# Local Knowledge suggests significant wildlife decline and forest loss in insurgent affected similipal Tiger Reserve, India

Authors: Sahoo, Sasmita, Puyravaud, Jean-Philippe, and Davidar, Priya

Source: Tropical Conservation Science, 6(2) : 230-240

Published By: SAGE Publishing

URL: https://doi.org/10.1177/194008291300600205

**Research Article**

# Local knowledge suggests significant wildlife decline and forest loss in insurgent affected Similipal Tiger Reserve, India

**Sasmita Sahoo[1], Jean-Philippe Puyravaud[1] and Priya Davidar[1]***

[1]*Department of Ecology and Environmental Sciences, Pondicherry University, Kalapet, Puducherry 605014.*
**Correspondence: Prof. Priya Davidar. Email: pdavidar@gmail.com*

**Abstract**
Similipal Tiger Reserve is a large insurgent-affected protected area (PA) located in the northern Eastern Ghats, India, with a resident tribal population of about 12,500. In 2007-08, we carried out a survey of conservation attitudes among 217 men and women (>20 years old) and documented their perceptions of wildlife and forest decline over a 20-year period from 1997-2007. Using data from the Forest Survey of India, we ascertained the decrease in forest cover (>40%), and using available census information we assessed tiger status over this period. Most of the respondents were primarily agriculturists (79%), and all households collected fuel-wood from the forest; 13% hunted and 49% fished. The majority of the respondents (80%) agreed that trees had disappeared, and 90% agreed that the tiger and elephant had disappeared. Respondents' recollections of Bengal tiger and Asian elephant sightings over a 20-year period indicated a drastic decline in their numbers, and perceptions of forest loss were supported by assessments of changes in dense forest cover indicating an annual deforestation rate of 1.577% $yr^{-1}$ over a 20-year period, or loss of 274 $km^2$ of dense forest. This suggests that forest dwelling communities have an acute awareness of disappearing forests and wildlife, and informant-based surveys can be indicative of the status of wildlife and forests in situations such as Similipal, where ecological studies are problematic due to civil conflict.

**Keywords**: annual deforestation rate; Eastern Ghats; India; insurgency; local attitudes; Similipal Tiger Reserve; wildlife decline.

Received: 2 October 2012; Accepted: 12 December 2012; Published: 24 June 2013.



**Cite this paper as**: Sasmita Sahoo, Jean-Philippe Puyravaud and Priya Davidar. 2013. Local knowledge suggests significant wildlife decline and forest loss in insurgent affected Similipal Tiger Reserve, India. *Tropical Conservation Science* Vol. 6(21):230-240. Available online: www.tropicalconservationscience.org

## Introduction

Indigenous people living in wilderness areas often have a deep traditional knowledge of nature and natural resources [1], and this information is invaluable for conservation [2]. Surveys can provide an insight into the local people's knowledge of biodiversity and appreciation for conservation [3]. For instance, surveys have been used to assess the decline of the chimpanzee population in Guinea [4]; have provided information into the diverse causes of wildlife loss in Côte d'Ivoire [5]; have played a role in assessing long term changes in the range sizes of large mammals in southern India [6]; and were useful for obtaining information on the abundance and distribution of the dugong in Malaysia [7]. However, certain homogeneity of the respondents is required: for instance, migrants may not have as extensive a knowledge of wildlife as the local people [8], and perceptions of wildlife-related issues may differ between groups [9].

Surveys can be useful in situations where sampling and long term monitoring of wildlife populations are difficult. Several tropical countries rich in biodiversity are beset by civil conflict and war, which often increase deforestation, adversely impact wildlife populations, and result in the breakdown of protected area management [10-13]. In the Indian subcontinent, Maoist led insurgencies have seriously affected the functioning of many protected areas through violent attacks on Forest Department infrastructure and staff, rendering them incapable of carrying out their duties [10, 14]. In Similipal Tiger Reserve, the destruction of infrastructure such as beat and Range offices, and the shooting of forest staff and domestic elephant have resulted in lack of motivation among forest staff and disruption of protected area management [15].

In this paper we look at the case of Similipal Tiger Reserve (STR), which lies within the Mayurbhanj district of the state of Odisha, and is critically located as a passageway between the forests of central India, the Eastern Ghats and the North East. Similipal is facing an ongoing Maoist insurgency [15, 16], that reportedly started in 1998 [17] and has decimated the forests and wildlife [18-21]. Due to the insurgency, long-term research and monitoring of wildlife in Similipal have suffered [15], but informant-based surveys can provide insights into loss of wildlife and forests where intensive sampling and long term monitoring are prevented by violence.

We carried out a questionnaire survey among 217 men and women from 16 villages belonging to tribal communities such as the Kohla, Bathudi, Mankidia, Ho and the Gonds, who had lived in the core and buffer zones of Similipal Tiger for generations [18]. The objective of the survey was to gain an understanding of the people's perception of wildlife decline and forest loss over a 20-year period, from 1988-89 to 2007-08, which covers the pre-insurgency and insurgency phase (Table 1).

From the Forest Survey of India, we obtained information on forest cover loss over the same period for the Mayurbhanj district of Odisha, where Similipal Tiger Reserve is located. Approximate tiger numbers were obtained from various sources [22-24]. We tested the hypotheses that: 1) there would be no association between the local attitudes towards conservation and perceptions of wildlife decline, and 2) perceptions of wildlife decline would not concur with available data on deforestation rates and tiger numbers over a 20-year period.

## Methods

*Study area*

Similipal is a large protected area situated in the Mayurbhanj district of Odisha state, at the crux between the Northern Eastern Ghats and the Central Indian forests (Fig. 1). The local populations belong to tribal communities such as the Kharias, Mankdias, Santhal, Gonds, Mundas, Kolhas, Bhumija, Bhuyan, Mahalis, Sounti and Saharas and others [23]. The Kharias and Bathudis were among the early

settlers of Similipal, whereas many of the Kolhas, Santhals, Gonds and Mundas have migrated from neighboring districts in Odisha, West Bengal and undivided Bihar during the last century [25]. Many tribals practice Christianity [26], and have been victims of religious violence in this region [27]. This is relevant in the context of protected area management, because Christian tribals have been alleged to provide tacit support to the Maoists [28], and have provoked the antagonism of state agencies, including the Forest staff, towards the tribals (personal observation), which has apparently caused hostility between the tribal communities and the Forest Department.

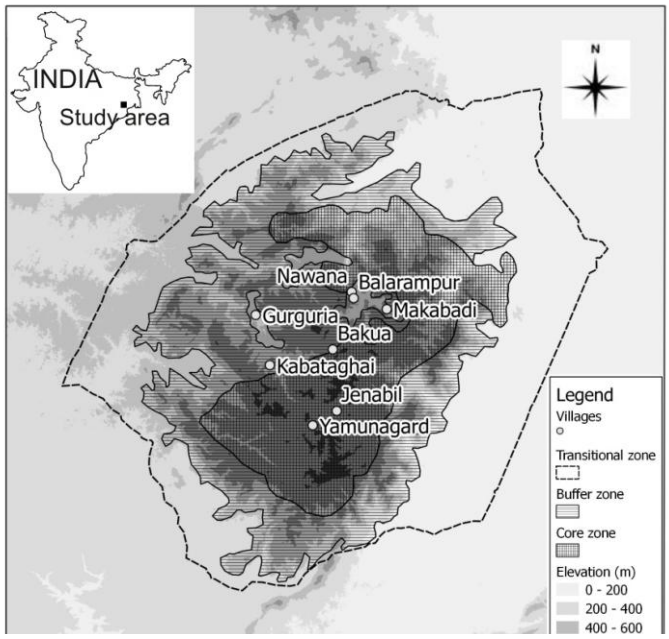


**Fig. 1. Similipal Tiger Reserve showing the location of some of the study villages.**

The Tiger Reserve, which covers an area of about 2,750 km$^2$, was created in 1973 under Shri S. R. Choudhury as its first Field Director. There are about 61 villages located within the reserve and about 1,200 villages along the periphery, which support a population of over 0.45 million people [20]. The tribal villages in the core zone of the reserve have been earmarked for resettlement outside the PA [22, 29].

We used a structured questionnaire to carry out the survey (Table 1). The participants were selected based on their willingness to take part in the interview. The interview was open-ended and conducted by the senior author in Oriya or the local tribal language with the help of an interpreter. A total of 217 men and women above the age of 20, residing in 16 tribal villages in the core and buffer zone of the reserve, participated in the survey. Each individual represented one household and in all comprised about 10% of the local population that were familiar with the forest. About 62% of the respondents were illiterate [20]. These villages were representative of the tribal communities and covered different areas of the reserve (Fig. 1).

*Conservation Attitudes*

Villagers' opinions on conservation in general and on the management of Similipal protected area in particular were solicited through a questionnaire (Table 1). They were asked whether: a) they accepted conservation as a common heritage of the people; b) Conservation was acceptable but often imposed on local people; or 3) No conservation accepted since poor people needed to eat, i. e., conservation competes with developmental initiatives. Their opinion on whether Similipal Tiger Reserve should be managed by the Forest Department, by local communities or by no management, was solicited (Table 1).

The opinions on conservation were coded from 0 to 2, with 0 indicating total opposition to conservation (=poor people need to eat), 1 signifying conservation with reservations (acceptable but imposed), and 2 showing support for conservation as a heritage of the people. Their opinion on the protected area management was coded as 0 = no management, 1=management by local communities, and 2= management by the Forest Department. The respondents were categorized as young (20-34 yrs), middle aged (35-49 yrs) and older (50+). Responses to the queries of whether the tiger has disappeared, elephant has disappeared and forest is gone were coded 1 for yes and 0 for no.

We chose the abundance of two keystone species, the Asian elephant and the Bengal Tiger, as proxies for wildlife. Tigers and elephants dramatically shape their ecosystem, create conflicts with humans, and are threatened with extinction. These species are more likely to be remembered by the local population. Trees are an important resource for fuel-wood, fodder and construction material. Their disappearance is more likely to be noticed and tracked by the local population.

To estimate wildlife abundance over time, the respondents were asked to recollect the number of tigers (Bengal tiger, *Panthera tigris*) and elephants (Asian elephant, *Elephas maximus*) they had sighted during their forays into the forest over a period of one year, 20- years ago (1988-1989), 10-years ago (1998-1999) and during the time of the study (2007-2008). They were asked to agree or disagree with the statement that the tiger, the elephant and large trees had disappeared (=gone) over the past 20-years (Table 1). They were also asked whether they hunted and fished, and to agree or disagree with the statements that hunting was easier 20- years ago (1988-1989), 10-years ago (1998-1999) and during the time of the study (2007-2008). Ease of hunting could be an indirect proxy for herbivore abundance. The respondents had inhabited this region for generations, and since they often walked extensively in Similipal Tiger Reserve to visit the local markets, participate in tribal festivals, collect forest products, and participate in traditional hunts, they were quite familiar with wildlife.

To support these observations, we used available information on the status of wildlife such as the tiger, and state of the forest reports by the Forest Survey of India for the Mayurbhanj district of Orissa where Similipal Tiger Reserve is located [30, 31]. We looked at the change in forest cover in the >40% canopy cover category since Similipal has dense forest, receiving on average about 1,500 mm of rainfall annually [20]. The 1993 assessment where district wise data were available used satellite imagery from 1989-1991 [30], and this was compared with the 2011 assessment using satellite images from 2008-2009 [31]. Although the forest survey does not distinguish native forests from plantations [32, 33], nevertheless, the data are indicative of trends. We used the total extent of forest in these two assessments to calculate the annual rate of deforestation using FAO estimator and method suggested by Puyravaud [34].

We obtained tiger estimates for 1989 from The Samaj (2002) cited in Rath and Sutar [22] and the 2006 and 2008 tiger estimates from the official tiger census [23, 24].

Table 1. Sample questionnaire used to assess socio-economic characteristics, conservation attitudes and recollections of wildlife sightings over a 20- year period among 217 respondents living within Similipal Tiger Reserve.

| Name: | | Date: |
|---|---|---|
| Age: | | Gender: |
| Village: | | Occupation: |
| SL | Person/household | Response |
| 1 | Do you collect wood from the forest? | Yes/No |
| 2 | Do you fish? | Yes/No |
| 3 | Do you hunt? | Yes/No |
| 4 | Have you been living in the same village for the past 20 years? | Yes/No |
| 5 | 20-years ago | |
| | How many tigers did you see in one year? | Open |
| | How many elephants? | Open |
| | Were there bigger trees than today? | Open |
| | Were there more trees than today? | Open |
| 6 | Ten years ago | |
| | How many tigers did you see in one year? | Open |
| | How many elephants? | Open |
| | Were there bigger trees than today? | Yes/No |
| | Were there more trees than today? | Yes/No |
| 7 | Now | |
| | How many tigers did you see in one year? | Open |
| | How many elephants? | Open |
| 8 | Do you agree with this statement that presently: | |
| | Tigers have disappeared | Yes/No |
| | Elephants have disappeared | Yes/No |
| | Trees have disappeared | Yes/No |
| 9 | What would describe your attitude: Do you think that: | |
| | Conservation is fine for India as we must preserve our common heritage? | Yes/No |
| | Conservation is OK but too often imposed on local people | Yes/No |
| | No conservation since poor people need to eat | Yes/No |
| 10 | What is your attitude towards the protected area management? | |
| | PA management by Forest Department is acceptable | Yes/No |
| | PA management by local communities | Yes/No |
| | Against PA's | Yes/No |

*Data analysis*

Chi-square tests or G test, depending on the sample sizes in each cell, were used to look at the association of conservation attitudes with gender, age and occupation, and the likelihood of agreement with the statement that the forests had disappeared, tiger and elephant had disappeared and hunting was more difficult at present than 20 years ago. Only respondents ≥30 years were included in this analysis as those <30 would have been too young to document changes over a 20-year period. The Wilcoxon signed rank test was used to see whether the annual sightings of the tiger and elephant differed between 1987-88 and 2007-08. All statistical analyses were conducted using Systat 2000 [35].

## RESULTS

*Age, gender and occupation of the respondents*

There were 116 younger (20-34 yrs), 79 middle aged (35-49 yrs) and 22 older people (50+) among the respondents, and of them 146 were men and 71 women. About 79% of the respondents were primarily agriculturists with fewer engaged in wage labour and very few employed by the Forest Department (Table 2). Fourteen respondents had multiple occupations and were classified according to their primary occupation. The majority of the respondents (190) were from buffer zone villages and 27 from the core zone. Fuel-wood was the major product harvested from the forest by all households surveyed (Table 2). Fewer collected other Non Timber Forest Products since this was a seasonal activity [21].

*Support for conservation*

About 53% supported conservation as a heritage of the people, 42% were ambivalent, and very few agreed with the statement '*no conservation since poor people have to eat*' (Table 3). There was no significant association of conservation attitudes with gender ($\chi$2=1.20, df=2, ns), and age (G test = 0.60, df=4, ns). Among the occupational classes, only the agriculturists and daily wage earners were compared due to the small samples in the other categories. There were no differences in the attitudes of the two occupational classes to conservation ($\chi^2$=1.53, df=2, ns). About 19 respondents (9%) supported management by the Forest Department, 138 (64%) supported PA management by local communities, and 60 (28%) were against any protection. There was no significant difference in opinion between the different age classes (G test= 2.87, df=4, ns) and gender ($\chi$2=2.56, df=2, ns) towards support of the PA.

*Conservation attitudes and perceptions of wildlife decline and forest loss*

The majority of the people (≥ 30 years of age, n= 139) agreed with the statement that the tiger, the elephant and large trees had disappeared over a 20-year period (Table 3). However, there was no significant association between their attitudes towards conservation (Yes, No and Mixed) and perceptions of tiger, elephant and forest loss (Table 3).

A minority of 28 (20%) agreed with the statement that hunting was easier in 1987-88 compared to 2007-08. None agreed that hunting was easy in 2007-08. Significantly more people agreed with the statement that there were more trees in 1987-88 compared to 2007-08 ($\chi$2= 21.17, df=1, p<0.0001), and bigger trees in 1987-88 compared to 2007-08 ($\chi$2 = 124.44, df=1, p<0.0001). There was no relationship between attitudes towards conservation and the perception that tigers, elephants and trees had disappeared ($\chi$2 = 0.82, df=4, ns), and attitudes towards the protected area management and perception that tigers, elephants and trees had disappeared ($\chi$2 = 0.95, df=4, ns).

Sightings of tigers $yr^{-1}$ were significantly higher in 1987-88 compared with 2007-08 (Wilcoxon signed rank test Z=-5.195, p<0.0001) and similarly on average more elephants sighted $yr^{-1}$ in 1987-88 compared with 2007-08 (Wilcoxon signed rank test Z=-7.56, p<0.0001, Table 4).

Table 2. Occupation of the 217 respondents and dependence on forest fuelwood, NTFP's and bush meat.

| Age | N | Occupation (%) | | | | Forest fuel-wood | Other NTFP's | Hunting | Fishing |
|---|---|---|---|---|---|---|---|---|---|
| | | Agriculture | NTFP | Daily wage | Forest Dept. | | | | |
| Younger (20-34) | 116 | 95 (82) | 5 (4) | 13 (11) | 3 (3) | 116 | 6 | 7 | 19 |
| Middle (35-49) | 79 | 59 (75) | 4 (5) | 14 (18) | 2 (3) | 79 | 4 | 5 | 23 |
| Elder (50+) | 22 | 17 (77) | 3 (13) | 2 (9) | 0 | 22 | 4 | 1 | 7 |
| Total | 217 | 171 (79) | 12 (6) | 27 (12) | 5 (2) | 217 | 14 | 13 | 49 |

*Deforestation rates and tiger numbers*

Using official statistics which covered the period 1989-1991 [29] and 2008-09 [30], the total forest cover in Mayurbhanj district was 4,062 $km^2$ in the 1989-1991 assessment, of which 3,325 $km^2$ was dense forest (>40% canopy cover). In the 2008-09 assessment the total forest cover was 3,992 $km^2$ of which 3,051 $km^2$ was dense forest cover. This indicates a loss of 274 $km^2$ of dense forest over a 20 year period. The annual rate of deforestation works out to be 1.577% $yr^{-1}$ (FAO) and 1.59003 $yr^{-1}$ [34].

There were reported to be about 93 tigers in STR in 1989 (The Samaj (2002) cited in Rath and Sutar [22]), and official statistics claim 98 tigers and 449 elephants in the 1997 census [17]. The 2008 tiger survey report provides an estimate of between 17-23 and the 2011 report 12-34 tigers [23, 24].

The status of elephants was also precarious: about 570 were reported to have died over the past 19 years (1991-2010), 41% being attributed to poaching and 29% to accidents. This is an estimated decline of 20% in the past 25 years [36]. This data although from journalistic sources, except for the national tiger census report, unequivocally report the loss of tigers and elephants from Similipal Tiger Reserve.

## Discussion

Our survey indicates a high level of understanding of conservation issues by the local people. On the positive side, the majority favored conservation, and did not perceive that it undermined human wellbeing, a specious argument used to impose development projects within or near protected areas in India [37, 38]. The respondents displayed a keen awareness of the loss of wildlife and forest cover in Similipal Tiger Reserve.

Conservation attitudes were not associated with perceptions of species decline and forest loss, indicating that these measures are independent. This suggests that in situations when it is difficult to

directly sample wildlife populations, informant-based measures could be useful in obtaining baseline data. Informant surveys have been used to obtain data on wild plant resources [39] and the status of large mammals in the southern Western Ghats [6], although some caution is required [40].

Table 3. Association between conservation attitude and perceptions of species loss among 139 respondents' ≥30 years of age. Conservation attitude and tiger disappeared (G test = 4.16, df= 2, ns), elephant disappeared (G test = 1.28, df= 2, ns), forest gone (G test = 0.938, df= 2, ns),

| Conservation attitude | Total | Tiger disappeared Yes | Elephant disappeared Yes | Forest gone Yes |
|---|---|---|---|---|
| Yes | 76 | 67 | 67 | 71 |
| No | 7 | 4 | 5 | 7 |
| Maybe | 56 | 50 | 49 | 53 |

The widespread perception that wildlife and forests are disappearing in STR [15, 18-21] is supported by the insights of the local people. There appears to have been a sharp decline in tigers from the earlier estimates of around 93 in 1989 [22]. The tiger census conducted by the Wildlife Institute of India in 2006 and 2010 put the estimated number at around 20 and 23 respectively [23, 24] . This mirrors the perceptions of the local people and contradicts current state government estimates of about 101 tigers at Similipal [41].

Civil conflict is prevalent in many protected areas in tropical countries [12], and could adversely affect conservation because availability of arms fuels hunting for bushmeat and commercial poaching, and the larger populations within the reserve increase deforestation thereby impacting the resource base of local communities [12, 42-43]. The limitations of this study were that parts of the reserve were inaccessible at times due to Maoist activity, and the local communities were intensely hostile to outsiders. Since the senior author's family was from this district and had contacts with the tribal communities, research was facilitated. However, more in-depth inquiries met with resistance. Our personal observation was that illegal logging and poaching were widespread within the reserve.

The example of the Maoist insurgency in Nepal provides insights into how conservation of wildlife could be managed under adverse conditions [10]. Community-based conservation efforts were more resilient to attacks by Maoist insurgents, and in many instances the NGOs collaborated successfully with the rebels as well as officials to maintain conservation activities. Therefore, garnering support for conservation among local communities could be vital even in extreme situations [10].

Table 4. Mean annual sightings of the Bengal Tiger and the Asian Elephant by local people (≥30 years, n=139) since 20-years, 10-years and present, and concurrence with the statement that there were 'more trees' and 'larger trees' over the same time frame.

| Time frame | Annual tiger sightings (Mean ± SD) | Annual elephant sightings (Mean ± SD) | More trees 20-years ago Yes (%) | Larger trees 20- years ago Yes (%) | Hunting easy (%) |
|---|---|---|---|---|---|
| 20 years ago (1987-88) | 0.597 ± 1.09 | 2.76 ± 3.07 | 98 (71) | 97 (70) | 28 (20) |
| 10 years ago (1997-98) | 0.324 ± 0.68 | 1.13 ± 1.1 | 130 (94) | 101(73) | 8 (6) |
| Now (2007-08) | 0.122 ± 0.46 | 0.53 ± 0.77 | 60 (43) | 7 (18) | 0 |

## Implications for conservation

Local populations living within and adjacent to protected areas in India often have a resource interest in the forest and are reluctant to support conservation initiatives [44, 45]. This is no different at Similipal. However, although the local people were antagonistic towards the Forest Department, there was still substantial support for conservation [20]. Therefore, concerted efforts need to be made to involve the local communities in conservation, in partnership with protected area management and civil society [10, 12] in order to reverse wildlife decline and forest loss in Similipal.

Finally, although this study is preliminary in nature, we hope that it will lead to more research in Similipal Tiger Reserve, an important wilderness area, which has not received the attention it deserves [15].

## Acknowledgements

We thank the Odisha Forest Department particularly Dr. Lala A. K. Singh IFS, Chief Wildlife Warden, Odisha, and the Field Director of Similipal Tiger Reserve for permission to carry out research. We appreciate the cooperation of many residents of Similipal who gave their time and insights to make this study a success. We thank Prafulla Marandi for his assistance in data collection. Belinda Wright provided insightful comments on earlier drafts of the manuscript. We thank two anonymous reviewers for critical comments on the manuscript.

## References

[1] Gadgil, M., Berkes, F. and Folke, C. 1993. Indigenous knowledge for biodiversity conservation. *Ambio* 22: 151–156.

[2]Huntington, H.P. 2000. Using traditional ecological knowledge in science: methods and applications. *Ecological Applications* 10: 1270–1274.

[3] Hunter, L. M. and Brehm, J. 2003. Qualitative insight into public knowledge of, and concern with, biodiversity. *Human Ecology* 31: 309-320.

[4] Sugiyama, Y. and Soumah, A. 1988. Preliminary survey of the distribution and population of chimpanzees in the Republic of Guinea. *Primates* 29: 569-574.

[5] Bassett, T. J. 2005. Card-carrying hunters, rural poverty, and wildlife decline in northern Côte D'Ivoire. *The Geographical Journal* 171: 24-35.

[6] Pillay, R., Johnsingh, A. J. T., Raghunath, R. and Madhusudan, M. D. 2011. Patterns of spatiotemporal change in large mammal distribution and abundance in the southern Western Ghats, India. *Biological Conservation* 144: 1567-1576.

[7] Rajamani , L. and Marsh, H. 2010. Using parallel regional- and local-scale initiatives to inform conservation management of rare wildlife: a case study of the dugong *Dugong dugon* in Sabah, Malaysia. *Endangered Species Research* 13:17-23.

[8] Nyhus,P., Sumianto, and Tilson, R. 2003. Wildlife knowledge among migrants in southern Sumatra, Indonesia: implications for conservation. *Environmental Conservation* 30: 192-199.

[9] Wieczorek Hudenko, H., Decker, D. J. and Siemer, W. F. 2008. Reliance on informants in wildlife management situation analysis-shortcut or shortcoming? ? *Human Dimensions of Wildlife* 13: 459-470.

[10] Baral, N. and Heinen, J.T. 2006. The Maoist people's war and conservation in Nepal. *Political and the Life Sciences* 24**:** 2-11.

[11] Kanyamibwa, S. 1998. Impact of war on conservation: Rwandan environment and wildlife in agony. *Biodiversity and Conservation* 7: 1399-1406.

[12] Dudley, J.P., Ginsberg, J.R., Plumptre, A.J., Hart, J.A. and Campos, L.C. 2002. Effects of war and civil strife on wildlife and wildlife Habitats. *Conservation Biology* 16: 319-329.

[13] Loucks, C., Mascia, M. B., Maxwell, A., Huy, K., Duong, K., Chea, N., Long, B., Cox, N. and Seng, T. 2009. Wildlife decline in Cambodia, 1953–2005: exploring the legacy of armed conflict. *Conservation Letters* 2: 82-92.

[14] Raman, B. 2010. The Maoist insurgency in India. Paper No. 3715. South Asia Analysis Group (http://www.southasiaanalysis.org/%5Cpapers38%5Cpaper3715.html).

[15] Wright, B. and Mohanty. B. 2010. *Similipal Tiger Reserve: Assessment of recent elephant poaching and protection initiatives.* Report submitted to the National Tiger Conservation Authority, Ministry of Environment and Forests, New Delhi.

[16] South Asian Terrorism Portal 2011, viewed 05-12-2012: http://www.satp.org/satporgtp/southasia/index.html

[17] Project Tiger website 2012, viewed 02-10-2013: http:// www.projecttiger.nic.in/similipal.htm

[18]Parida, R.C. 1997. Sustainable exploitation of natural resources of Similipal. In: *Similipal: A Natural Habitat of Unique Biodiversity.* Tripathy, P.C. and Patro, S.N. (eEs.), pp. 139-145, Orissa Environmental Society, Bhubaneswar.

[19] Raut, D.K. and Behera, G. 1997. Application of remote sensing for management of natural resources in Similipal biosphere reserve. In: *Similipal: A Natural Habitat of Unique Biodiversity.* Tripathy, P.C. and Patro, S.N. (eEs.), pp. 139-145, Orissa Environmental Society, Bhubaneswar.

[20] Das Mohapatra, S. 2012. *Impact of resource dependence by local communities on Similipal Tiger Reserve.* Unpublished Ph. D. thesis, Pondicherry University.

[21] Sahoo, S. and Davidar, P. 2013. Effect of harvesting pressure on plant diversity and vegetation structure of Sal forests of Similipal Tiger Reserve, Odisha. *Tropical Ecology* 54: 97-107.

[22] Rath. B. and Sutar, P.C. 2004. Human issues in protected areas: a case study in Similipal Tiger Reserve. *VASUNDHARA*: 1-33

[23] Jhala, Y. V., Gopal, R. and Qureshi, Q. Eds. 2008. *Status of the tigers, co-predators, and prey in India*. National Tiger Conservation Authority, Govt. of India, New Delhi, and Wildlife Institute of India, Dehra dun, 151 pp.

[24] Jhala, Y. V., Qureshi, Q., Gopal, R. and Sinha. P. R. Eds. 2011 . *Status of the tigers, co-predators, and prey in India 2010*. National Tiger Conservation Authority, Govt. of India, New Delhi, and Wildlife Institute of India, Dehradun, 302 pp.

[25] Mishra, N., Rout, S.D. and Panda, T. 2011. Ethno-zoological studies and medicinal values of Similipal Biosphere Reserve, Odisha, India. *African Journal of Pharmacy and Pharmacology* 5: 6-11

[26] Sahoo, M. 2011. Relocation is not our fate, Similipal Tiger Reserve: Part 3. Saching.com URL: http://www.saching.com/Articles/Relocation-is-Not-Our-Fate-Simlipal-Tiger-Reserve-Part-3-9834.html.

[27] Kanungo, P. 2008. Hindutva's fury against Christians in Orissa. *Economic and Political Weekly* 43: 16-19.

[28] Majority of Maoists supporters in Orissa are Christians. Downloaded 05-12-2012, http://www.hindu.com/thehindu/holnus/001200810051766.htm

[29] Das, S. and Das, B.P. 2008. Similipal Biosphere: Genesis of historicity. Orissa Review.

[30] Forest Survey of India. 1993. *State of forest report 1993*. Forest Survey of India, Ministry of Environment and Forests, Government of India, Dehra Dun, India.

[31] Forest Survey of India. 2011. *State of forest report 2011.* Forest Survey of India, Ministry of Environment and Forests, Government of India, Dehra Dun, India.

[32] Puyravaud, J-Ph., Davidar, P. and Laurance, W. F. 2010. Cryptic loss of India's native forests. *Science* 329: 33.

[33] Puyravaud, J-Ph., Davidar, P. and Laurance, W. F. 2010. Cryptic destruction of India's native forests. *Conservation Letters* 3: 390-394.

[34] Puyravaud J-Ph. 2003. Standardizing thecalculation of the annual rate of deforestation. Forest Ecology and Management 177: 593-596.

[35] SPSS Inc. 2000. Systat, Version 10. SPSS Inc., Chicago, IL.

[36] Death of three more elephants in Similipal rings alarm bell. Downloaded 02-10-2012; http://articles.economictimes.indiatimes.com/2011-02-15/news/28539345_1_similipal-national-heritage-animal-elephants ).

[37] Bagla, P. 2009. Indian neutrino detector hits snag on environmental concerns. *Science* 323: 197.

[38] Davidar, P. 2009. Indian neutrino detector: environmental costs. *Science* 323: 1427-1428.

[39] Kristensen, M. and Mette Lykke, A. 2003. Informant-based valuation of use and conservation preferences of savanna trees in Burkina Faso. *Economic Botany* 57: 203-217.

[40] Gavin, M. C. and Anderson, G. J. 2005. Testing a rapid quantitative ethnobiological technique: First steps towards developing a critical conservation tool. *Economic Botany* 59: 112-121.

[41] Tiger census: Orissa rejects numbers. Downloaded 02-10-2012; http://www.ndtv.com/article/india/tiger-census-orissa-rejects-numbers-95597).

[42] Formoli, T. A. 1995. The impacts of the Afghan-Soviet war on Afghanistan's environment. *Environmental Conservation* 22: 66-69.

[43] Draulans, D. and Van Krunkelsven, E. 2002. The impact of war on forest areas in the Democratic Republic of Congo. *Oryx* 36: 35-40.

[44] Davidar, P., Sahoo, S., Mammen, P.C., Acharya, P., Puyravaud, J.P., Arjunan, M., Garrigues, J.P. and Roessingh, K. 2010. Assessing the extent and causes of forest degradation in India: Where do we stand? *Biological Conservation* 143: 2937-2944.

[45] Arjunan, M., Holmes, C., Puyravaud, J.P. and Davidar, P. 2006. Do developmental initiatives influence local attitudes toward conservation? A case study from the Kalakad-Mundanthurai Tiger Reserve, India. *Journal of Environmental Management* 79: 188–197.