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Change in Vegetation Cover of Dampa Tiger Reserve, Mizoram, North East India: A Serious Threat to Tiger Population

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Abstract

Change in vegetation cover drastically alters the status of a habitat. A dramatic change in vegetation cover of Dampa Tiger Reserve was observed during the last 27 years. There was a prominent increase in built up (590%), bamboo forest (192.89%) and scrub (74.67%) areas. These increases are simultaneously accompanied by decrease in cover area of evergreen/semi evergreen closed forests from 152.47 sq km in 1978 to 95.27 sq km in 2005. Meanwhile the population of tiger as per tiger census during this period in the reserve was only four to five. As there is hardly any report of poaching, we assume that this constant population instead of growth may largely be due to change in vegetation cover. The root cause of this vegetation change was due to practice of shifting cultivation by villagers in and around the reserve and people reaching from far away places. This in totality resulted in shrinkage of tiger habitat. Though the reserve based on IUCN framework, scored 121 score grading among all the tiger reserves in India and placed in category, 'Good', the changing pattern of vegetation is alarming and pose a serious threat to the present tiger population within the reserve.

Key Words: Habitat loss, Tiger Reserve, conservation, shifting cultivation, keystone species, land cover.

Introduction

The preservation of carnivores becomes an important consideration in conservation biology[1]. Tigers are important carnivores occupying topmost position in the ecological pyramid, a symbol of wilderness and well being of the ecosystem being a significant keystone species and conservation of tigers can provide a means for conserving native biodiversity[2] as they are the first to suffer when the ecosystem around them starts to erode[3].

The tiger once had the widest geographical distributions of any cat, stretching originally from almost 10˚ latitude south of the equator (Java and Bali) to more than 60˚ north (the Russian Far East) and through more than 100˚ longitude[4,5]. Distribution of the tiger once spanned Asia, from eastern Turkey to the sea of Okhotsk. Over the last 50 years, its range has been greatly reduced, but tigers are still found in a broad variety of forest types, including dry deciduous, moist deciduous, semi evergreen, wet evergreen, reverine, swamp and mangrove[6]. The 8 distinctive sub-species of the tiger in the world[5,7] are now critically endangered with a report of extinction of 3 sub species and a fourth is close to extinction in the wild[5]. All populations are under severe pressure from the loss of habitat. Over the last century the tiger's landscape has changed dramatically. An expanding human population has put increased pressure on the tiger's habitat. Forest and grasslands have been lost, degraded and fragmented and ungulate populations have declined precipitously, both in abundance and distribution. Tiger numbers have also declined, and almost all remaining populations are now small and isolated. In the last 25 years, these changes have accelerated threatening the existence of the tiger.

In India, 28 Tiger reserves are recognized, of which 9 tiger reserves viz. Dampa (Mizoram), Nameri (Assam), Manas (Assam), Pakke (Arunachal Pradesh), Nagarjunsagar-Srisailam (Andhra Pradesh), Namdapha (Arunachal Pradesh), Ranthambhore (Rajasthan), Indrawati (Chhattishgarh), and Sariska (Rajasthan) are at considerable risk and require immediate remedial action[8]. Under such circumstances, a quick and easy method of assessment of tiger habitats is required and remote sensing and GIS prove to be more practical. Attempts were made in the Chitwan National Park, Nepal, to generate land use /cover maps for the tiger habitat[9] and in some National Parks in India like Kanha[10,11]. In this direction, Dampa tiger reserve has been selected for studying the habitat of Bengal Tiger (*Panthera tigris*) which is an endangered species. So far no attempt has been made on the reserve to study the status of the habitat. Considering the remoteness, inaccessible terrain for tradional suvey, remote sensing and GIS technique is used in the study.

Status of distribution, population and habitat of Bengal tiger

The Bengal tiger, *Panthera tigris* ssp. *tigris* L. under the family Felidae is distributed in India and Southeast Asia (Table 1) in tropical forests and grassland. It is known by various local names in India (*Bagha*: Oriya, *Hoolee*: Kannada, *Naree*:

Malayalam, *Kaduwa, Vengai Puli*: Tamil, *Patery Wagh*: Marathi, *Pedda Puli*: Telegu, *Bagh*: Bengali/ Assamese, *Bagh, Sher*: Hindi).

Tigers prefer thick grass, dense jungle and undergrowth in which they stock for their prey. The stripes on the hide of the tiger act as an incredible camouflage and help to conceal itself in tall grass and vegetation. In the dry jungles of wildlife parks in Ranthambore and Sariska in Rajasthan, India, tigers are often seen in the ruins of monuments and temples in the park. Tigers unlike other cats prefer pools of water to stay cool in hot summers.

Many researchers laid down the strategies for tiger conservation5, 13, 14 and identified habitat integrity, poaching pressure and population status in the order of importance of 4:2:1 ratio 15.

More than 3000 Bengal tigers were recorded all over the world and more than 2500 in India during 1998 (Table 1). This represents a significant percentage of population of Bengal tigers in India. Realizing this fact of India supporting a sizable population of tiger, Project Tiger was launched on April 1, 1973, based on the recommendations of a Special Task Force of the Indian Board for Wildlife. Initially, the project included nine Tiger Reserves, covering an area of 16,339 sq. km with a population of 268 tigers, which has now increased to 28 Tiger Reserves, distributed in 17 States in India and encompassing 37,761 sq. km of land with an estimated population of 1,498 tigers. At present, Bengal tigers are suffering from severe threats like poaching, habitat loss, fragmentation of habitat and decline in prey population resulting in endangered status being included under schedule I of IUCN/WPA/CITES red list[16].

Table 1. Status and country-wise distribution of Bengal tiger (*Panthera tigris* ssp. *tigris*) in Asia as in May 1998[12]

Country	Minimum	Maximum
Bangladesh	362	362
Bhutan	67 *	81 *
China	30	35
India	2500	3750
Myanmar, western	124	231
Nepal	93 *	97 *
Total	3167	4556

*Adults only

Study area

Dampa tiger reserve is located in Mamit District of Mizoram along the Bangladesh border. It covers an area of *ca.* 500 sq kms, falls within 23° 23' 15"N - 23° 42' 20''N latitudes and 92° 16' 25"E - 92° 25' 55"E longitudes and lies in the western part of Mizoram. Altitude in the reserve is from 800 to1100m above mean sea level. The annual rainfall ranges from 2000 mm to 2500 mm and maximum rainfall occurs during June to August. Pleasant and warm climate prevails in the reserve throughout the year with moderate to chill winter during November to January at higher altitude.

Temperature ranges from 12^0C to 25^0C during winter and between 22^0C to 35^0C during summer. The surface of the mountain is slope on the eastern side while high cliff is frequent on the western side. The rocks in the riverbeds are smooth and continuous There are four main rivers which flow inside Dampa Tiger Reserve. The reserve is also fed by hundreds of streams and they are well distributed inside the reserve. There are four fountains inside Teirei Range, one of which is salty along with several drainages. This salty fountain is below Chikha Tlang and is said to be used for salt production in Mizo legend. The western boundary is the river Khawthlang Tuipui/ Tuilianpui/ Sazalui, the other bank of this river is Bangladesh. The Reserve consists of moist deciduous forests at the lower reaches and evergreen and semi-evergreen with natural grassland at higher altitudes (*ca.* 1200 m) which make the reserve a conducive habitat for Bengal tigers.

Dampa was notified as wildlife sanctuary in 1985 with an area of 681 sq. km (approx) and re-notified as sanctuary by excluding portion of the initial area with an area of 340 sq. km (approx). It was finally re-notified on attaining the status Project Tiger in 1994 as Dampa tiger reserve with a total area of 500 sq. km. The Reserve has two range headquarters - Teirei in the north and Phuldungsei in the west.

There were four tigers when the reserve was notified in 1994. Other important animals found are leopard, elephant, gaur (Indian Bison), wild dog, sambar, barking deer, sloth bear, slow Loris, jungle cat, porcupine, etc. The Reserve also supports substantial primate diversity and is one of the important sites for the Phayre's Leaf Monkey and the Hollock gibbon. Information on the wildlife animals census for last few years are provided in table 2. All the above mentioned species are under severe threat of extinction due to habitat fragmentation and human interference.

Table 2. Wildlife animals in Dampa Tiger Reserve (As per wildlife census)

Species	1989	1995	1996
Tiger	4	4	5
Elephant	2	5	4
Leopard	4	9	13
Sambar	44	59	42
Barking deer	56	63	70
Serow	18	15	21
Wild boar	8	27	25
Sloth bear	6	10	8
Porcupine	30	20	12
Hollock gibbon	38	41	15
Rhesus macaque	274	210	217
Common langur	148	136	160
Indian civet	18	14	17
Jungle cat	16	17	19
Otter	18	21	23
Indian pangolin	6	11	10
Malayan giant squirrel	12	23	17

Materials and Methods

The satellite data used in the study were Landsat MSS data of path 146 and row 44(15-04-1978), Landsat TM data of path 136 and row 44(22-02-1989), IRS-ID LISS-III data of path 112 and row 55(19-01-1999), IRS-ID PAN sub-scene-d data of path 112 and row 55numbers (27-02-2003), IRS-P6 LISS-III data of path 111 and row 55 (05-03-2005) and 112-55 (14-04-2005).

The satellite data were rectified and visually interpreted using standard procedure. The vegetation and land cover types were identified and delineated on screen based on the tone, texture, size, shape, pattern, location and association seen on imagery. Vegetation type and land cover maps were generated for the four periods, approximately at an interval of ten years and maps were assessed for classification accuracy. The overall accuracies for the four layers are above 87%.

Results and Discussion

Forests cover types in Dampa tiger reserve (based on 2005 data)

The forest cover types identified in Dampa tiger reserve are closed evergreen/ semi evergreen forest (crown density >40%), open evergreen/ semi evergreen forest (crown density 10% to 40%), closed moist deciduous forest, open moist deciduous forest, scrub forest (crown density cover <10%), bamboo brakes and forest blank.

Closed evergreen/semi evergreen forest

Temporal satellite data (January, March and April) used in the study enabled us to distinguish closed evergreen/ semi evergreen forest type from deciduous species. This forest type is identified on the satellite imagery using data of the period from January to February season as the leaf shedding of the deciduous species was easily observed. However, it is difficult to separate or distinguish the evergreen forests which are occurring in small patches from the dominant semi evergreen forest. Therefore both the forests types were clubbed into single class. This forest is characterized by a crown density of above 40% and appears bright red to dark red in colour in varying sizes, smooth to medium texture. The forest in the reserve is represented by species like *Mesua ferrea, Dipterocarpus turbinatus, D. retusa, Artrocarpus chalpasa, Terminalia myriocarpa, T. bellerica, Michelia doltsopa, Adina cordinofolia, Amoora wallichii, Syzygium cuminii, Toona ciliata, Bischofia javanica, Castanopsis indica, Eleocarpus aristatus, E. floribundus, Knema angustifolia*, *Vitex glabra, Diospyros grata, D. cacharensis, Syzygium cerasoides, Stereospermum colais, Eleocarpus lanceofolius, Mangifera sylvatica, Garcinia cowa, Leea indica,* etc. It covers a total area of 95.27 sq km and represents 22.88 % of the total area of the reserve (Table 3).

In the reserve this forest type covers the north eastern portion and some scattered patches in the central region. Over the years from 1978 up to 2005 the change in forests cover is remarkable. A total 37.52% of closed evergreen/semi evergreen forest is lost since 1978.

Open evergreen/ semi evergreen forest

This forest type is characterized by crown canopy closer between 10%-40%. The species composition of this type is similar to that of closed evergreen/ semi evergreen forest types with less number of trees. This forest type has resulted from opening of the closed evergreen/ semi evergreen forest due to anthropogenic disturbances over a period of time. A total area of 64.35 sq km is represented by this forest type and it covers 15.46% of total geographical area in Dampa Tiger Reserve (Table 3). It was observed that this forest type has increased by 24.61 % since 1978.

Closed moist deciduous forest

In the satellite imagery, deciduous forest was identified by its tone which appears as darkish green in colour after shedding of leaves. This forest type is also characterized by canopy closer >40%. It is represented by species such as *Terminalia myriocarpa, T. bellerica, Dillenia indica, Gmelina arborea,* etc. Closed moist deciduous forest covers an area of 43.53 sq km which is about 10.46% of the reserve (Table 3). There is a reduction of this forest by 7.19 % since 1978.

Open moist deciduous forest

This forest type is also similar to closed moist deciduous type except that it differs only in the percentage of canopy closure which is between 10-40%. The species composition is

also similar to that of closed moist deciduous. An area of 13.09 sq. km is represented by this type which is about 3.14 % of the reserve (Table 3). Open moist deciduous forest has increased by 32.49% since 1978.

Bamboo brakes

Bamboo can be identified from other forest type in the satellite imagery by its tone and texture. It appears as light pinkish to purplish in colour with a very smooth texture. Only pure bamboo patches were delineated. Bamboo growing area is confined mostly in the north western and western part of the reserve along the Bangladesh border. It has resulted from the severe degradation of the primary forest in the past mainly due to the of practiced jhum cultivation before the declaration of the sanctuary status. The common bamboo species found in the reserve are *Melocanna baccifera*, *Bambusa tulda, Dendrocalamus hamiltonii* and *Schizostachyum polymorphum*. It covers an area of 48.21 sq. km which is 11.58% of the total geographical area of the reserve (Table 3). Bamboo growing area has increased by 192.89 % during the study peroid.

Scrub forest (Tree cover <10%)

This forest type is represented by canopy cover <10% and it is a result of the destruction of primary forest. Along with the evergreen, semi evergreen and moist deciduous species, bamboo was also found to occur in this forest type. Extensive tract of the land in the western and the southern side of the sanctuary is covered by mainly bamboo forest mixed with tree species. Maximum area (103.28 sq. km) in the reserve is under this forest type which covers about 24.81% of the total area of the reserve (Table 3).

Forest blank

These are the openings amidst forest areas, devoid of tree cover, observed as openings of assorted size and shapes as manifested on the imagery. They possess regular to irregular shape, scattered in the forested areas. These areas are mostly seen along hill tops/slopes midst forest areas. Only 2.03 sq. km is under forest blank category which is about 0.5 % of the reserve (Table 3).

Vegetation types and cover changes in Dampa tiger reserve

The analysis carried out on land cover changes in the reserve were detected under 10 categories (Table 3). A remarkable change was detected in components of vegetation cover in Dampa tiger reserve during the last four decades i.e. 1978 – 2005 (Table 4).

The forest cover change was characterized by a continuous decrease in closed forest areas and a continuous increase in built up and bamboo areas from the year 1989 to 2005. The study revealed that closed evergreen / semi evergreen forests which contributed 36.62% of the total land cover of the reserve in 1978 was reduced to only 22.88% in 2005. This major forest type was depleted by 37.52% and the maximum loss of this forest cover incurred during the period 1999 - 2005 witnessing a total loss of 30.02%. Open evergreen/semi evergreen forest type has increased by 24.61% during the period. Major changes were observed in bamboo areas and scrub forest where both the classes were increased by 192.89 % and 74.67% respectively. Most of the closed evergreen/ semi evergreen forest were replaced by bamboo brakes and scrub forests. At present, the existing forest is highly fragmented especially towards the western part of the reserve. The change is observed during the entire period of study (between 1978 and 2005) and shows that built-up land has increased maximum (590%) although it contributes to only 0.69 sq km and it is followed by bamboo brakes (192.89%), scrub (74.67%), open moist deciduous forest (32.49%). The area under abandoned jhum has come down by 51.52% and it is followed by closed semi evergreen forests (37.52%), current jhum (35.41%) and closed moist deciduous forest (7.19%).

Amongst the non forest categories, jhum area was most prevalent.

Area under abandoned jhum was 42.10 sq. km in 1978 which was reduced to 17.43 sq. km in 1989 (i.e. 58.60% reduction) and by 51.52% during 1978-2005. Current jhum from 1978-1989 has increased by 48.58% and subsequently it has reduced by 35.41% from1978 to 2005. Jhum cultivation has affected the habitat of the tiger and reduced it to fragmented remnants scattered throughout the reserve except the northern part. This has posed serious threat for the survival of tiger.

A comparison of the land cover composition in the years 1978, 1989 , 1999 and 2005 showed that in the year 1978, closed forests had highest land cover and forests blank, built up, bamboo and scrub forest contributed to the least land cover area (Table 3). On the other hand, in the year 2005, scrub forests had the highest cover and there were also marked increase in built up and bamboo brakes cover which was largely compensated by the decreased cover of closed forest.

Causes for change in vegetation

The livelihood of people within and outside the reserve depends largely on shifting cultivation which causes fire in the buffer zone. Extractions of firewood and timber are putting pressure on the tiger habitat. The area along the international border of the reserve is under constant threat of encroachment.

There are two villages within the Dampa tiger reserve and 20 villages around the reserve, with a population of roughly 10,000 tribal. Their livelihood mostly depends largely on age-old agriculture system of slash and burn (jhum). The requirement of people for firewood, small timber and building materials etc. in adjacent forests is a pressure in the buffer area. As such tigers are hardly recorded to stay in the eastern buffer area of the reserve.

Suitable forest types for Bengal tiger

Habitat suitability analysis of tigers within the reserve showed that closed evergreen/semi evergreen is best suited among all the other forest types. It is followed by scrub forests which is generally less suitable for tiger habitat in comparison to moist deciduous forest[17].

Status of prey of Bengal tiger

Tigers in Dampa tiger reserve feed on deer, sambar, buffalo, wild boar, etc. The prey density was recorded in the years 1989, 1995 and 1996. There was somewhat constancy in the prey population in the reserve.

Table 3 Vegetation and land cover Classes in Dampa tiger reserve

Vegetation and Land Cover types	Area in sq km			
	1978	1989	1999	2005
Closed Evergreen/ Semi evergreen Forest	152.47	139.76	136.14	95.27
Open Evergreen/ Semi evergreen Forest	51.64	42.53	80.24	64.35
Closed Moist Deciduous Forest	46.59	50.98	44.41	43.53
Open Moist Deciduous Forest	9.88	11.12	6.46	13.09
Forest Blank	2.03	3.15	3.68	2.03
Scrub Forest	59.13	67.52	60.37	103.28
Bamboo	16.46	27.87	40.28	48.21
Current Jhum	35.92	53.37	29.15	23.20
Abandoned Jhum	42.1	17.43	12.96	20.41
Water Body	*	2.27	2.28	2.28
Built Up	0.10	0.32	0.33	0.69
Total	416.32	416.32	416.32	416.32

Table 4 Change in land cover in percentage in Dampa Tiger Reserve

Change in percentage				
Vegetation and Land Cover types	1978-89	1989-1999	1999-2005	1978-2005
Closed evergreen/ Semi evergreen Forest	-8.34	-2.59	-30.02	-37.52
Open evergreen/ Semi evergreen Forest	-17.64	+88.67	-19.80	+24.61
Closed Moist Deciduous Forest	+8.70	-12.89	-1.98	-7.19
Open Moist Deciduous Forest	+12.55	-41.91	+102.63	+32.49
Forest Blank	+55.17	+16.83	-44.84	0.00
Bamboo	+69.32	+44.53	+19.69	+192.89
Scrub Forest	+113.31	-10.59	+71.08	+74.67
Current Jhum	+48.58	-45.38	-20.41	-35.41
Abandoned Jhum	-58.60	-25.65	+57.48	-51.52
Water Body	*	+0.44	0.00	*
Built Up	+220.00	+3.13	+109.09	+590.00

− loss in land cover

+ increased in land cover

* Due to low resolution water body could not be detected from the satellite imagery.

Conclusion

Over the years, the increase in biotic pressure, mainly the practice of jhum cultivation, extraction of firewoods, timber and minor forests products resulting in diverse land uses in the forested landscape, have adversely affected the tiger bearing forests in Dampa tiger reserve. In spite of these limitations, the ecological status of this Tiger Reserve is relatively better and harbour viable populations of tiger, co-predators and prey animals (Table 2).

The threat in the Dampa tiger reserve is clear from the vegetation change analysis which revealed a very significant and prominent change in the forests cover, a remarkable loss of close evergreen/ semi evergreen and moist deciduous forests which may obviously be the root cause for the low tiger population in the reserve. Again from habitat suitability analysis, it was found that closed evergreen/ semi evergreen forests are best suitable for tigers[17]. However, this particular forest cover had reduced dramatically since 1978 in this reserve which was a major problem. The closed evergreen/ semi evergreen forests are replaced by scrub land and jhum areas which are not suitable habitats for tigers. Tigers need space for breeding, but due to loss and shrinkage of habitat due to human activities, their population is somewhat constant in the reserve rather than increasing. Since poaching is not pronounced in the area, the main reason for very low rate of their population growth is held by human activities particularly the practice of Jhum cultivation. The practice is continuously operated by not only by the tribes settling within and around the reserve (Bru & Mizo) but also by the tribes reaching from far away places (Chakmas). It is a very important to understand that human habitation causes shrinkage of tiger habitat and then disturbs breeding and ultimately results to a declining tiger population. Increasing practice of jhuming within the reserve and loss of suitable forest cover within the reserve are the present threats which, if not checked, will push the tiger reserve into a “Poor status”.

After an overall analysis of our study we suggest following conservation and management strategies to maintain and improve the status of tiger reserve, control tiger habitat loss, preserve tigers in their natural habitat for surviving and growing to a desired population.

i.Human settlement within the buffer area should be shifted to other areas outside the reserve.

ii.The human activities especially jhuming cultivation within the reserve should be banned except for the buffer zones. Limitation of human activities in the buffer areas.

iii.Ecotourism development and people’s participation in the forests management programmes could be encouraged so as to provide an alternative earning rather than jhum cultivation for the local people.

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