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ARTICLE

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ARTICLE

Spatiotemporal movement pattern of Asian Elephants *Elephas maximus* Linnaeus, 1758 in Sindhudurg District, Maharashtra, India

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Abstract: The extension of the Asian Elephant's *Elephas maximus* range in the northern Western Ghats (Sahyadri) was observed since 2002. This colonization was marked by elephant crop raiding events in the newly colonized Sindhudurg District, where the local community had no experience of living with elephants. The present study was conducted to understand the spatiotemporal patterns of crop depredation (raiding) and to prioritize areas to inform future interventions on managing this ecological phenomenon turned conflict. Data on crop raiding between 2002 and 2015 was obtained from compensation records with the state forest department, and mapped at village scale. Subsequently, we used three indices of crop raiding, viz., Crop Raiding Frequency (CRF), Relative Crop Raiding Intensity (RCRI), and Crop Raiding Vulnerability Index (CRVI). Results show a gradual northern movement of elephants and of the crop raiding zone over the period of 2002–2015. The rankings provided by CRVI, identified villages in a narrow strip of foothills of the Sahyadri mountains as severely vulnerable. With sufficient long term data, CRVI would be a highly useful index for prioritization of villages for resolving human-elephant negative interactions; and other cases of human-wildlife interactions too.

Keywords: Crop raiding, range extension, vulnerable areas, Western Ghats.

Marathi मराठी सारांश: सन २००२ पासून सह्याद्री पर्वतांत आशियायी हत्तींचा वावर उत्तरेकडे हळूहळू वाढत गेलेला दिसतो. उत्तर पश्चिम घाटातील सिंधुदुर्ग जिल्ह्यात हत्तींचा वावर वाढल्याने, तसेच येथील स्थानिक लोकांना हत्तीसोबत सहजीवनाचा कोणताही पूर्वानुभव नसल्याने पीक नुकसानीच्या घटनांमध्ये वाढ झालेली दिसून येते. याच पार्श्वभूमीवर हत्तींचा सिंधुदुर्ग जिल्ह्यातील वावर आणि पीक नुकसानी होत असलेली गावे यांचा एकंदर अभ्यास करण्यात आला. सन २००२ ते २०१५ या कालावधीत महाराष्ट्र राज्य वन विभागाकडून वेळोवेळी संकलित करण्यात आलेल्या माहितीच्या आधारे सिंधुदुर्ग जिल्ह्यातील पीक नुकसान भरपाईची आवश्यक ती गाव-निहाय माहिती एकत्र केली गेली. या माहितीचे विश्लेषण करून तीन गुणोत्तरे गाव-निहाय अभ्यासण्यात आली. यात अनुक्रमे पीक नुकसानीची वारंवारता, सापेक्ष पीक नुकसानीची तीव्रता आणि पीक-नुकसान-प्रवण गुणोत्तर यांचा समावेश होता. या गुणोत्तरांवर आधारित पीक नुकसानी दर्शविणारे नकाशे बनविण्यात आले. प्राथमिक निष्कर्षानुसार सिंधुदुर्ग जिल्ह्यातील हत्तींच्या हालचाली आणि पीक नुकसानीचा क्षेत्रीय विस्तार दक्षिणेकडून उत्तरेकडे हळूहळू सरकत गेल्याचे दिसून आले. तिन्ही गुणोत्तरांचा आणि या गुणोत्तरांवर आधारित नकाशांचा तौलनिक अभ्यास केला असता असे आढळून आले की अन्य दोन गुणोत्तरांच्या तुलनेत 'पीक-नुकसान-प्रवण गुणोत्तरा'वर आधारित नकाशा सह्याद्रीच्या पायथ्याची गावे हीच अधिक नुकसान-प्रवण असल्याचे दर्शवितो. अधिक कालावधीसाठीची आवश्यक ती सांख्यांकी माहिती उपलब्ध असल्यास 'पीक-नुकसान-प्रवण गुणोत्तरा'वर आधारित सध्याची तसेच भविष्यातील संभाव्य पीक नुकसान-प्रवण गावे प्राधान्यक्रमाने मांडणे शक्य असल्याचे दिसून आले. अशा माहितीचा वापर मोठ्या भूभागावरील हत्ती तसेच इतर वन्यप्राण्यांकडून होत असलेल्या नुकसानीवर गाव निहाय प्रभावी उपाय योजना करताना तसेच भविष्यातील धोरणात्मक नियोजन आखताना होऊ शकेल असे दिसते.

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Author contribution: MDP collected the data, MDP and VKP analysed the data and wrote the manuscript. NAM gave valuable inputs in data processing and made comprehensive thematic maps.

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INTRODUCTION

Negative interactions between humans and elephants are a consistently rising conservation and social problem across the range of elephants in Asia (Gubbi et al. 2014). Given the ancient records of crop depredation (raiding) and other negative interactions, they are part of the cultural and social memories in the areas of human-elephant interface (Sukumar 1991). Thus, these issues need to be approached by integrating the dimensions of ecology, social perception, and economics in order to resolve the conflict and mitigate the losses (Choudhury 2004; Sukumar et al. 2012; Patil & Patil 2018, 2019).

The Asian Elephant *Elephas maximus* (hereafter 'elephant') is listed as "Endangered" on the IUCN Red List of Threatened Species (IUCN 2017). It is distributed in the Indian subcontinent and southeastern Asia, where it is found in a small fraction of its historical range (Sukumar 2006). A significant elephant population is present in the Western Ghats of peninsular India, where the northern limit of population was recorded up to the Uttara Kannada landscape (Choudhary et al. 2008; Baskaran 2013; Mehta & Kulkarni 2013). The historical range of elephants in the Western Ghats is suggested to have extended farther north than the present range. Numerous petroglyphs dating from the Neolithic age and depicting elephants, have been recently discovered in Ratnagiri and Sindhudurg districts of Maharashtra (https://www.thehindu.com/news/national/other-states/the-petroglyphs-of-ratnagiri/article25265399.ece), which is north of the known limit of elephant distribution in the Western Ghats. Yet, the traditional elephant range did not include the states of Maharashtra, Goa, and northern parts of Karnataka state (Mehta & Kulkarni 2013). At the outset of the 21st century, however, an elephant herd from the Haliyal-Dandeli Forest Division moved north and colonized Belgaum Forest Division in 2001 (Baskaran 2013; Mehta & Kulkarni 2013). Since November 2002, elephants from Dandeli Wildlife Sanctuary were reported further north in the forest-plantation mosaic of Sindhudurg and Kolhapur districts of Maharashtra. Here, the elephants had not been reported for at least 100 years before this colonization, thus limiting the societal memory of living with elephants. As a consequence, the colonization was marked by many villagers reporting elephant raiding cases to the state forest department. Since then, the influx has been continuous and elephants have become resident in this area.

Crop raiding by elephants can influence the perception of local communities towards wildlife and allied services, and result in conflict situations (Balasubramanian et al. 1995). There have been demands from local people to remove elephants from their villages and send them back to the 'wild'. Following public pressure, a few elephants were captured by the forest department in 2009 from Dodamarg Taluka of Sindhudurg. They were released to their native habitat in northern Karnataka; however, understanding the habitat fragmentation in this landscape, elephants are likely to disperse more seeking forage, refuge, and water, and thus increasing interface with people (Bhaskaran et al. 2010). Hence, it is essential to understand the spatiotemporal pattern of elephant movement and the raiding hotspots in the landscape. Although the problem of crop raiding by elephants has been widespread in Sindhudurg District, the intensity and distribution of the problem was not uniform throughout. Several factors including elephant behaviour, topography, and physiography of landscape, human landuse and interventions determine these patterns. Forest department officers mentioned the number of elephants in the study area varied from 4 to 11 individuals over the study period.

Within this context, the present study was conducted to understand distinct spatiotemporal patterns in crop raiding, and to prioritize areas for future interventions so that the recurring problem can be successfully handled.

MATERIAL AND METHODS

Study area

The Sindhudurg District (15°37'–16°40' N and 73°19'–74°18'E) is the southern coastal district in western Maharashtra, with a geographical area of 5,207km^2. The study area has a tropical climate and the year could be divided into three seasons consisting of summer (February to May), monsoon (June to September), and winter (October to January). The terrain is hilly with coastal lowlands. Around 52% of Sindhudurg is covered by moist deciduous and semi-evergreen forests (FSI 2015), out of which 89% is under the ownership of private landholders and communities (Patil et al. 2016). Figure 1 depicts the location of Sindhudurg District, its talukas and villages, with reference to the forest cover and terrain. The villages with elephant crop raiding cases are numbered and the names of these 225 villages are provided in the supplementary information (Appendix 1). The Sindhudurg District is subdivided into eight talukas (administrative divisions), viz., Vaibhavvadi, Devgad, Kankavli, Malwan, Kudal, Vengurla, Sawantwadi, and Dodamarg, which in total hold 748

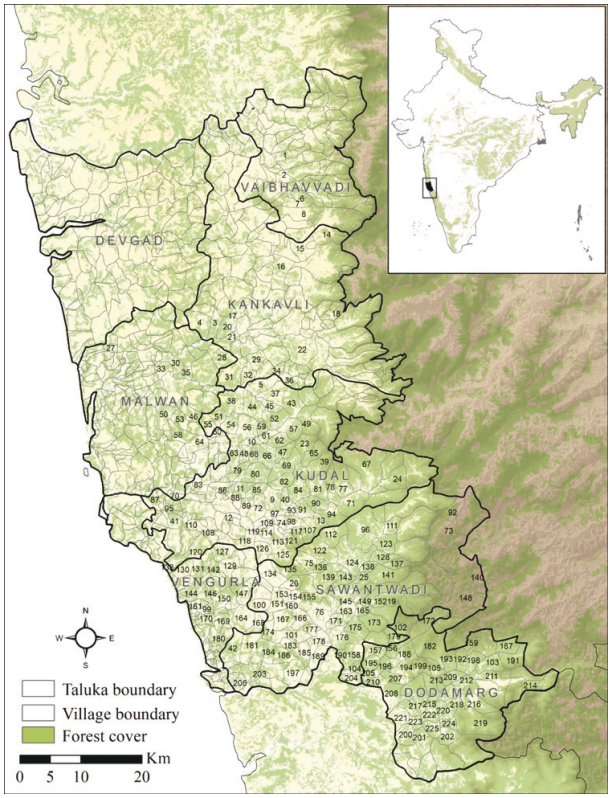

Figure 1. Map depicting the location of Sindhudurg District, its talukas and villages, with reference to the forest cover and terrain. Villages with elephant crop raiding cases are numbered and the names of these 225 villages are provided in the supplementary information.

villages. Approximately, 87% of the human population in Sindhudurg is engaged in agriculture with an average landholding of one hectare (www.censusindia.gov.in). Major crops include rice, millet, and pulses. Rice is planted twice a year: June to September and November to February. The second phase is locally specific based on availability of either natural water or if irrigation is available. A large proportion of land is cultivated as orchards such as mango, cashew, coconut, areca nut, banana, and pineapple. Spices like nutmeg and black pepper are cultivated within coconut orchards. Home gardens are a widely adopted traditional agroforestry system. Thus, the vegetation cover in the area is an intense mosaic of orchards, farms, and natural as well as degraded forest patches.

Data collection

Data on crop raiding between 2002 and 2015 was obtained from compensation records in the range offices of the state Forest Department. We defined a 'case' as an entry in the forest department register of compensation, which was used for reporting elephant caused damage by local people. We defined a 'raid' as a specific instance of damage of a particular crop. A single 'case', where more than one type of crop was damaged, would represent a number of 'raids'.

For each crop raiding case, the name of the crop owner, forest range of jurisdiction, taluka, village, date of crop raiding, crop damage & magnitude, and the compensation paid were noted. Data of area under cultivation for coconut, areca palm, banana, and rice was obtained from the State Agriculture Department. It must be noted, however, that the data for two years (2002 and 2015) were incomplete. Reports on crop raiding appeared towards the end of the year 2002 and therefore data was not available for earlier months. Similarly, for the year 2015, the cases recorded only till August matched with the study time-frame.

Data analysis

Hoare (1999) suggested use of Raid Frequency Index (RFI), which, in the present case, can be calculated as elephant raids per village per month; however, being an absolute index, RFI cannot be compared across studies, nor does it provide a standardized value between certain limits. Therefore, three different indices of crop raiding were used to assess spatial patterns of crop raiding by villages, viz., Crop Raiding Frequency (CRF), Relative Crop Raiding Intensity (RCRI), and Crop Raiding Vulnerability Index (CRVI).

CRF is the total raiding instances in a village over the entire study period.

$$\mathbf{CRF} = N_1 + N_2 + N_3 + ... + N_i$$

Where,

N number of raiding cases in a year

i study period in years

RCRI is a plain measure of crop raiding intensity incorporating the ratio of number of raiding instances to months of raiding occurrence.

$$\mathbf{RCRI} = \frac{CRF}{j}$$

Where,

j number of nominate months in which raiding occurred

CRVI is based on standardized Levin's measure, where the number of cases in a particular month is weighed (multiplied) by the number of years in which raiding occurred in that month. Here, for the purpose of this index, only the count of months out of 12 nominate months was taken and total number of months of raiding in entire study period was not considered.

$$\mathbf{CRVI} = \frac{\left(\frac{1}{\sum_{i=1}^{12} p_i^2}\right)^{-1}}{12-1}$$

$$\because p_i = \frac{q_i}{(\sum_{i=1}^{12} q_i)}$$

$$\because q_i = \frac{n_i k_i}{\sum_{i=1}^{12} n_i k_i} \times 100$$

where,

i Corresponding to the nominate months (January to December)

Number of cases in ith month in the entire study period

Number of years in which raiding occurred in the ith month during the study period

Spatial data for district, taluka, and village boundaries was obtained from the Survey of India for the year 2011. The basic unit in this database was village, whereas that in the compensation database was a compensation claim registered in the name of a person belonging to a particular village. The compensation data was reduced to village level by calculating the above mentioned indices. These indices were joined as attributes to the spatial database to prepare maps based on indices at the scale of villages. These rank correlations were estimated for the first 10 villages based on CRF.

Further, the compensation data was sorted by years in the study period and similarly maps of raiding frequency were prepared for each year to show the progression of the crop raiding by elephants in the study area. Apart from the crop availability, elephant movement is known to be influenced by the availability of water and habitat cover (Venkataraman 2005). High resolution (~30 m) satellite images depicting forest cover (FSI, 2015) and water (Pekel et al. 2016) were used to understand the habitat cover and water availability. The locations of affected farms and the interviewed farm owners were mapped using ArcGIS 10.6.1 (Redlands, CA).

RESULTS

From the compensation records of the forest department, information was available for 9,148 cases. The conflict situation under study was spread over an area of ~4,300km^2 of Sindhudurg District. The database revealed 244 villages (33% of the total villages) affected by crop-raiding elephants (Table 1). The top 20 worst affected villages by elephant crop raiding in various talukas during 2002 to 2015 are given in Table 2.

There was a gradual increase in raiding frequency from 2002 to 2008. Then, there was a sudden dip during 2009–10 after which it increased again (Figure 2). Again in 2015 the raiding frequency dipped. Since elephants colonized this area, the highest number of cases was recorded in the year 2007 (Figure 2). Further, four elephants in Kudal were captured by the forest department in 2009, and three were captured in 2015 and hence the frequency of crop raiding reduced during those years.

Table 1. Villages affected by elephant crop raiding (CR) in different talukas during 2002–2015 in Sindhudurg District, Maharashtra.

Taluka	No. of villages	Conflict villages	CR cases
Kudal	124	83 (67%)	4,837 (52%)
Sawantwadi	82	62 (76%)	2,642 (29%)
Dodamarg	62	47 (79%)	1,292 (14%)
Vengurla	83	20 (24%)	260 (03%)
Kankavli	105	16 (15%)	59 (1%)
Malwan	135	11 (08%)	51 (1%)
Vaibhavvadi	59	5 (8%)	7 (0.1%)
Devgad	98	-	-
Total	**748**	**244 (33%)**	**9148**

CRF and RCRI of all affected villages are shown in Figure 3 and 4, respectively. The distribution of villages in various RCRI classes is shown in Figure 5. Tulsuli K. Narur, Naneli, Wados, Karivane, Nivaje, Sonurli, and Dingne villages had highest CRF and RCRI values. CRVI was calculated for all villages (Figure 6) and the distribution of villages in various CRVI classes is shown in Figure 7. The highest CRVI was observed in the villages of Hirlok, Tulsuli K. Narur, Wados, Amberi, Pawashi, Tulsuli, and Kariwade (Table 2)

CRF, RCRI and CRVI provide useful information for identifying villages with severe problem of crop raiding. In the present case study, however, the prioritization of villages based on CRF and RCRI was found to be highly correlated for the three most affected talukas, viz., Kudal, Sawantwadi, and Dodamarg (Table 3).

DISCUSSION

Patil & Patil (2019) published trends and patterns of elephant crop raiding in the same study area during the period 2002 to 2015. They mentioned coconut palms (44%), paddy (22%), banana (20%), and areca palms (8%) were the most damaged crops by elephants. Paddy was found to be the attractant for elephants. They also found that raiding frequency was maximum during winter season which coincides with the maturity and

Table 2. Top 20 villages affected severely by elephant crop raiding based on CRF, RCRI, and CRVI in Sindhudurg District, Maharashtra (2002–2015).

Ranking	Village	CRF	Village	RCRI	Village	CRVI
1	Tulsuli K.Narur	468	Tulsuli K. Narur	39.00	Hirlok	0.82
2	Naneli	352	Naneli	29.33	Tulsuli K.Narur	0.70
3	Wados	349	Wados	29.08	Wados	0.67
4	Karivane	322	Karivane	26.83	Amberi	0.60
5	Nivaje	296	Nivaje	24.67	Pawashi	0.56
6	Sonurli	254	Sonurli	23.09	Tulsuli	0.53
7	Dingne	250	Dingne	22.73	Kariwade	0.50
8	Padlos	224	Majgaon	22.33	Wafoli	0.50
9	Mangeli	209	Kalse	20.00	Naneli	0.49
10	Hirlok	202	Padlos	18.67	Khocharewadi	0.48
11	Majgaon	201	Hewale	18.33	Ghavanale	0.48
12	Khocharewadi	169	Mangeli	17.42	Mangaon	0.48
13	Hewale	165	Hirlok	16.83	Kesari	0.47
14	Tembgaon	148	Palye	16.67	Taligaon	0.47
15	Ghavanale	144	Asoli	15.00	Karivane	0.46
16	Amberi	138	Oras Bk.	14.25	Bavlat	0.46
17	Gothos	138	Khocharewadi	14.08	Kalane	0.45
18	Mangaon	128	Gothos	13.80	Nivaje	0.44
19	Otavane	127	Tembgaon	13.45	Adali	0.44
20	Kaleli	124	Bambarde T. Kalsuli	13.44	Bengaon	0.42

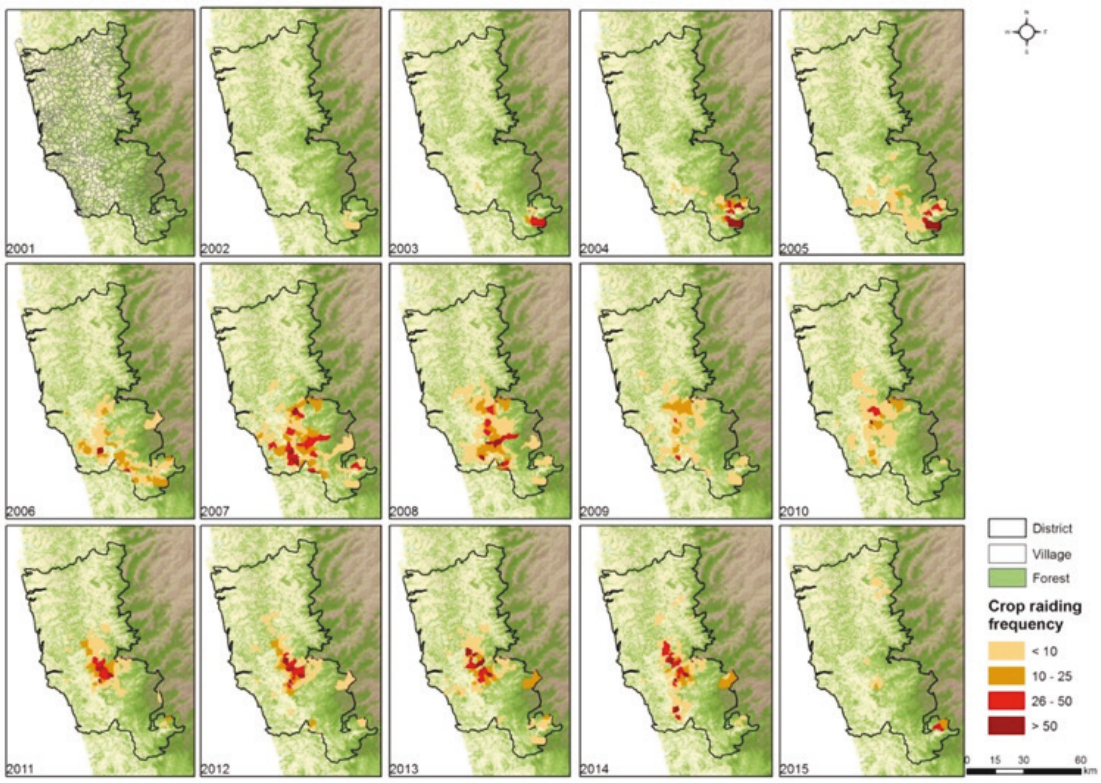

Figure 2. Annual progression of elephant crop raiding in Sindhudurg District (2002–2015).

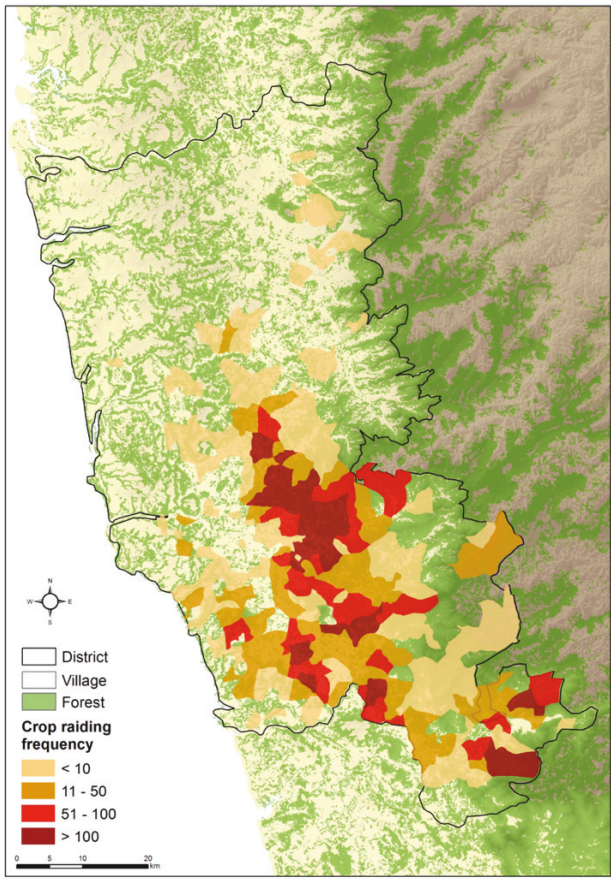

Figure 3. Crop raiding frequency (CRF) of villages in Sindhudurg District (2002–2015).

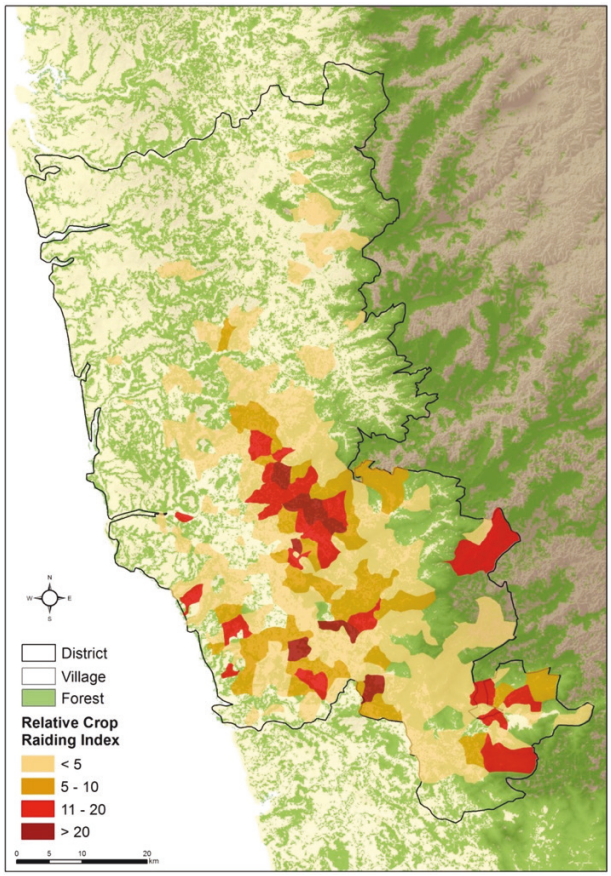

Figure 4. Relative Crop Raiding Intensity (RCRI) of villages in Sindhudurg District (2002–2015).

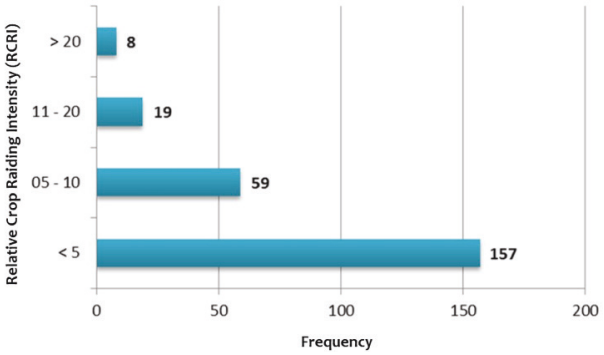

Figure 5. Frequency distribution of villages across classes of Relative Crop Raiding Intensity (RCRI).

harvesting period of paddy in the Sindhudurg. Patil & Patil (2017) published farmers' perception survey towards elephant crop raiding in Sindhudurg. Here, they presented the details of crop protection measures and their effectiveness, ongoing ex-gratia schemes by the forest department in the study area with possible coexistence approach. The present study is the extension of these two studies.

Excluding the incomplete data-years of 2002 and 2015, the trend in annual raiding frequency seems to have followed the number of elephants active in those particular years. The number of elephants active in a particular year, in turn, was dependent on the influx of elephants and efforts of the state forest department to capture and/or translocate elephants back to their southern population. Various guestimates on the number of elephants ranging 4–11 individuals was provided by the forest department and secondary sources (Sarma & Easa 2006; Mehta & Kulkarni 2013).

Gradual extension of the conflict zone over the period from southern to northern parts of Sindhudurg was observed during 2002–2015. It was also observed that crop raiding was severe in the talukas nestled in the Sahyadri Mountain ranges, while coastal talukas had relatively less cases. Similarly, because elephants extended their range from south to north, the northernmost talukas were either unaffected or less affected during the study period.

Figure 2 shows the gradual extension of conflict

Table 3. Rank correlation among Crop Raiding Frequency (CRF), Relative Crop Raiding Intensity (RCRI), and Crop Raiding Vulnerability Index (CRVI). Figures below diagonal are Spearman's r values and above diagonal are probabilities.

Kudal			
	CRF	RCRI	CRVI
CRF		<0.001	0.44247
RCRI	0.99937		0.46644
CRVI	0.27467	0.26097	
Sawantwadi			
	CRF	RCRI	CRVI
CRF		<0.001	0.57841
RCRI	0.94225		0.36547
CRVI	-0.20061	-0.32121	
Dodamarg			
	CRF	RCRI	CRVI
CRF		0.020713	0.78784
RCRI	0.71269		0.04036
CRVI	-0.09792	-0.6537	

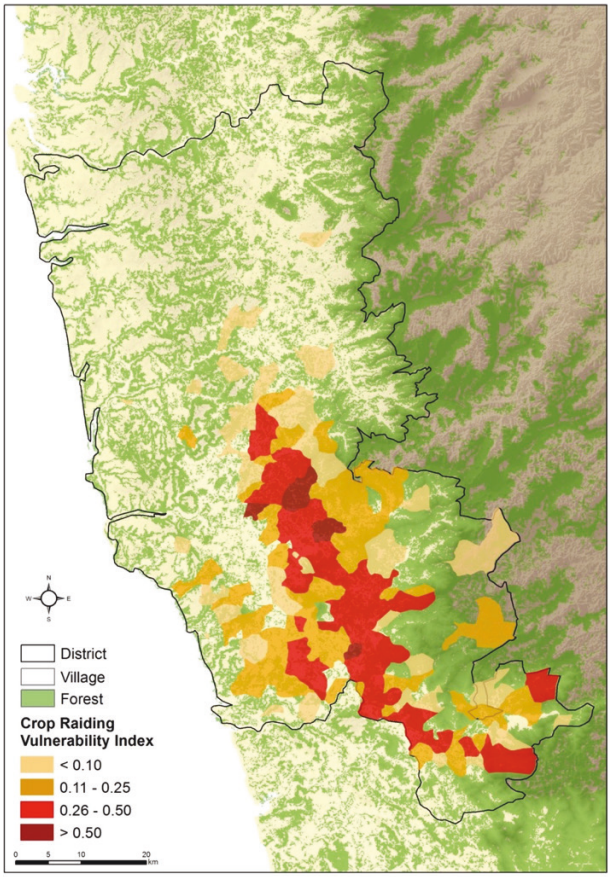

Figure 6. Crop Raiding Vulnerability Index (CRVI) of villages in Sindhudurg District (2002–2015).

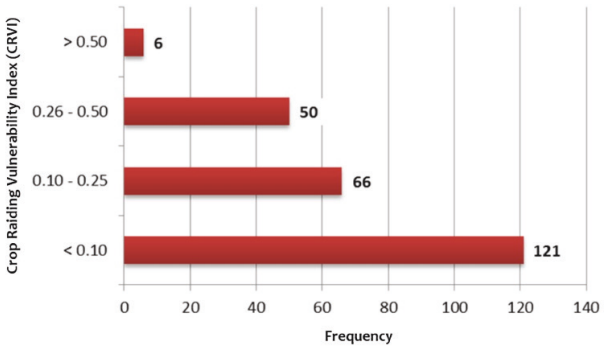

Figure 7. Frequency distribution of villages across classes of Crop Raiding Vulnerability Index (CRVI).

zone (area wise) in the study area over the period of 2002–2015. It could be clearly seen that during 2002 to 2008, the raiding events by elephants were spatially widespread and could be potentially exploratory in nature. In 2009, four elephants were captured (out of which two died) for translocating them back to the closest population in Karnataka. It is presumed by villagers and forest department personnel that these translocated elephants soon returned along with two other elephants. In this second stint from 2010 to 2015, the map clearly depicts increased crop-raiding events from the Kudal range. Towards 2014–15, the elephants started to further explore northwards.

Indices calculated in the present study are based on detailed ex-gratia records proved by the forest department. CRF indicates that villages on the steeper ranges were not affected much compared to the foothills; however, the absolute CRFs or their proportion per village do not provide opportunity for comparing the intensity of crop raiding across studies. Therefore, an attempt was made to calculate two further indices of vulnerability of villages to crop raiding based on historical data.

The high crop raiding villages identified using CRF and RCRI do not reveal the actual vulnerable villages because many of these villages were affected for a relatively brief duration with higher intensity. Here we may conclude that villages with higher CRF or RCRI may not be vulnerable as elephants might have explored these villages for available resources intensively during earlier years but, finding them unsuitable, might have altogether stopped approaching.

CRVI, as previously stated, is the number of cases in a particular month weighed by the number of years in which raiding occurred in that month. It provides a different ranking of the villages thus showing low

correlation with both earlier indices (Table 3). The rankings provided by CRVI appear to provide more meaningful geographical or ecological information. A comparative look at Figures 3, 4, and 6 reveals that CRVI identifies villages in a narrow strip of foothills of Sahyadri mountains as severely vulnerable. Gross factors determining elephants' use of a certain area are food, cover and water (Fairet 2012). It appears that the best possible combination of these three factors was available to the elephants in the area identified by CRVI. Subsequently, CRVI could become a useful index to identify villages highly vulnerable to crop raiding by elephants. The prioritization of villages for resolving human-elephant negative interaction can be based on CRVI, rather than CRF or RCRI, when sufficient long-term data on elephant crop raiding is available. CRVI can also be compared across studies if crop-raiding instances are tabulated by villages or any small geopolitical units. Use of these geopolitical units will facilitate implementation of various schemes for alleviating crop raiding problem.

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Appendix 1. Name of villages with elephant crop raiding cases numbered in the Figure 1.

Map ID	Taluka name	Village name
1	Vaibhavvadi	Pimpalwadi
2	Vaibhavvadi	Narkarwadi
3	Kankavli	Pise Kamate
4	Kankavli	Bidwadi
5	Kudal	Ambrad
6	Vaibhavvadi	Mohitewadi
7	Vaibhavvadi	Khambale
8	Vaibhavvadi	Achirne
9	Kudal	Khutvalwadi
10	Kudal	Rumadgaon
11	Kudal	Pawashi
12	Kudal	Pinguli
13	Kudal	Kanduli
14	Kankavli	Ghonsari
15	Kankavli	Lore-1
16	Kankavli	Damare
17	Kankavli	Tarandale
18	Kankavli	Bhiravande
19	Dodamarg	Konas
20	Kankavli	Varavade
21	Kankavli	Ashiye
22	Kankavli	Shivdav
23	Kudal	Kusagaon
24	Kudal	Wasoli
25	Sawantwadi	Bavlat
26	Sawantwadi	Brahmanpat
27	Malwan	Chindar
28	Malwan	Asarondi
29	Kankavli	Kasavan
30	Malwan	Rathivade
31	Kankavli	Osargaon
32	Kankavli	Bordave
33	Malwan	Chunavare
34	Kankavli	Phanas Nagar
35	Malwan	Hiwale
36	Kankavli	Kalasuli
37	Kudal	Pokharan
38	Kudal	Kasal
39	Kudal	Narur
40	Kudal	Khocharewadi
41	Kudal	Humarmala
42	Kudal	Bhattwadi
43	Kudal	Bhadgaon Bk.
44	Kudal	Kunde

Map ID	Taluka name	Village name
45	Kudal	Kusabe
46	Kudal	Waingavade
47	Kudal	Kinlos
48	Kudal	Humarmala
49	Kudal	Nirukhe (K)
50	Malwan	Golwan
51	Kudal	Padave
52	Kudal	Warde
53	Malwan	Dikval
54	Kudal	Ranbambuli
55	Kudal	Gaorai
56	Kudal	Oras Bk.
57	Kudal	Kadawal
58	Malwan	Nandos
59	Kudal	Oras Kh.
60	Malwan	Sukalwad
61	Kudal	Tembgaon
62	Kudal	Avalegaon
63	Kudal	Anav
64	Malwan	Kusarave
65	Kudal	Girgaon
66	Kudal	Karivane
67	Kudal	Nerur K.narur
68	Kudal	Digas
69	Kudal	Hirlok
70	Malwan	Kalse
71	Kudal	Pulas
72	Kudal	Rangana Tulsuli
73	Sawantwadi	Amboli
74	Kudal	Naneli
75	Sawantwadi	Kolgaon
76	Sawantwadi	Insuli
77	Kudal	Keravade K.Narur
78	Kudal	Nileli
79	Kudal	Pandur
80	Kudal	Bambarde Tarf Kalsuli
81	Kudal	Gothos
82	Kudal	Tulsuli
83	Kudal	Sarambal
84	Kudal	Bamnadevi
85	Kudal	Mitkyachiwadi
86	Kudal	Kavilkate
87	Kudal	Gandhigram
88	Kudal	Belnadi

Map ID	Taluka name	Village name
89	Kudal	Mulade
90	Kudal	Wados
91	Kudal	Amberi
92	Sawantwadi	Gele
93	Kudal	Ghavanale
94	Kudal	More
95	Kudal	Mudyacha Kond
96	Sawantwadi	Sangeli
97	Kudal	Namaspur
98	Kudal	Bengaon
99	Vengurla	Bhendamala
100	Sawantwadi	Talavade
101	Sawantwadi	Ronapal
102	Dodamarg	Zolambe
103	Dodamarg	Hewale
104	Sawantwadi	Dongarpal
105	Dodamarg	Ker
106	Kudal	Namasgaon
107	Sawantwadi	Kaleli
108	Kudal	Goveri
109	Kudal	Ghatakarnagar
110	Kudal	Raygaon
111	Sawantwadi	Kalambist
112	Sawantwadi	Ambegaon
113	Kudal	Dholkarwadi
114	Kudal	Salgaon
115	Kudal	Kattagaon
116	Kudal	Mangaon
117	Kudal	Taligaon
118	Kudal	Bambarde Tarf Mangaon
119	Kudal	Jambharmala
120	Kudal	Tendoli
121	Kudal	Bhattgaon
122	Sawantwadi	Kunkeri
123	Sawantwadi	Ovaliye
124	Sawantwadi	Madkhol
125	Kudal	Akeri
126	Kudal	Humras
127	Vengurla	Palkarwadi
128	Vengurla	Devasu
129	Vengurla	Adeli
130	Vengurla	Talekarwadi
131	Vengurla	Khanoli
132	Vengurla	Vetore
133	Vengurla	Kelus

Map ID	Taluka name	Village name
134	Sawantwadi	Nemale
135	Sawantwadi	Bhom
136	Sawantwadi	Nirukhe (S)
137	Sawantwadi	Danoli
138	Sawantwadi	Satuli
139	Sawantwadi	Charathe
140	Sawantwadi	Masure
141	Sawantwadi	Kesari
142	Vengurla	Sataye
143	Sawantwadi	Bhairavwadi
144	Vengurla	Dabholi
145	Sawantwadi	Otavane
146	Vengurla	Math
147	Vengurla	Hodawade
148	Sawantwadi	Choukul
149	Sawantwadi	Sarmale
150	Vengurla	Tulas
151	Sawantwadi	Niravade
152	Sawantwadi	Dabhil
153	Sawantwadi	Malgaon
154	Sawantwadi	Kumbharli
155	Sawantwadi	Majgaon
156	Dodamarg	Talkat
157	Dodamarg	Morgaon
158	Sawantwadi	Dingne
159	Dodamarg	Terwanmedhe
160	Sawantwadi	Vetye
161	Vengurla	Adari
162	Vengurla	Ubhadanda
163	Sawantwadi	Vilavade
164	Vengurla	Matond
165	Sawantwadi	Bhalawal
166	Sawantwadi	Kshetrapal
167	Sawantwadi	Sonurli
168	Vengurla	Pendur
169	Vengurla	Pal
170	Vengurla	Ansur
171	Sawantwadi	Wafoli
172	Dodamarg	Khadpade
173	Sawantwadi	Tamboli
174	Sawantwadi	Nhaveli
175	Sawantwadi	Degave
176	Sawantwadi	Banda
177	Sawantwadi	Nigude
178	Sawantwadi	Sherle

Map ID	Taluka name	Village name
179	Sawantwadi	Padve Majgaon
180	Vengurla	Asoli
181	Sawantwadi	Malewad
182	Dodamarg	Bhekurli
183	Sawantwadi	Padlos
184	Sawantwadi	Dandeli
185	Sawantwadi	Madura
186	Sawantwadi	Aros
187	Dodamarg	Bambarde
188	Dodamarg	Kolzar
189	Sawantwadi	Kas
190	Sawantwadi	Galel
191	Dodamarg	Ghatiwade
192	Dodamarg	Palye
193	Dodamarg	Morle
194	Dodamarg	Kumbral
195	Dodamarg	Adali
196	Dodamarg	Ugade
197	Sawantwadi	Satarda
198	Dodamarg	Sonawal
199	Dodamarg	Shirwal
200	Dodamarg	Kasai
201	Dodamarg	Girode
202	Dodamarg	Usap

Map ID	Taluka name	Village name
203	Sawantwadi	Talawane
204	Sawantwadi	Netarde
205	Dodamarg	Phondye
206	Sawantwadi	Aronda
207	Dodamarg	Bhike-Konal
208	Dodamarg	Sasoli
209	Dodamarg	Ghotgewadi
210	Dodamarg	Kalane
211	Dodamarg	Aynode
212	Dodamarg	Konal
213	Dodamarg	Ghotge
214	Dodamarg	Kendre Bk.
215	Dodamarg	Sateli Bhedshi
216	Dodamarg	Shirange
217	Dodamarg	Kudase
218	Dodamarg	Khanyale
219	Dodamarg	Mangeli
220	Dodamarg	Bodade
221	Dodamarg	Maneri
222	Dodamarg	Zarebambar
223	Dodamarg	Ambeli
224	Dodamarg	Khokaral
225	Dodamarg	Pikule

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