



SHORT NOTE

Monitoring of Forest Fires in Bhadra Wildlife Sanctuary

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Abstract The Western Ghats constitute one of the three biodiversity hot spots in India, which is under constant threat from various quarters. Among the several anthropogenic causes, fire is one of the important anthropogenic factor, which plays a pivotal role in vegetation succession and ecosystem processes. It is very important to understand the ecological changes due to fire and other anthropogenic factors for conservation and management of biodiversity. Because of its synoptic, multi-spectral

and multi-temporal nature remote sensing data can be a good source for forest fire monitoring. In the present study, an effort has been made to monitor the burnt areas using March 2000 and 2004 IRS LISS – III data. The study revealed that an area of 2.15 km² and 4.46 km² was affected by fire in 2000 and 2004 respectively. Repeated drought, followed by mass flowering and dying of bamboo accelerated the spread of fire from ground to canopy in areas with high bamboo density.

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Introduction

Fire has long been playing a significant role in most forest ecosystem succession. The degree of damage caused depends on the type of fire as well as the type of forest. The deciduous forests experience annual fires. Among the 16 major forest types (type groups) in the country, largest area is covered by deciduous forests (moist deciduous –37% and dry deciduous

–26.8%). They together contribute to the bulk (69.6%) of the forest area. An estimate made by Forest Survey of India indicated that fire occurred as many as 17,852 times affecting about 5,72,417 km² of which most of the cases reported are from deciduous forests. The total extent of forests in Karnataka is 3.87 Mha of which about 45 ha of the forests are under the threat of fire, encroachment, smuggling etc. About 2330 km² of forests have been lost due to various developmental projects in the state between 1956 and 1994.

The recent incidents of wide spread forest fires in various wildlife sanctuaries in Karnataka including Bhadra and Nagarhole have received wide press coverage and aroused much public concern. FSI (1997) fire monitoring survey revealed that Bhadra Wildlife Sanctuary and Bandipur Tiger Reserve are repeatedly affected by fire over the last few years, which have been enhanced by drying up of bamboos flowers, once in a life time and dies thereafter.

Remote sensing and GIS are effective tools to study forest fires. The satellites data have proved to be extremely useful in mapping the fire events (Badarinath *et al.*, 2004; King 2002) and temporal satellite imagery have been used for forest fire monitoring (Emilio, 1999; Basappanavar, *et al.*, 1993).

Study area

Bhadra wildlife sanctuary (Anon, 1995) is located (75°15' – 75°50' E and 13°25' – 13°50' N) in Chikmagalur and Shimoga districts in the Western Ghats. These geographic barriers isolate the sanctuary from the neighboring forest belt, providing both protection to the inhabiting wildlife and posing genetic problems to terrestrial species. The area surrounding the sanctuary is almost completely converted to agricultural land, and crops like paddy, sugarcane, banana and arecanut are cultivated. In 1951, the Government of Mysore declared this region as the Jagara Valley Game Reserve and in 1974 it was reconstituted as the Bhadra Wildlife Sanctuary. It was declared as the 25th Tiger Reserve of the country in 1998. It covers 492.30 km², comprising four wildlife ranges viz Muthodi, Hebbe, Lakkavalli and Tanigebail.

The temperature ranges from 36°C in March to 10°C in December. The humidity is very high during the monsoon season, generally exceeding 90%. Winds are generally very light. From May to September, wind blows predominantly from directions between southwest and northeast. The annual rainfall varies from 1200–1500 mm.

The prevailing forests are climatic climaxes. The vegetation broadly falls into 4 types as per Champion and Seth (1968), viz., dry mixed deciduous hill forest, moist mixed deciduous forest, semi-evergreen “shola” forest and scrub forest. More than 120 plant species have so far been identified within the sanctuary boundaries, including 50 endangered species (Anon, 1995). Economically important timber species present include *Tectona grandis*, *Dalburgia latifolia*, *Terminalia paniculata*, *Pterocarpus marsupium* etc. The area is rich in bamboo, both *Dendracalamus strictus* and *Bambusa arundinacea* occur throughout the sanctuary and all along the river and valley portions. The sanctuary is rich in wildlife such as Tiger, Leopard, Sloth bear, Giant Squirrel, Gaur, Sambar, Elephant and Slender Loris. The sanctuary is also home to many birds and reptiles (Anon, 1995).

The clear felling of extensive primary moist forest stands, to raise monoculture plantations such as Teak during 1904 (2566 ha) and later Eucalyptus (1607 ha). However, the presence of livestock, regular fires in the dry season, poaching of both timber and animals, and the human population living within Bhadra are other associated problems. Infact, the forest fires were more widespread and severe within Bhadra during 1980–1994, when massive quantities of dead bamboo were exploited. The presence of thousands of dead bamboo had caused far worse fire-management problems in the sanctuary during this period.

Data and methodology

Indian Remote Sensing Satellite IRS 1C LISS III data of 9th February (pre-fire) and 4th March (post-fire) of 2004 and 1st March 2000 have been used to identify the burnt areas. Data available from sensors

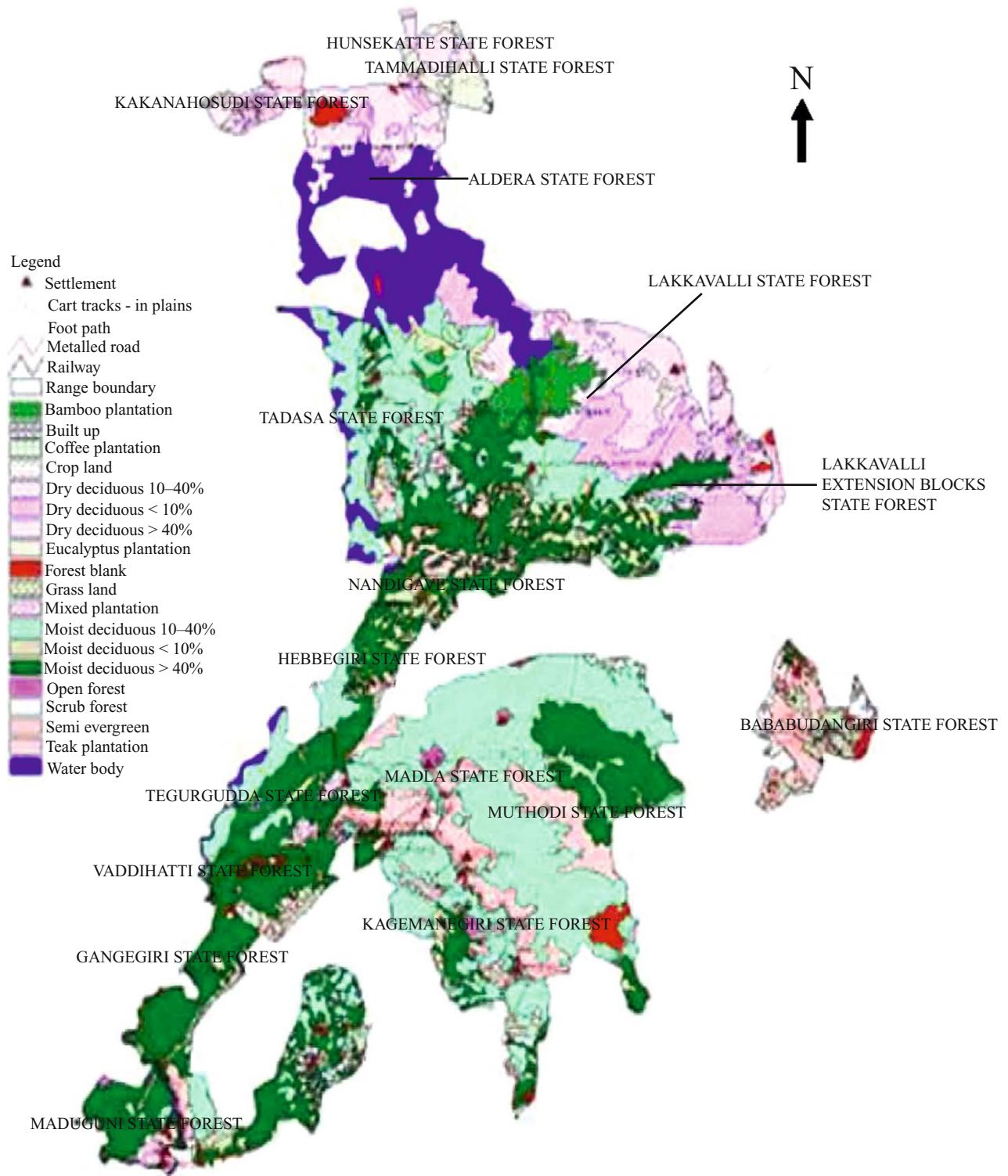


Fig. 1 Land use/Land cover of Bhadra Wild Life Sanctuary (March, 2000, pre-fire).

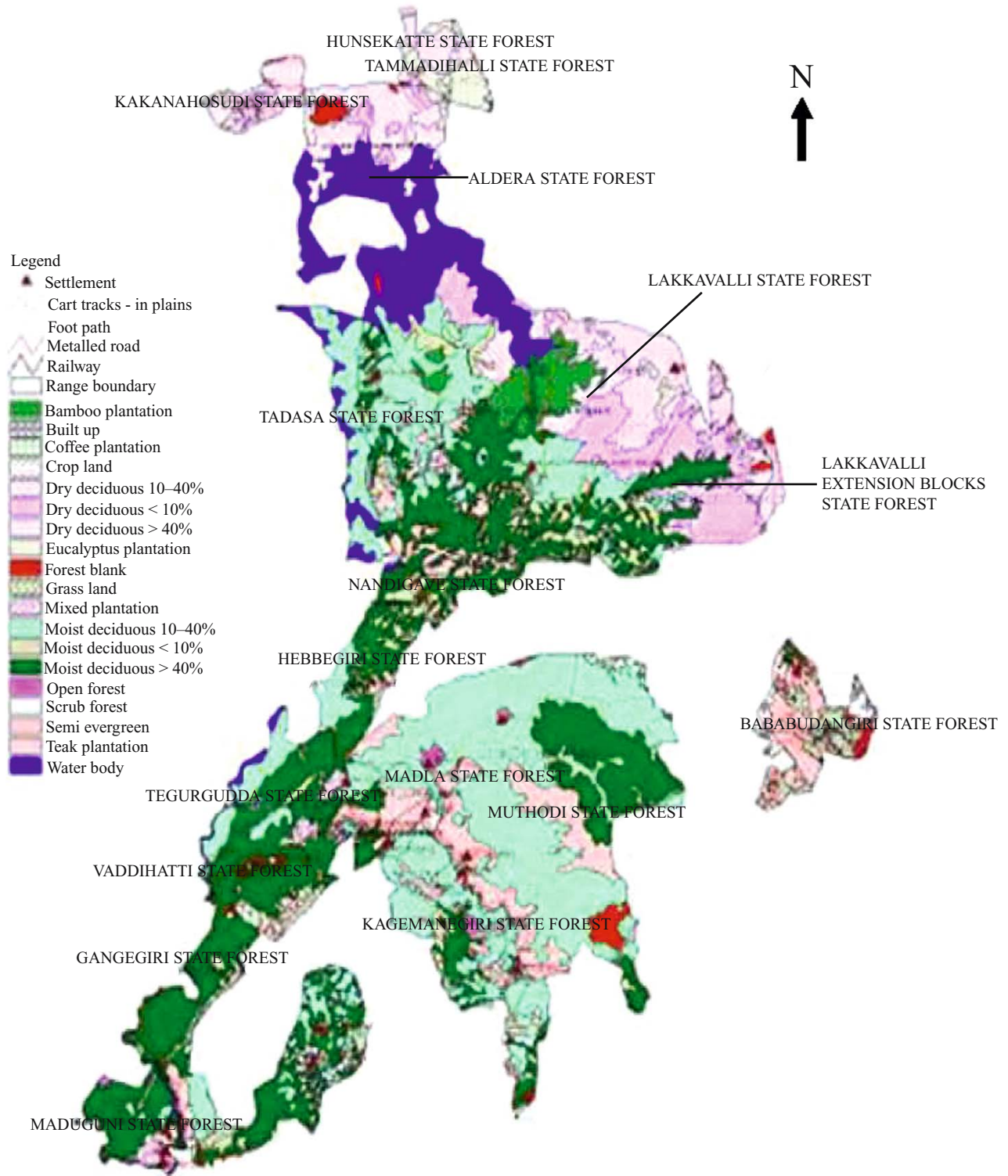


Fig. 2 Land use/Land cover of Bhadra Wild Life Sanctuary (March, 2004, post-fire).

yield uniform spectral and radiometric characteristics. The Survey of India topomaps on 1:50,000 scale were used to prepare the base maps.

Visual and digital interpretation are two major techniques used for land use/land cover mapping. All the images were registered with topographic maps. Images of the same period were procured to minimize radiometric problems. Images were enhanced using linear contrast stretch. Various land use categories and burnt areas were identified and mapped.

The vegetation maps generated by French Institute (1982) for Western Ghats were referred to classify and interpret, dry and moist deciduous and semi evergreen forests. The moist and dry deciduous forests were further grouped into three canopy density classes i.e., < 10%, 10–40%, > 40%. Five types of forest plantations viz., Mixed, Eucalyptus, Coffee, Bamboo and Teak were also identified and mapped.

Results and discussion

Results interpreted from the imagery indicate that the main forest types of the sanctuary are dry deciduous, moist deciduous and semi-evergreen, of which the moist deciduous covers a larger area. The moist deciduous forest of density category 10–40% covers major part of the sanctuary followed by dry deciduous forests. The bamboo plantations can be distinctly seen in the upper parts of sanctuary. Teak plantations are widespread in moist and dry deciduous forests areas. Coffee plantations are seen around the sanctuary but a small area of plantation is also distinguished within the sanctuary. The results also indicate that the main forest type affected by fire is dry deciduous, followed by grassland and moist deciduous to a considerable extent (Figs. 1 and 2). The results also revealed that moist deciduous forest has been changed to dry deciduous forest type (Table 1) over the fiveyear period. However the extent of semi-evergreen forest has increased in the same period. Bamboo dominated forest and coffee plantations have been reduced by 0.86 km² and 0.56 km² respectively.

The total extent of area burnt between 9th Feb-ruary and 4th March 2004, is estimated to be 4.46 km²

(1%) while the forest area affected during 1st March 2000 is 2.15 km² (0.4%) (Table 1). The moist deciduous forest was burnt to a large extent (2.03 km²), followed by dry deciduous forest (about 1.93 km²). This is due to the disturbances caused by the village community as a result of relocation of 12 village communities from the sanctuary (Table 1). The dry deciduous forest type was burnt in most parts and the scrub forest showed least extent of area burnt in March 2004.

A maximum percentage of forests of the sanctuary is covered by moist deciduous forest type. The rainfall of the place signifies the forest type of the landscape and the geographical distribution. The mixed plantation consists of *Acacia and Terminalia* that are found in few regions of the sanctuary. As compared to the French Institute (1982) forest maps, the coffee plantations throughout the sanctuary have been reduced considerably. This is due to the relocation of the villages to reduce the pressure on land to enable effective habitat conservation.

Fire occurrence depends on the accumulation of fuels, the moisture content and ignition incidence.

Table 1 Land use/Land and cover in Bhadra Wildlife Sanctuary

Land use/Land cover	Area (Km ²)	
	1 st March 2000	9 th Feb 2004
Burnt area	2.15	4.46
Dry deciduous forest	69.70	71.09
Moist deciduous forest	273.38	270.48
Semi-evergreen forest	9.03	10.26
Scrub forest	1.32	8.68
Grassland	10.61	9.46
Mixed plantations	1.96	3.48
Eucalyptus plantations	6.39	6.77
Coffee plantations	3.26	2.07
Teak plantations	30.75	31.68
Bamboo plantations	5.48	4.62
Others (water bodies)	36.64	32.37
Total	455.14	455.14

The results indicate that the main forest type affected by fire is moist deciduous. The litter layer covering the forest floor contains organic matter in various stages of decomposition. This induces fire, which spreads within this layer characterized by smoldering edge and smoke (Davis, 2001). Greater litter production is contributed by the deciduous type of forests. Grassland and moist deciduous are also affected by fire to a considerable extent. However, fire behavior is largely controlled by topography, elevation, aspect and slope. In winter, there is widespreading of dry grass on the forest floor. The dry season extending for 4–5 months, provides suitable plant form, once the fire is initiated, whether both natural or man-made. The dried grasses along with dry litter provide supporting fuel for fire to spread.

The fire occurring in the moist deciduous forest of Muttodi wildlife range is mainly due to deliberate fires set by the fringe villagers and can be attributed to the dead bamboo plantations in this area. The spread of fire has been stimulated mainly by the dead bamboo distributed in considerable areas within the range. The height of the bamboos enhanced vertical spread of fire from the ground level. In some parts of the Muttodi wildlife range, the fire has affected even the crown of some trees.

A similar study has been carried out on forest fire prone areas in Mudumalai and Mukurti Wildlife Sanctuaries and Rajiv Gandhi National Park (Ranganath *et al.*, 1994). The forest fire prone zones have been integrated by vegetation type, density, proximity to the road and settlements and past history of forest fire occurrence.

Conclusion

From the present study, it is evident that the major part of the forests burnt in the sanctuary is attributed to the standing dead bamboo clumps formed as an outcome of mass flowering and fruiting. The fire in moist and dry deciduous forests of the sanctuary were aggravated by the prevailing drought conditions during the study period. The fire prone area

of the sanctuary is mainly in the Lakkavalli block. Although the area burnt is small, it is suggested that appropriate and timely precautionary measures must be taken to minimize the conditions contributing to recurrence of forest fires.

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