	Total
Sanvav	Gir Gadhada	Gir Somnath	22
Jambudi	Visavadar	Junagadh	22
Talala	Talala	Junagadh	22
Dangavadar	dhari	Amreli	21
Ranigam	(blank)	Bhavnagar	21
Choravadi	Junagadh	Junagadh_N	21
Dervan	Junagadh	Junagadh_ N	21
Vandh	Jafrabad	Amreli	21
Pipalava	Khambha	Amreli	21
Dedakiyal	Mendarada	Junagadh	21
Bhacha	Gir Gadhada	Gir Somnath	21
Bhakha	Una	Junagadh	21
Hasnapur	Visavadar	Junagadh	21
Piyava	Visavadar	Junagadh	21
Paniya	Amreli	Amreli	20
Rajsthali	dhari	Amreli	20
Hirava	dhari	Amreli	20
Bhavardi	Khambha	Amreli	20
Savni	Veraval	Junagadh_ N	20
Moti Vadal	(blank)	Bhavnagar	20
Nani Rajasthali	(blank)	Bhavnagar	20
Alavani	Mendarada	Junagadh	20
Khambha	Sutrapada	Junagadh_ N	20
Nagadiya	Gir Gadhada	Gir Somnath	20
Nathej	Una	Gir Somnath	20
Motisar	Gir Gadhada	Amreli	20

Table A2: Villages with magnitude of conflict more than < 20.

Village name	Taluka	District	Total
Mandlikpur	Junagadh	Junagadh_ N	19
Khadiya	Junagadh	Junagadh_ N	19
Adri	Veraval	Junagadh_N	19
Moraj	Sutrapada	Junagadh_N	19
Mota Asrana	(blank)	Bhavnagar	19
Kenadipur	Mendarada	Junagadh	19
Surajgadh	Mendarada	Junagadh	19
Dungar	Rajula	Amreli	19
Barpatoli	Rajula	Amreli	19
Mitiyala	Khambha	Amreli	19
Absang	Savarkundla	Amreli	19
Dudhala	Mendarada	Junagadh	19
Manekpur	Una	Gir Somnath	19
Manekvada	(blank)	Amreli	18
Ranpur	Bhesan	Junagadh_N	18
Bharad	dhari	Amreli	18
Khicha	Dhari	Amreli	18
Facharia	dhari	Amreli	18
Shedhavadar	Liliya	Amreli	18
Bhaniya	Khambha	Amreli	18
Ningala No-1	Rajula	Amreli	18
Vanshiyali	Savar Kundala	Amreli	18
Amrutvel	Mendarada	Junagadh	18
Sonariya	Gir Gadhada	Gir Somnath	18
Ugla	Gir Gadhada	Gir Somnath	18

Village name	Taluka	District	Total
Jetalvad	Visavadar	Junagadh	18
Devla	Dhari	Amreli	17
Chanchai	dhari	Amreli	17
Sanaliya	Liliya	Amreli	17
Baliyavad	Junagadh	Junagadh_N	17
Kovaya	Rajula	Amreli	17
Nal	Savarkundala	Amreli	17
Ghud Jinjva	Gir Gadhada	Gir Somnath	17
Mahobatpara	Veraval	Junagadh_N	17
Sasan	Mendarada	Junagadh	17
Kansiya ness	Mendarada	Junagadh	17
Borvav	Talala	Junagadh	17
Umedpara	Gir Gadhada	Gir Somnath	17
Bhutdi	Visavadar	Junagadh	17
Khambhaliya	Dhari	Amreli	16
Chakrava	Khambha	Amreli	16
Jamka	Bagsara	Amreli	16
Lumbha	Veraval	Junagadh_ N	16
Gujarda	(blank)	Bhavnagar	16
Amrapur	Mendarada	Junagadh	16
Kotdi	Rajula	Amreli	16
Jejad	Jesar	Bhavnagar	16
Pithvadi	Savarkundala	Amreli	16
Mandorna	Talala	Junagadh	16
Nitli	Gir Gadhada	Gir Somnath	16
Chalala (M)	dhari	Amreli	16
Patla	Bhesan	Junagadh_N	15

Village name	Taluka	District	Total
Karamdadi	dhari	Amreli	15
Gigasan	dhari	Amreli	15
Hudli	Dhari	Amreli	15
Timbi	(blank)	Amreli	15
Kotiya	(blank)	Bhavnagar	15
Jesar	(blank)	Bhavnagar	15
Moda	(blank)	Bhavnagar	15
Sheriyaj	Mangrol	Junagadh_N	15
Karsangadh	Mendarada	Junagadh	15
Madhupur	Talala	Junagadh	15
Mevasa	Khambha	Amreli	15
Bhamar	Savarkundala	Amreli	15
Chikhali	Gir Gadhada	Gir Somnath	15
Khapat	Gir Gadhada	Gir Somnath	15
Bediya	Gir Gadhada	Gir Somnath	15
Dhari	dhari	Amreli	14
Vaghvadi	dhari	Amreli	14
Patla	Dhari	Amreli	14
Bhatvadar	Jafrabad	Amreli	14
Dudhala	Jafrabad	Amreli	14
Sakariya Mota	(blank)	Amreli	14
Dhavadiya	Khambha	Amreli	14
Ingorala	Khambha	Amreli	14
Kantala	Khambha	Amreli	14
Pachapachiya	Khambha	Amreli	14
Luvariya	Lathi	Amreli	14
Vaniya vav	Mendarada	Junagadh	14

Village name	Taluka	District	Total
Patva	(blank)	Amreli	14
Chanch	(blank)	Amreli	14
Zadkala	Savarkundala	Amreli	14
Gadhakda	Savar Kundala	Amreli	14
Luvara	Savarkundala	Amreli	14
Hadida	Savarkundala	Amreli	14
Virodar	Sutrapada	Junagadh_ N	14
Kadsala	Visavadar	Junagadh	14
Bodidar	Gir Gadhada	Gir Somnath	14
Gangda	Una	Gir Somnath	14
Kalavad	Visavadar	Junagadh	14
Lilapani	Dhari	Amreli	14
Samatpara	Junagadh	Junagadh_ N	13
Morzar	dhari	Amreli	13
Krangsa	dhari	Amreli	13
Navagam	Junagadh	Junagadh_ N	13
Antaliya	(blank)	Amreli	13
Dholafi	Jafrabad	Amreli	13
Kadiyali	Jafrabad	Amreli	13
Bhad	Khambha	Amreli	13
Nava Malaknes	Khambha	Amreli	13
Mota Samadhiyala	Khambha	Amreli	13
Nanudi	Khambha	Amreli	13
Kutana	Liliya	Amreli	13
Kankot Mota	(blank)	Amreli	13
Devgam	Maliyahatina	Junagadh	13
Kerala	Savarkundala	Amreli	13

Village name	Taluka	District	Total
Fachariya	Savarkundla	Amreli	13
Kantrodi	Savarkundala	Amreli	13
Bagoya	Savarkundala	Amreli	13
Jasadhar	Una	Junagadh	13
Sukhpur	Dhari	Amreli	13
Mahuva (M + OG)	(blank)	Bhavnagar	13
Lakhapadar	dhari	Amreli	12
Jamaka	Junagadh	Junagadh_ N	12
Borala	Khambha	Amreli	12
Ningala	Khambha	Amreli	12
Arnej	Kodinar	Junagadh	12
Dari	Veraval	Junagadh_ N	12
Paldi	Veraval	Junagadh_ N	12
Umarala	Veraval	Junagadh_ N	12
Devka	Rajula	Amreli	12
Bhachadar	Rajula	Amreli	12
Senjal	Savarkundala	Amreli	12
Thoradi	Savarkundala	Amreli	12
Rasulpara	Una	Gir Somnath	12
Delwada	Gir Gadhada	Gir Somnath	12
Vajdi	Una	Gir Somnath	12
Prempara	Visavadar	Junagadh	12
Ghodasan	Visavadar	Junagadh	12
Rajula (M)	Rajula	Amreli	12
Paswala	Bhesan	Junagadh_N	11
Samadhiyala Nana	Dhari	Amreli	11
Kaner	Dhari	Amreli	11

Village name	Taluka	District	Total
Jaljivadi	dhari	Amreli	11
Vadli	Rajula	Amreli	11
Kotda	Khambha	Amreli	11
Juna Malaknes	Khambha	Amreli	11
Singhaj	Kodinar	Junagadh	11
Amba	(blank)	Amreli	11
Bhetali	Veraval	Gir Somnath	11
Nakhada	Veraval	Junagadh_ N	11
Devaliya	(blank)	Bhavnagar	11
Pipalava	Talala	Junagadh	11
Itali	Mendarada	Junagadh	11
Gundiyali	Mendarada	Junagadh	11
Sanjanasar	(blank)	Bhavnagar	11
Khada ness	Talala	Junagadh	11
Goradka	Savarkundala	Amreli	11
Bhalchhel	Mendarada	Junagadh	11
Ambada	Una	Gir Somnath	11
Undari	Gir Gadhada	Gir Somnath	11
Champathal	Amreli	Amreli	10
Dudhala	Bhesan	Junagadh_ N	10
Ditla	dhari	Amreli	10
Chhatradiya	Dhari	Amreli	10
Mevasa	Junagadh	Junagadh_ N	10
Babarpur	Khambha	Amreli	10
Velan	Kodinar	Junagadh	10
Krishna gadh	Lathi	Amreli	10
Katrasa	Maniya Hatina	Junagadh_N	10

Village name	Taluka	District	Total
Balapara	Maniya Hatina	Junagadh_N	10
Moti Khodiyar	Mendarada	Junagadh	10
Inaj	Veraval	Junagadh_ N	10
Chiroda	(blank)	Bhavnagar	10
Vadodara Dodiya	Sutrapada	Junagadh_ N	10
Hindorna	(blank)	Amreli	10
Ghoba	Jesar	Amreli	10
Borala	Khambha	Amreli	10
Shelana	(blank)	Amreli	10
Dolti	Savarkundala	Amreli	10
Anjar	Una	Gir Somnath	10
Timbarva	Gir Gadhada	Gir Somnath	10
Sapness	Una	Junagadh	10
Dron	Gir Gadhada	Gir Somnath	10
Timbla	Amreli	Amreli	9
Jaliya	Amreli	Amreli	9
Gavadka	Amreli	Amreli	9
Bordi	dhari	Amreli	9
Tarsingada	dhari	Amreli	9
Hemal	Rajula	Amreli	9
Pati	Khambha	Amreli	9
Hanumanpur	Khambha	Amreli	9
Itali	Maniya Hatina	Junagadh_N	9
Dharampur	Maniya Hatina	Junagadh_N	9
Panderiya	(blank)	Bhavnagar	9
Chhatadiya	Mendarada	Junagadh	9
Amblash	Talala	Junagadh	9

Village name	Taluka	District	Total
Nana Bhamodra	Savarkundla	Amreli	9
Giniya	Savarkundla	Amreli	9
Gorakh Madhi	Sutrapada	Junagadh_ N	9
Vavadi	Sutrapada	Junagadh_ N	9
Surva	Talala	Junagadh	9
Naliyeri Moli	Una	Gir Somnath	9
Jaragli	Gir Gadhada	Gir Somnath	9
Jhanjhesar	Visavadar	Junagadh	9
Dadhiya	Mendarada	Junagadh	9
Mandavda Mota	Amreli	Amreli	8
Hadmatiya khakhra	Bhesan	Junagadh_N	8
Shivad	dhari	Amreli	8
Mithapur Nakki	Dhari	Amreli	8
Toraniya	Junagadh	Junagadh_ N	8
Mota Mansa	Jafrabad	Amreli	8
Jikadri Navi	(blank)	Amreli	8
Visavadar Nana	Khambha	Amreli	8
Lonki	Liliya	Amreli	8
Modaliya	(blank)	Bhavnagar	8
Amrapur	Mendarada	Junagadh	8
Nataliya	Mendarada	Junagadh	8
Nani Khodiyar	Mendarada	Junagadh	8
Dhareshvar	Rajula	Amreli	8
Gunavantpur	Veraval	Junagadh_ N	8
Mota Bhamodra	Savar Kundala	Amreli	8
Ghandla	Savarkundala	Amreli	8
Kathital ness	Mendarada	Junagadh	8

Village name	Taluka	District	Total
Bamanasa	Talala	Junagadh	8
Shirvan	Mendarada	Junagadh	8
Jepur	Talala	Junagadh	8
Dhava	Talala	Junagadh	8
Bandharda	Una	Gir Somnath	8
Manandiya	Visavadar	Junagadh	8
Vankiya	(blank)	Amreli	7
Devaliya	Amreli	Amreli	7
Rajasthali	Amreli	Amreli	7
Kagdadi	(blank)	Amreli	7
Chanaka	Bhesan	Junagadh_N	7
Nana Gujariya	Bhesan	Junagadh_N	7
Bhader	Dhari	Amreli	7
Sodvadar	Junagadh	Junagadh_N	7
Sokhda	(blank)	Amreli	7
Kathrota	Junagadh	Junagadh_ N	7
Vadal	Junagadh	Junagadh_ N	7
Tantaniya	Khambha	Amreli	7
Kodiya	Khambha	Amreli	7
Ambaliyala	Khambha	Amreli	7
Barman Mota	Khambha	Amreli	7
Valadar	Visavadar	Junagadh	7
Bhayavadar	Rajula	Amreli	7
Bherala	Veraval	Junagadh_ N	7
Gadhada	(blank)	Bhavnagar	7
Khorasa (Gir)	Maniya Hatina	Junagadh_N	7
Arena	Mangrol	Junagadh_N	7

Village name	Taluka	District	Total
Umba	Veraval	Junagadh_ N	7
Kundaliyala	Rajula	Amreli	7
Chotra	Rajula	Amreli	7
Jaliya	(blank)	Bhavnagar	7
Satana Nes	(blank)	Bhavnagar	7
Chhapari	Veraval	Junagadh_ N	7
Agariya Mota	Rajula	Amreli	7
Pipavav	Rajula	Amreli	7
Vanda	Savarkundala	Amreli	7
Nana Zinzuda	Savarkundla	Amreli	7
Amrutvel	Savarkundla	Amreli	7
Mota Zinzuda	Savar Kundala	Amreli	7
Meriyana	Savarkundala	Amreli	7
Vadla	Talala	Junagadh	7
Ghunsiya	Talala	Junagadh	7
Simar	Gir Gadhada	Gir Somnath	7
Padapadar	Una	Amreli	7
Limadhra	Mendarada	Junagadh	7
Chorvad	Maniya Hatina	Junagadh_N	7
Kerala	(blank)	Amreli	6
Gokharvala Mota	Amreli	Amreli	6
Vaghaniya	Bhesan	Junagadh_N	6
Kharchiya	Bhesan	Junagadh_N	6
Dahida	dhari	Amreli	6
Dudhala	dhari	Amreli	6
Rameshvar	Junagadh	Junagadh_N	6
Khara	Liliya	Amreli	6

Village name	Taluka	District	Total
Kanthariya Koli	(blank)	Amreli	6
Rohisa	Jafrabad	Amreli	6
Ishapur	Junagadh	Junagadh_ N	6
Gidardi	Khambha	Amreli	6
Vankiya	Khambha	Amreli	6
Fachariya	Jafrabad	Amreli	6
Vadnagar	Kodinar	Junagadh	6
Govindpara	Veraval	Junagadh_ N	6
Sarera	(blank)	Bhavnagar	6
Khanderi	Veraval	Junagadh_ N	6
Bolas	Veraval	Junagadh_N	6
Sonariya	Veraval	Junagadh_ N	6
Kalimbhada	Maniya Hatina	Junagadh_N	6
Doliya	(blank)	Bhavnagar	6
Kobadiya	(blank)	Bhavnagar	6
Karjala	(blank)	Bhavnagar	6
Ratanpar	(blank)	Bhavnagar	6
Karmadiya	(blank)	Bhavnagar	6
Patla	Maniya Hatina	Junagadh_N	6
Chuladi	Maniya Hatina	Junagadh_N	6
Shapur	Mangrol	Junagadh_N	6
Ayavej	(blank)	Bhavnagar	6
Hasnavadar	Veraval	Junagadh_ N	6
Mandardi Navi-Juni	Rajula	Amreli	6
Vavera	Rajula	Amreli	6
Dantardi	(blank)	Amreli	6
Khambhaliya	Rajula	Amreli	6

Village name	Taluka	District	Total
Maljinjava	Talala	Junagadh	6
Khera	Veraval	Junagadh_ N	6
Piyava	Savar Kundala	Amreli	6
Badhada	Savarkundala	Amreli	6
Dhajdi	Savarkundla	Amreli	6
Tobra	Sutrapada	Junagadh_ N	6
Chitravad	Talala	Junagadh	6
Jasapur	Talala	Junagadh	6
Galiyawad	Talala	Junagadh	6
Ratidhar	Talala	Junagadh	6
Semaliya	Talala	Junagadh	6
Maghardi	Gir Gadhada	Gir Somnath	6
Sanakhda	Una	Gir Somnath	6
Paswala	Gir Gadhada	Gir Somnath	6
Jamvala	Visavadar	Junagadh	6
Amodra	Dhari	Amreli	6
Mahobatpara	Sutrapada	Junagadh_N	6
Nandrakh	Una	Gir Somnath	6
Fareda	Una	Junagadh	6
Ishvariya	Visavadar	Junagadh	6
Sendarda	(blank)	Bhavnagar	6
Kodinar	Kodinar	Junagadh	6
Vithalpur	Amreli	Amreli	5
Juna Charkha	dhari	Amreli	5
Garamali Moti	dhari	Amreli	5
Zar	Dhari	Amreli	5
Dabhali	Dhari	Amreli	5

Village name	Taluka	District	Total
Sakariya Nana	Jafrabad	Amreli	5
Vijapur	Junagadh	Junagadh_N	5
Sanjantimba	Amreli	Amreli	5
Hathigadh	Liliya	Amreli	5
Bavada	Liliya	Amreli	5
Rabarika	Khambha	Amreli	5
Sugala	Kodinar	Junagadh	5
Jagatiya	Kodinar	Junagadh	5
Anandpur	Una	Junagadh	5
Chhachhar	Kodinar	Junagadh	5
Adpokar	Kodinar	Junagadh	5
Gohil ni Khan	Kodinar	Junagadh	5
Sarkhadi	Kodinar	Junagadh	5
Khared	(blank)	Bhavnagar	5
Matalpar	(blank)	Bhavnagar	5
Nana Pipalva	(blank)	Bhavnagar	5
Ambalgadh	Maniya Hatina	Junagadh_N	5
Pikhor	Talala	Junagadh	5
Virdi	Maniya Hatina	Junagadh_N	5
Kadaya	Maniya Hatina	Junagadh_N	5
Jhinjhuda	Mendarada	Junagadh	5
Hathsani	Dhari	Amreli	5
Chhapri	Rajula	Amreli	5
Visaliya	(blank)	Amreli	5
Khadkala	Savarkundala	Amreli	5
Vijayanagar	Savar Kundala	Amreli	5
Vanot	Savarkundala	Amreli	5

Village name	Taluka	District	Total
Bhojde	Talala	Junagadh	5
Vansavad	Sutrapada	Junagadh_ N	5
Untwala	Una	Gir Somnath	5
Lakhapara	Sutrapada	Gir Somnath	5
Vithalpur	Kodinar	Junagadh	5
Hiranvel	Talala	Junagadh	5
Sangodra	Talala	Junagadh	5
Lushala	Talala	Junagadh	5
Sonpura	Gir Gadhada	Gir Somnath	5
Vadviyala	Gir Gadhada	Gir Somnath	5
Nathal	Una	Gir Somnath	5
Garal	Una	Gir Somnath	5
Men	Una	Junagadh	5
Panderi	Gir Gadhada	Gir Somnath	5
Naliya Mandvi	Gir Gadhada	Gir Somnath	5
Rampara	Una	Gir Somnath	5
Hadala	Una	Gir Somnath	5
Navabandar	Una	Gir Somnath	5
Pankhan	Una	Gir Somnath	5
Lamdhar	Una	Gir Somnath	5
Kankchiyala	Visavadar	Junagadh	5
Mandavad	Visavadar	Junagadh	5
Liliya	Visavadar	Junagadh	5
Balapur	(blank)	Amreli	4
Juna Mandva	Bhesan	Junagadh_N	4
Malshika	dhari	Amreli	4
┬áDholarva	Dhari	Amreli	4

Village name	Taluka	District	Total
Bhayavadar	dhari	Amreli	4
Garamali Nani	Dhari	Amreli	4
Kubda	Dhari	Amreli	4
Paniya Dungri	Dhari	Amreli	4
Kotda	dhari	Amreli	4
Luvara	(blank)	Bhavnagar	4
Thansa	(blank)	Bhavnagar	4
Velavadar	(blank)	Bhavnagar	4
Bhankodar	(blank)	Amreli	4
Ivanagar	Junagadh	Junagadh_N	4
Lor	(blank)	Amreli	4
Lothpur	(blank)	Amreli	4
Mitiyala	(blank)	Amreli	4
Bhada	Jafrabad	Amreli	4
Sandhnidhar	Kodinar	Junagadh	4
Arithiya	Kodinar	Junagadh	4
Morvad	Kodinar	Junagadh	4
Navagam	Kodinar	Junagadh	4
Sayajirajpura	Una	Gir Somnath	4
Supasi	Veraval	Junagadh_ N	4
Babara (Gir)	Maniya Hatina	Junagadh_N	4
Bagdana	(blank)	Bhavnagar	4
Bila	(blank)	Bhavnagar	4
Kotamoi	(blank)	Bhavnagar	4
Gundarani	(blank)	Bhavnagar	4
Dhanej	Talala	Junagadh	4
Akala (Gir)	Maniya Hatina	Junagadh_N	4

Village name	Taluka	District	Total
Mendarada	Mendarada	Junagadh	4
Barvala	Bhesan	Junagadh_N	4
Gundala	Mendarada	Junagadh	4
Gandhol	(blank)	Bhavnagar	4
Juna Padar	(blank)	Bhavnagar	4
Nesdi	Khambha	Amreli	4
Rangpur	Sutrapada	Junagadh_ N	4
Moradiya	Sutrapada	Junagadh_ N	4
Vadodara Jhala	Sutrapada	Junagadh_N	4
Ankolvadi	Talala	Junagadh	4
Gabha	Talala	Junagadh	4
Jasadhar	Talala	Junagadh	4
Anida	Talala	Junagadh	4
Bhimdeval	Talala	Junagadh	4
Dudhala	Kodinar	Junagadh	4
Varsingpur	Gir Gadhada	Gir Somnath	4
Simasi	Una	Gir Somnath	4
Yajpur	Una	Gir Somnath	4
Sondardi	Una	Gir Somnath	4
Kansari	Una	Gir Somnath	4
Ratad	Una	Junagadh	4
Nana Samadhiyala	Una	Junagadh	4
Chavand juni	Visavadar	Junagadh	4
Ravani Kuba	Visavadar	Junagadh	4
Ratang	Visavadar	Junagadh	4
Javantri	Talala	Junagadh	4
Barvaniya nes	Visavadar	Junagadh	4

Village name	Taluka	District	Total
Lashkar Shobhavadala	Visavadar	Junagadh	4
Jafrabad (M)	Jafrabad	Amreli	4
Hamapur	Kunkavav	Amreli	3
Rafaliya	Bhesan	Junagadh_N	3
Bamangadh	Bhesan	Junagadh_N	3
Umarali	Bhesan	Junagadh_N	3
Vandarvad	Bhesan	Junagadh_N	3
Mota Gujariya	Bhesan	Junagadh_N	3
Paniya(Devasthan)	Dhari	Amreli	3
Kerala	Dhari	Amreli	3
Parbadi	dhari	Amreli	3
Fategadh	Dhari	Amreli	3
Gadhiya Chavand	Dhari	Amreli	3
Mandanpara	Junagadh	Junagadh_ N	3
Patapur	Junagadh	Junagadh_ N	3
Ghenspur	Jafrabad	Amreli	3
Patrapasar	Junagadh	Junagadh_N	3
Bamangam	Junagadh	Junagadh_N	3
Dadli	Khambha	Amreli	3
Rugnathpur	Khambha	Amreli	3
Sarakadiya Divan	Khambha	Amreli	3
Talda	Khambha	Amreli	3
Devalpur	Kodinar	Junagadh	3
Advi	Kodinar	Junagadh	3
Fafni Moti	Kodinar	Junagadh	3
Mitiyaj	Kodinar	Junagadh	3
Meghpur	Veraval	Gir Somnath	3

Village name	Taluka	District	Total
Akala	Lathi	Amreli	3
Timbdi	(blank)	Amreli	3
Lusadi	(blank)	Bhavnagar	3
Thorala	(blank)	Bhavnagar	3
Janadi	Maniya Hatina	Junagadh_N	3
Datrana	Mendarada	Junagadh	3
Manpur	Mendarada	Junagadh	3
Mathasuriya	Veraval	Junagadh_N	3
Morchupana	(blank)	Bhavnagar	3
Sarasva	Veraval	Junagadh_N	3
Simar	Veraval	Junagadh_ N	3
Kindarva	Veraval	Junagadh_ N	3
Agariya Dhudiya	(blank)	Amreli	3
Hadmatiya	Rajula	Amreli	3
Khakhbai	(blank)	Amreli	3
Luvara	Savarkundla	Amreli	3
Solaj	Sutrapada	Junagadh_ N	3
Rabarika	Jesar	Bhavanagar	3
Bhonkarva	Savarkundala	Amreli	3
Hipavadli	Savarkundala	Amreli	3
Dedkadi	Savarkundla	Amreli	3
Ramgadh	Savarkundala	Amreli	3
Ambardi	Savarkundla	Amreli	3
Lati	Sutrapada	Junagadh_ N	3
Chagiya	Sutrapada	Junagadh_N	3
Matana	Sutrapada	Junagadh_ N	3
Ramarechi	Talala	Junagadh	3

Village name	Taluka	District	Total
Semarvav	Talala	Junagadh	3
Dhramanva	Talala	Junagadh	3
Saiyad Rajpara	Una	Gir Somnath	3
Sanosri	Gir Gadhada	Amreli	3
Zanzamer	(blank)	Bhavnagar	3
Elampur	Una	Gir Somnath	3
Dhrabavad	Una	Gir Somnath	3
Khajudra	Una	Gir Somnath	3
Chanchakvad	Una	Gir Somnath	3
Thordi	Una	Junagadh	3
Ghantiyan	Visavadar	Junagadh	3
Bhalgam	Visavadar	Junagadh	3
Virpur	Visavadar	Junagadh	3
Bagasara (M)	Bagasara	Amreli	3
Sonariya	(blank)	Amreli	2
Chadiya	Amreli	Amreli	2
Thordi	(blank)	Amreli	2
Kadaya	Visavadar	Junagadh	2
Charan pipali	Bagasara	Amreli	2
Jethiavadar	(blank)	Amreli	2
Nava Charkha	Dhari	Amreli	2
Kotha Pipariya	Dhari	Amreli	2
Vavdi	Dhari	Amreli	2
Amrutpur	dhari	Amreli	2
Chitrasar	Jafrabad	Amreli	2
Balana	Jafrabad	Amreli	2
Rajkot Nana	(blank)	Amreli	2

Village name	Taluka	District	Total
Bodiya	(blank)	Amreli	2
Bhensan	(blank)	Amreli	2
Ebhalvad	Kodinar	Junagadh	2
Chhelana	(blank)	Amreli	2
Dharabandar	(blank)	Amreli	2
Prabhatpura	Junagadh	Junagadh_ N	2
Vangadhara	Khambha	Amreli	2
Trakuda	Khambha	Amreli	2
Bhundani	Khambha	Amreli	2
Salva	Khambha	Amreli	2
Malgam	Kodinar	Junagadh	2
Kadvasan	Kodinar	Junagadh	2
Nagadara	Kodinar	Junagadh	2
Jithla	Kodinar	Junagadh	2
Pipali	Kodinar	Junagadh	2
Dolasa	Kodinar	Junagadh	2
Dudana	Kodinar	Junagadh	2
Sanala	(blank)	Amreli	2
Pipalva	Liliya	Amreli	2
Rampur	Kunkavav	Amreli	2
Ambaliyala	Veraval	Junagadh_N	2
Ugalvan	(blank)	Bhavnagar	2
Dudheri	(blank)	Bhavnagar	2
Dhrabavad	Maniya Hatina	Junagadh_N	2
Bildi	(blank)	Bhavnagar	2
Madhiya	(blank)	Bhavnagar	2
Jangar	Maniya Hatina	Junagadh_N	2

Village name	Taluka	District	Total
Kerala	Maniya Hatina	Junagadh_N	2
Lachadi	Maniya Hatina	Junagadh_N	2
Jhunjharpur	Maniya Hatina	Junagadh_N	2
Januda	Maniya Hatina	Junagadh_N	2
Patarama	Mendarada	Junagadh	2
Lilava	Mendarada	Junagadh	2
Kanthala nes	Mendarada	Junagadh	2
Barbatana	(blank)	Amreli	2
Dungarpur	(blank)	Bhavnagar	2
Depla	(blank)	Bhavnagar	2
Kajali	Veraval	Junagadh_N	2
Agariya Nava	Rajula	Amreli	2
Simaran	Savarkundala	Amreli	2
Dhar	Savarkundla	Amreli	2
Dadhiya	Savarkundla	Amreli	2
Bhenkra	Savarkundala	Amreli	2
Madhada	Savar Kundala	Amreli	2
Amargadh	(blank)	Bhavnagar	2
Piparala	(blank)	Bhavnagar	2
Malvan	(blank)	Bhavnagar	2
Navagam	Sutrapada	Junagadh_ N	2
Padruka	Sutrapada	Gir Somnath	2
Timbdi	Sutrapada	Junagadh_N	2
Alidhra	Sutrapada	Junagadh_N	2
Bhuva timbi	Sutrapada	Gir Somnath	2
Devaliya	Mendarada	Junagadh	2
Khirdhar	Talala	Junagadh	2

Village name	Taluka	District	Total
Moruka	Talala	Junagadh	2
Patapur	Una	Gir Somnath	2
Madhgam	Una	Gir Somnath	2
Jhudvadali	Gir Gadhada	Gir Somnath	2
Leria	Gir Gadhada	Gir Somnath	2
Tulsishyam	Una	Junagadh	2
Vadli	Gir Gadhada	Gir Somnath	2
Rameshvar	Una	Gir Somnath	2
Bhebha	Gir Gadhada	Gir Somnath	2
Lerka	Una	Junagadh	2
Senjaliya	Una	Gir Somnath	2
Chikhli	Una	Gir Somnath	2
Jhankharvada	Una	Gir Somnath	2
Damasa	Gir Gadhada	Gir Somnath	2
Fulka	Gir Gadhada	Gir Somnath	2
Velakot	Una	Junagadh	2
Kakidi Moli	Una	Gir Somnath	2
Nesda	Una	Junagadh	2
Gundala	Una	Gir Somnath	2
Chaparda	Visavadar	Junagadh	2
Vajdi	Visavadar	Junagadh	2
Sukhpur	Maniya Hatina	Junagadh_N	2
Kotada Mota	Visavadar	Junagadh	2
Hadmatiya Nana	Visavadar	Junagadh	2
Chhalda	Visavadar	Junagadh	2
Rabarika	Visavadar	Junagadh	2
Sudavad	Visavadar	Junagadh	2

Village name	Taluka	District	Total
Rupavati	Visavadar	Junagadh	2
Desai vadala	Visavadar	Junagadh	2
Monpari Nani	Visavadar	Junagadh	2
Moniya	Visavadar	Junagadh	2
Veraval	Veraval	Junagadh_N	2
Sutrapada	Sutrapada	Junagadh_ N	2
Sajiyavadar	Amreli	Amreli	1
Lapalia	(blank)	Amreli	1
Pithavajal	Amreli	Amreli	1
Vadera	Amreli	Amreli	1
Kamigadh	Amreli	Amreli	1
Bhandariya Mota	(blank)	Amreli	1
Nana Gokharvala	(blank)	Amreli	1
Ishvariya	(blank)	Amreli	1
Ranpar	(blank)	Amreli	1
Miya Khijadiya	(blank)	Amreli	1
Hulariya	(blank)	Amreli	1
Haliyad Navi	Kunkavav	Amreli	1
Galath	Bhesan	Junagadh_N	1
Morwada	Bhesan	Junagadh_N	1
Chuda	Junagadh	Junagadh_N	1
Gorviyali	Bhesan	Junagadh_N	1
Gorakhpur	Bhesan	Junagadh_N	1
Kathirvadar	Dhari	Amreli	1
Mithapur	dhari	Amreli	1
Madhupur	Dhari	Amreli	1
Navagam	Dhari	Junagadh	1

Village name	Taluka	District	Total
Sarambhada	(blank)	Bhavnagar	1
Sukhpar	Amreli	Amreli	1
Varahsvarup	(blank)	Amreli	1
Avatadiya	Junagadh	Junagadh_N	1
Thumbala	Junagadh	Junagadh_N	1
Saldi	(blank)	Amreli	1
Kanthariya Khalsa	(blank)	Amreli	1
Jikadri Juni	(blank)	Amreli	1
Bela	Junagadh	Junagadh_N	1
Bagadu	Junagadh	Junagadh_N	1
Badalpur	Junagadh	Junagadh_N	1
Ajab	Keshod	Junagadh_N	1
Anida	Khambha	Amreli	1
Samadhiyala No-2	Khambha	Amreli	1
Chauhan ni Khan	Kodinar	Junagadh	1
Pavti	Kodinar	Junagadh	1
Chidivav	Kodinar	Junagadh	1
Sedhaya	Kodinar	Junagadh	1
Girdevli	Kodinar	Junagadh	1
Bodva	Kodinar	Junagadh	1
Pedhavada	Kodinar	Junagadh	1
Kareda	Kodinar	Junagadh	1
Ronaj	Kodinar	Junagadh	1
Jantrakhadi	Kodinar	Junagadh	1
Chhara	Kodinar	Junagadh	1
Kaj	Kodinar	Junagadh	1
Chhabhadiya	(blank)	Amreli	1

Village name	Taluka	District	Total
Kunkavav Nani	(blank)	Amreli	1
Harsurpur	Lathi	Amreli	1
Eklera	Liliya	Amreli	1
Haripur	Liliya	Amreli	1
Kantasar	(blank)	Bhavnagar	1
Navapara	Veraval	Junagadh_N	1
Kumbhariya	(blank)	Bhavnagar	1
Bhaguda	(blank)	Bhavnagar	1
Shantinagar	(blank)	Bhavnagar	1
Shetrana	(blank)	Bhavnagar	1
Bordi	(blank)	Bhavnagar	1
Tared	(blank)	Bhavnagar	1
Goras	(blank)	Bhavnagar	1
Akhegadh	(blank)	Bhavnagar	1
Moti Pipalva	(blank)	Bhavnagar	1
Sathara	(blank)	Bhavnagar	1
Tarsingda	Maniya Hatina	Junagadh_N	1
Matarvaniya	Maniya Hatina	Junagadh_N	1
Maliya Hatina	Maniya Hatina	Junagadh_N	1
Juna Vandarvad	Maniya Hatina	Junagadh_N	1
Vadiya	Maniya Hatina	Junagadh_N	1
Juna Kotda	Mangrol	Junagadh_ N	1
Arniyala	Mendarada	Junagadh	1
Chiroda	Mendarada	Junagadh	1
Nagalpur	Mendarada	Junagadh	1
Devgadh	Mendarada	Junagadh	1
Najapur	Mendarada	Junagadh	1

Village name	Taluka	District	Total
Rajesar	Mendarada	Junagadh	1
Amargadh	Mendarada	Junagadh	1
Chandravadi	Mendarada	Junagadh	1
Ranidhar	Mendarada	Junagadh	1
Gadakiya	Mendarada	Junagadh	1
Chok	(blank)	Bhavnagar	1
Rabhda	(blank)	Amreli	1
Gheti	(blank)	Bhavnagar	1
Bhutiya	(blank)	Bhavnagar	1
Rohishala	(blank)	Bhavnagar	1
Lapaliya	(blank)	Bhavnagar	1
Bhandariya	(blank)	Bhavnagar	1
Medha	(blank)	Bhavnagar	1
Bodana Nes	(blank)	Bhavnagar	1
Vijana Nes	(blank)	Bhavnagar	1
Virpur (Chok)	(blank)	Bhavnagar	1
Deda	Veraval	Gir Somnath	1
Badalpara	Sutrapada	Gir Somnath	1
Bhalpara (CT)	Veraval	Gir Somnath	1
Ralgon	(blank)	Bhavnagar	1
Kundhada	(blank)	Bhavnagar	1
Kherali Moti	Rajula	Amreli	1
Doliya	Rajula	Amreli	1
Bhakshi	(blank)	Amreli	1
Balapar	(blank)	Amreli	1
Zanzarda	Rajula	Amreli	1
Dharano Nes	(blank)	Amreli	1

Village name	Taluka	District	Total
Majadar	(blank)	Amreli	1
Kedariya	Jesar	Bhavanagar	1
Kadali	Talala	Junagadh	1
Moldi	Savarkundla	Amreli	1
Jambuda	Savarkundla	Amreli	1
Vijapdi	Savarkundla	Amreli	1
Khodiyana	Savarkundla	Amreli	1
Ghantiya	Sutrapada	Junagadh_ N	1
Chitrod	Talala	Junagadh	1
Sara	Sutrapada	Junagadh_ N	1
Kanad	(blank)	Bhavnagar	1
Nava Jaliya	(blank)	Bhavnagar	1
Bosan	Sutrapada	Junagadh_N	1
Barula	Sutrapada	Junagadh_N	1
Biliyat nes	Una	Junagadh	1
Amrapur	Sutrapada	Junagadh_N	1
Thareli	Sutrapada	Junagadh_N	1
Lodhva	Sutrapada	Junagadh_N	1
Juna Sangana	(blank)	Bhavnagar	1
Kodiya	(blank)	Bhavnagar	1
Valar	(blank)	Bhavnagar	1
Madhuvan	(blank)	Bhavnagar	1
Abudi	Talala	Junagadh	1
Umrethi	Talala	Junagadh	1
Ankolali	Una	Junagadh	1
Moti Moli	Una	Gir Somnath	1
Kalapan	Una	Gir Somnath	1

Village name	Taluka	District	Total
Sokhada	Gir Gadhada	Gir Somnath	1
Kanakiya	Gir Gadhada	Gir Somnath	1
Ambavad	Una	Junagadh	1
Bhiyal	Una	Junagadh	1
Tad	Una	Gir Somnath	1
Kothariya	Una	Gir Somnath	1
Babariya	Una	Junagadh	1
Rasulpara	Talala	Junagadh	1
Sonaradi	Vanthali	Junagadh_N	1
Luvarsar	Vanthali	Junagadh_N	1
Selra	Vanthali	Junagadh_N	1
Ghudvadar	Vanthali	Junagadh_N	1
Navaniya	Visavadar	Junagadh	1
Kanavadla	Visavadar	Junagadh	1
Hadmatiya Mota	Visavadar	Junagadh	1
Mahudi	Visavadar	Junagadh	1
Kuba(ravani)	Visavadar	Junagadh	1
Bhat vavdi	Visavadar	Junagadh	1
Ambala	Gir Gadhada	Gir Somnath	1
Dadar	Visavadar	Junagadh	1
Sarsai	Visavadar	Junagadh	1
Baradiya	Visavadar	Junagadh	1
Monpari Moti	Visavadar	Junagadh	1
Govindpara	Visavadar	Junagadh	1
Ravni	Visavadar	Junagadh	1
Goradwala	Visavadar	Junagadh	1
Bhayadhar	Una	Gir Somnath	1

Leopard broke the door and killed two goats

Lioness killed two goats in this field

Site visit in Amreli division

Site visit Gir Somnath division

Site visit in Gir somnath division

Site visit in Dhari division

Livestock predation

Livestock predation

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