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**THE EFFECT OF
MINOR FOREST PRODUCE (MFP)
COLLECTION ON WILDLIFE IN AND
AROUND BUFFER ZONE OF
PALAMAU TIGER RESERVE, BIHAR.**

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CERTIFICATE

This is to certify that Mr. Prabhat Kumar Bhagat has carried out an original piece of research in partial fulfillment of his M.Sc (Wildlife) degree of the Saurashtra University, Rajkot. The topic of dissertation is "*The Effect of Minor Forest Produce Collection on Wildlife in and around Buffer Zone of Palamau Tiger Reserve, Bihar*" The investigations were carried out at the Wildlife Institute of India, Dehradun under my supervision from May to December 1989. I hereby certify that this work has not been submitted for any degree of any university.

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SUMMARY

This study on "the effect of Minor Forest Produce (MFP) Collection on Wildlife in and around buffer zone of Palamau Tiger Reserve, Bihar", was conducted from May to 10th of October, 1989. Four study areas (compartments) were selected, two each from core (undisturbed) and buffer (disturbed) area. One of them was approximately near the village and the other considerably far from the village. Twelve permanently marked transects (Forest Department census track lines), three in each compartment were followed, using foot transect methods for quantitative estimation of larger wild animals abundances such as - of Sambar (Cervus unicolor), Chital (Axis axis), Barking deer (Muntiacus muntjak), Rhesus monkey (Macaca mulatta) and Common langur (Presbytis entellus) including Indian giant squirrel (Ratufa indica). Data on vegetation, Minor Forest Produce collection and other biotic pressure were also recorded to analyse the impact of MFP collection on the wild animals. More wild animals were observed in core than buffer except Rhesus monkey which were seen only in buffer. Chital and Indian giant squirrel were not seen in buffer area. It was also found that sighting of Sambar indicate decrease with increase in the number of MFP collectors. On the other hand sighting of Rhesus monkey indicate an increase with increase in number of MFP collectors. Thus presence of MFP collector causing more direct impact than indirectly affecting the long term sustainability of the buffer area by reducing fodder, cover and water for wild animals. Other impacts such as fire, grazing, lopping for fodder and felling of trees were also observed more in buffer areas.

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1. INTRODUCTION

1.1 IN GENERAL

The pressures on the forest resources of India's protected areas by rural population requiring fuel wood, fodder and minor forest produce (MFP) have been well documented for decades (e.g, Sharad Kulkarni 1977, Trivedi 1980, MacKinnon et. al. 1986, Tewari 1981 & 1986, Kaul 1988, and Kothari et. al. 1989).

Conversely, if protected areas, are to conserve the wildlife resources they contain (animal, plant species and communities), they must be large enough and sufficiently well protected to maintain viable population of their component species. Attempts to solve this conservation dilemma have long dominated wildlife management thinking.

The solution suggested is the effective demarcation into separate core and buffer zones, as explained by Saharia (1982) and MacKinnon et al (1986). The core zone has the role of maintaining undisturbed ecosystems and thus resource use conflicts are unlikely to be serious in this zone. The buffer zone has two purposes of Socio-economic buffering: which is to ensure that rural people do not need to seek forest or other products in the core area. Villages for, instance, have predictable needs for fire wood, building material and MFP, so the buffer zone should be large enough to meet these requirements or provide a cash equivalent. Position of buffers should also consider approach by villagers. Secondly; Extension buffering : extends the area of those habitat contained within the protected area into the buffer zone, thus

allowing larger total breeding population of plant and animal species than could survive within the reserve alone.

Examples of such buffering can include selectively logged production forests, natural forests used by villagers for fire wood, MFP collection, unused wilderness and grazing pastures.

The purpose of this study is to examine the differences between typical core and buffer zone compartments of a major wildlife protected area to document differences in wildlife abundances which may be due to resource use by local people.

Resource utilization is of several types such as MFP collection which include variety of forest products as listed in Appendix (9) (Fig.3) Apart from MFP collection other problems in buffer areas are logging, bamboo felling, settlements, mining, construction of roads and dams, encroaching cultivation, hunting and livestock grazing.

The basic economic needs of the growing population in the developing countries, and the growing pressure on natural resources through increasing extent of industrialization, urbanization, development projects and from the developed world, means we cannot expect any substantial reduction in the level of exploitation (Johns 1985a). This includes even MFP.

Kothari et al (1989) report that 14 (36%) of the 39 National Parks and 104 (56%) of the 185 sanctuaries had reported extraction of MFP. These do not reflect those areas where it goes on without official sanction. Accordingly 56% of National Park have human population living within them and 83% have population in adjoining areas (10 Km radius), only 37% have reported the extraction of MFP.

Similarly 72% sanctuaries have human population living within the

boundaries, and 87% have human population in adjacent areas only 58% have reported extraction of MFP. Consequently it seems logical to assume that if there are human population within or around protected area, especially within it, they would make at least some use of the Park or sanctuary for their fuel and MFP needs. Thus this indicates that there is lack of information even on MFP collection activities in different Protected areas of the country.

Minor forest produce (MFP) collection is one of the major occupations of the local people in and around the Reserves. A large number of people are also involved. For example the work of MFP collection [especially Kendu (*Diospyros melanoxylon*) leaves] occupy a vast forest area in Bihar during the collection period (April to June) and with which lives of many people are interwoven (during 1987 the estimated man-days was about 5×10^6 for only Kendu leaves collection - BSFDC Ltd. 1988). It was also felt that wildlife have not received the due attention they deserve in those areas where the collection (activities) of MFP are going on especially in Protected areas.

One of the Protected areas in Bihar is Palamau Tiger Reserve and uptill now not much work has been done to asses the effect of these activities on wildlife in those areas. On the other hand the State Government is trying to overcome the barrier to development (Tribal development) by increasing the practice of MFP collection in larger tracts of forest areas. This needs assessment of the effect of MFP collection on wildlife especially within Protected Areas for wildlife. Therefore this present study is initiated to understand the impact of MFP collection on wildlife in the forest of Palamau Tiger Reserve in Bihar.

1.2. HYPOTHESIS: In order to design my study, I formulated the following hypothesis: that the pressure due to MFP collection activities in the buffer zone results in

- (a) lower wildlife values than in the core zone
- (b) a reduced vegetative cover than in the core zone.

1.3. OBJECTIVES

The main objective of the study then becomes: To test these effects of Minor Forest Produce collection on wildlife within the Buffer Zone of Palamau Tiger Reserve. Buffer and Core Zone are to be compared, selecting two areas (one near the village and the other approximately far from the village) each from Core and Buffer i.e, total 4 areas and the following specific components were to be investigated:

- (a) Wildlife population estimation in all the areas selected
- (b) Vegetation cover estimation in all the areas selected
- (c) Quantification of MFP collection in and around the area.

2. LITERATURE REVIEW

2.1 ANIMAL IN GENERAL

Apart from MFP collection other various factors are also affecting wildlife in protected areas such as logging, bamboo felling, settlements, mining, construction of roads and dams, encroachment, poaching, livestock grazing and other human pressures.

As Sale and Berkmuller (1988) state that human pressure on a protected area appears in a variety of forms, air and water pollution, attempts at commercial exploitation, and others as described above. The practice of MFP collection and others such as encroachment, and livestock grazing resulting in conflict between park authorities (for wild animals) and local people. They further state that a protected area is seldom small enough, or the budget large enough to deal with the human pressure problem in its entirety so part of the area and one or a group of villages must be selected for priority treatment. However they also mentioned about the methodology for assessing these impacts.

Wilson and Johns (1982) studied the diversity and abundance of selected animal species in undisturbed forest, selectively logged forest and plantations in East Kalimantan, Indonesia.

Conner et al (1975) studied about the wood pecker nesting habitat in cut and uncut woodlands in Virginia.

Other such effect of pole cuttings in Tanzanian forests was dealt by Hall & Rodgers (1986). There are many studies which are related to the effect of logging on wildlife such as Johns (1983) in which the author dealt with tropical forest primates. The same

author described about wildlife conservation in tropical rain forests with selective logging (1985) and with primates with relation to primary selectively logged forest habitats (1985 b).

Osemeobo (1988) discussed about the impacts of multiple forest land use on wildlife conservation in Benedel State, Nigeria. He states that forestry vigorously competes with alternative uses, such as agriculture, mineral exploitation and urban development which lead to the destruction of natural vegetation, consequently depleting the wildlife and their habitats.

Similarly impact of forest management practices on wildlife and the environment in Bangladesh is well documented by Siddique (1986). According to him forest exploitation is not always detrimental to wildlife, it is the forest management system that greatly determines the fate of the wildlife.

In India similar works has been carried out on the effect of the silvicultural practices on wildlife habitat, by Saharia & Sawarkar (1982). They discussed the present situation in India, particularly with regard to silviculture. They also present a model for predicting and assessing the impact of these systems on wildlife and suggest various ways, how to harmonize the timber and wildlife values.

Balakrishnan and Esa (1986) had well documented the habitat preferences of the larger mammals in the Parambikulam Wildlife sanctuary, Kerala, India, in which they state that Macaca radiata was more abundant in forest plantations and in deciduous forests. They further states that herbivores and carnivores were most abundant in grass lands and in Tectona grandis plantations.

Prasad et.al. (1975) discussed with the factors governing the

distribution of wild mammals in Karnataka in which they have also mentioned about the fragmentation of habitats including the invasion of Lantana and Eupatorium in deciduous forests due to degradation.

2.2 PROTECTED AREA There are many literature available on Protected Area Management such as by Saharia (1983 & 1982), Saharia et al (1979), Saharia & Sawarkar (1982), Panwar (1973, 1979 & 1982), Rodgers & Panwar (1988), Nair (1986) and Ramakrishnan (1986).

Similarly there are several studies done on Palamau Tiger Reserve such as by Prasad (1957), Mishra (1970), Shahi(1971), Sinha (1979), Sahay (1972 & 1979), and the current Management Plan for PTR by Sahay (1987).

2.3 MFP - There are also many literature are available which deal with MFP in general (Mehta 1981 and Tewari 1981). . Although MFP collection is wide spread throughout the country, not much work has been done on the effect of this on wildlife.

However much work has been done on improving the quantity and quality of MFP and further large scale exploitation for the development of rural people.

The lack of study on this particular topic (the effect on wildlife) even in different Protected areas may be due to the following three reasons :-

- (1) MFP collection activity is directly related to the socio-economic condition of the rural people.
- (2) Major felling, timber exploitation, grazing, fire, hunting and other developmental projects such as construction of road and dam had affected more directly and still continuing than the MFP

collection.

(3) Most rural people live by farming, fishing and forestry or closely related activities. Many are extremely poor and the Government is committed to the protection and preferential development of these weaker sections.

But on the other hand Siddiqi (1986) express that the protective role of forests is gaining precedence over the productive in all the developed countries of the world. Therefore it is the responsibility of the forest manager, wildlife conservationists and researcher to find out a line of convergence where economic exploitation of forests shall not be detriment to the management and conservation of wildlife and the environment.

3. DESCRIPTION OF THE STUDY AREA

3.1 GENERAL - The Palamau Tiger Reserve (PTR) lies in the western part of Chotanagpur Plateau in the State of Bihar, comprising most of the forest of Daltongonj (Fig. 1). The total area of the Reserve is 1026 km². The major portion of the Reserve falls under Daltongonj South Division and the remaining area of the Reserve extends in the adjoining forests of Latehar, Garhwa South and Ranchi West Divisions. The forests of the Reserve lie between latitude 23° 25' and 23° 55' North and longitude 83° 50' and 84° 36' East (Management Plan PTR 1987).

Of the total area of Palamau Tiger Reserve 1026 km², the Core zone is 213 km² and the remaining 813 km² falls under Buffer zone. Core zone is totally prohibited for any type of MFP collection activities, with the exception of the three core zone villages which still await relocation. On the other hand, it is going on in buffer zone. Almost the entire Buffer zone is outside the administrative control of the Field Director, Project Tiger and is controlled by the respective territorial DFO's (3) (Including MFPP Division Daltongonj). These DFO's are responsible for forest protection, MFP collection, bamboo extraction, grazing and maintenance of roads in the Buffer zone. The Field Director cannot directly influence any of these activities in the Buffer zone, he is responsible only for Wildlife protection and water development (Rao 1989).

According to the Management Plan of PTR 1987 there are 45 revenue villages and 10 forest villages within the Reserve. The

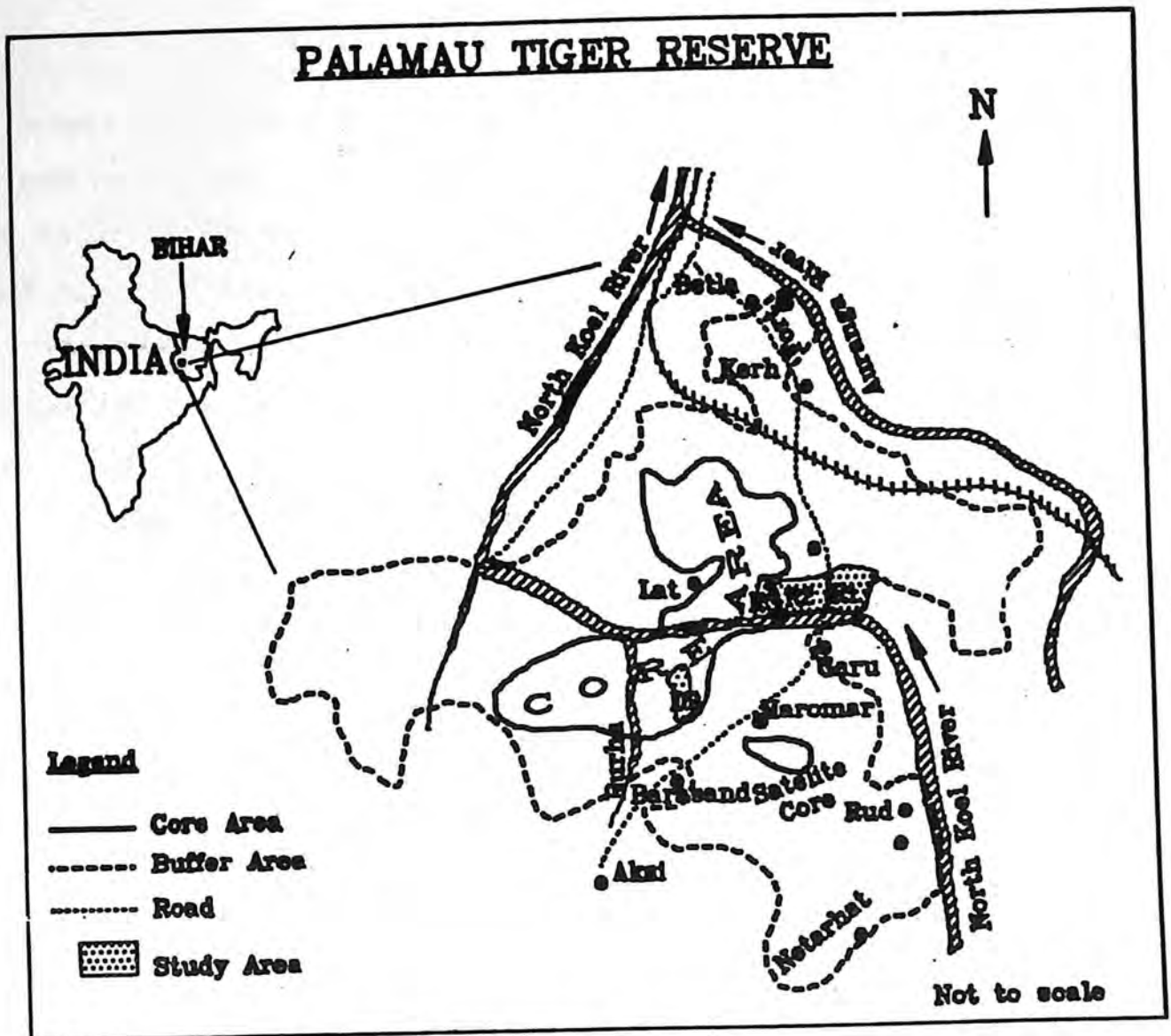


Fig. 1 Showing Study Area Map

total population of these villages is 8787. Accordingly the estimated number of cattle, that entirely depend on grazing in the forest is about 28,000 plus cattle from out side.

Of the ten forest villages three are situated in the Core zone. These are Ramandag, Kujrum, and Latu having population of about 550 (58 households - Rao 1989) and equal or more number of cattle.

About 250 Km² of forest situated on the northern portion of the present Tiger Reserve was intended to be managed as National Park, Betla since 1960 (Sahay 1979). But has not yet been declared a National Park even though the preliminary notification declaring intention to do so was issued as long back as September, 1986 and the prescribed procedure for investigation and determination of claims has long been completed. The matter is said to be pending with the District Collector, Daltongonj, Bihar (Rao 1989). Palamau Tiger Reserve was created in June, 1974 through Govt. of India Notification. Later on (very late) it was notified as Sanctuary in the year 1976 by Government of Bihar Notification and forms part of the Palamau Wildlife Sanctuary.

Forest were exposed to grazing throughout the year and quite a few cattle camps were established in these forests during past. Large tract of forests were burnt every year and fire is still continuing to take place in the months of April to June.

3.2 PHYSICAL FEATURES

3.2.1 THE TERRAIN, TOPOGRAPHY, GEOLOGY, ROCK AND SOIL

The area is gently undulating with hills running from East to West. The altitude varies from 300m. to about 1200m. above M.S.L. from

north to south. The general drainage is from south to north towards the river Sone, drained by the three major river systems viz. North Koel, the Auranga and the Burha. These rivers carry large volumes of water in the monsoon season but almost dry up during the summer season.

The soil, mineral and rocks of this region can be broadly classified into following groups Laterite, Quartzite, Gneiss, Gondwana, Amphibolite and Alluvial. Alluvial areas are limited to flat valleys of the Koel and its larger tributaries. They form sandy loam of good depth. They are fertile but are found over limited area (Management Plan PTR 1987).

3.2.2 CLIMATE

The climate of the area can be divided into four seasons (Management Plan PTR 1987) viz.,

Winter - mid-November to mid-February

Summer - mid-February to mid-June

Rainy - mid-June to mid-September and

Autumn - mid-September to mid-November.

Winter is quite cold and sometimes the temperature drops to 1°C in valleys specially at Garu (near the study area) and frost occurs almost every year throughout the Reserve, especially in open areas and along rivers. Fog occurs for one or two days during January and February.

The Summer months are very hot and dry, with temperature rising up to 50°C along the northern fringe. The southern areas being at higher elevations and covered with forests are comparatively less hot as can be seen from the Appendix -1D. More than 80% of the rainfall in this area is caused by south west monsoon. The

retreating monsoon has little effect.. Some rainfall is caused by the Western Disturbances from January to March. Rainfall is heavier in the hilly and forested tract of the south and gradually diminishes further north (Sahay 1987).

3.3 BIOGEOGRAPHIC LOCATION AND VEGETATION

The biogeographical realms in relation as given by Udverdy (1975 - quoted in Sahay 1987) together with Wallaces terminology is given below in relation to study area.

REALM	WALLACES TERMINOLOGY
Indo Malayan	Oriental

According to a recent report (Rodgers & Panwar 1986) it comes under Deccan peninsular Biogeographic Zone and Chotanagpur Biogeographic Province. The forests are mostly of the Northern Tropical Dry Deciduous type with pockets of Moist Deciduous type, as classified by Champion and Seth (1968). They are as follows:

5/B/C1C	Dry Peninsular Sal
5/B/C2	Northern Dry Mixed Deciduous Forests
5/F9	Dry Bamboo Brake
3C/C2ci	Moist Peninsular High Level Sal
3C/C2eii	Moist Peninsular Low Level Sal
3C/C3/2Si	Northern Secondary Moist Deciduous Forests
5/F	Eagle Forest

They may be broadly classified as Sal, Miscellaneous, Bamboo and Aegle forests. As some villages were shifted at the time of reservation, the abandoned fields and parts of forest used for regular cultivation, are still lack any tree growth and they now form small grassy meadows within the forests (Sahay 1987).

3.4 WILD ANIMALS OF THE AREA There were 34 species of wild animals were listed by Sounder (1895) (Sahay 1987). Elephant is an important omission from the list. The animals which became extinct

and listed are - the Black buck, Indian otter, Indian gazelle and the Leopard cat. Two other species, the Four horned antelope and the Indian mouse deer are very rare in these forests. The main wild animals of the Reserve are listed in Appendix (8) with the census figures of three years (i.e, of 1987, 1988, and 1989).

3.4 THREATS TO THE RESOURCE

3.4.1 HUMAN DISTURBANCE :

Demographic data about the village falling within the Reserve is already discussed. The intensive exploitation and grazing caused high degree of human movement and disturbance in the entire reserve. Labourers work in the bamboo and timber coupes (Buffer area) from October to June. There are forest roads, foot paths passing through the Reserve in Core as well as in Buffer Zone which the villagers use for going from one village to other and to the weekly markets. The forest roads are also used in the Buffer area for transport of forest produce from the forests to the depot.

3.4.1.1 POACHING

Although hunting has been prohibited, it is still continued by local villagers in the periphery of the reserve. There were no cases of poisoning but trapping, netting or snaring the animals in Reserve is still quite common. These activities have been playing an important role in reducing the wild ungulate population in these areas especially in buffer zone of the reserve (Report on PTR 1979).

Hide outs were also found erected near water hole to facilitate shooting the animals in buffer zone of the reserve.

3.4.1.2 GRAZING - In certain areas, especially near the villages

in buffer zone, and near water holes during summer as the cattle competes for water with wild animals the water becomes limiting factor. Thus cattle grazing is a major adverse factor in certain areas within the Reserve i.e, Buffer Zone near villages and worse situation is during pinch summer when water becomes limiting factor for wild animals.

3.4.1.3 FOREST EXPLOITATION

Entire Tiger Reserve was subjected to heavy felling during past i.e, prior to creation of PTR and management was totally commercialized. Almost every part of the forest was visited by the local people daily more so during the collection period for MFP collection. Plucking of Mahulan (Bauhinia vahlii) leaves, fire wood collection, tuber collection are done throughout the year, specially rainy season for Mahulan leaves and Tubers (mainly Dioscorea spp.) when large leaves are found and easy to dig out tubers, during summer season for fire wood when dry wood is available in large quantities and can be stored for rainy season.

3.4.1.4 FIRE

Palamau forests are vulnerable to fire. The use of fire is common during the collection of honey, Mahua (Madhuca latifolia) flowers, Sal seed collection, tubers (mainly Dioscorea spp.), poaching, to clear the forest floor prior to collection and to promote new grass growth. Almost all fire occurrence in this Reserve seems to be man made either accidentally or deliberately. Twelve fire incidence were observed during the study period. They were due to honey collection activities and two of them due to poaching out of which one was near the Tourism zone (Betla) of the Reserve and the other

in the Ramandag compartment No. 1 for catching Porcupine (Hystrix indica) from its burrow. Thus one of the major reasons for fire occurrence is due to MFP collection activities.

3.4.1.5 OTHER USES SUCH AS MINING AND CONSTRUCTION OF DAM ETC.

The mining area of Hutar colliery, a small Graphite mines in Tongari village and Bentonite in Baribandh are situated on the periphery of the Reserve. No extension of these are allowed uptill now. Two more dams are coming up, Kutku on river Koel in the western flank of the Reserve and the other on river Auranga in the Betla Zone. The construction on later has not yet started and the dam is being opposed but no final decision yet been taken (Rao 1989).

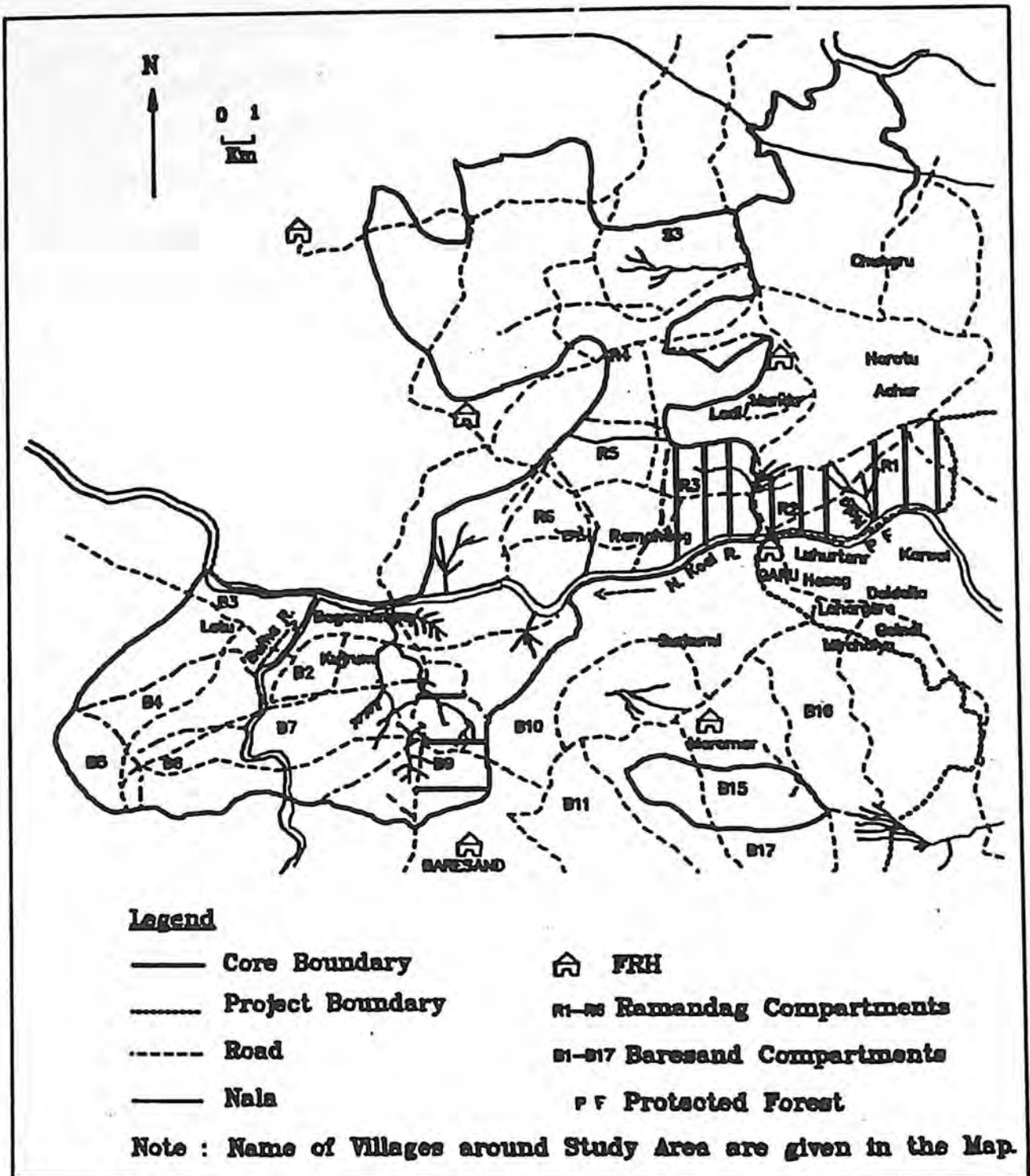


Fig. 2 Showing Study Area Map with Twelve Transects in Ramandag Comp. No. 1, 2, 3 and Baresand Comp. No. 9
Transects Line are shown in straight Bold Line

4. METHODOLOGY

4.1 SELECTION OF STUDY AREA

Four areas had been selected considering the following important factors based on the preliminary reconnaissance survey.

Those are:-

Buffer Areas

(1) Ramandag Compartment No. 1 (690 ha) - approximately 1 Km far from the village (Zone 1).

(2) Ramandag Compartment No. 2 (755 ha) - approximately (100 m) near the village (Zone 2).

Core Areas

(1) Ramandag Compartment No. 3 (1087 ha)- near the village (100 m) (Zone 1).

(2) Baresand Compartment No. 9 (1068 ha)- far from the village (Zone 2).

Important factors are-

(a) There was no forestry (major felling etc.) operation in all the four areas selected except MFP collection including fire wood, fodder, grazing and bamboo felling in buffer areas.

(b) Vegetation type as described by the management plan for study areas were similar in having dominated by miscellaneous forests.

(c) Climate (mean temperature and rainfall) varies from North to South, study areas were selected having similar situation.

(d) Type of terrain were found to be similar. Major differences were avoided as far as possible.

(e) Water availability were nearly similar. All had waterholes having water, but all rivers as well as nālas dried up during summer.

4.2 WILD ANIMALS - quantitative estimation

The following broad areas had been investigated and data had been collected using the methods as described below:-

4.2.1 For quantitative estimation of large mammals wildlife population, three parallel transect (forest department census track lines) per compartment were selected (Fig.2) at particular distance, (i.e, 800m. and 1200m) to avoid any interferences and to ensure maximum coverage of the area) those are as follows with their length in Km.:-

Buffer areas (Total transect length 19.45 Km)

- (a) Zone 1 (Ramandag Comp. No. 1) = 3 Transect (10.106)
 - (1) Transect No. 1 = 3.269
 - (2) Transect No. 2 = 3.216
 - (3) Transect No. 3 = 3.621
- (b) Zone 2 (Ramandag Comp. No. 2) = 3 Transect (9.343)
 - (1) Transect No. 1 = 3.216
 - (2) Transect No. 2 = 2.921
 - (3) Transect No. 3 = 3.206

Core areas (21.07)

- (a) Zone 1 (Ramandag Comp. No. 3) = 3 Transect (13.01)
 - (1) Transect No. 1 = 3.798
 - (2) Transect No. 2 = 4.291
 - (3) Transect No. 3 = 4.922
- (b) Zone 2 (Baresand Comp. No. 9) = 3 Transect (8.064)
 - (1) Transect No. 1 = 1.721
 - (2) Transect No. 2 = 3.173
 - (3) Transect No. 3 = 3.169

TOTAL 12 Transect = 40.52 Km.

These permanently marked systematically positioned transect have been followed using foot transect (Eberhardt 1968, Sale & Berkmueller 1988) method. These transect were travelled 5 times

once in May-June, July, August, September, and October to investigate differences in density/abundances i.e, during collection period (May-June) and in the remaining months.

The transect were followed using single census team (i.e, of two persons) and all the 12 transect were traversed on foot in a fixed known direction.

All the transect had known starting points and end points i.e, marked by natural features such as nalas, rivers, hills, roads, tracks and ridges and are clearly defined both on ground and on the map (Fig.2). Transect are far enough apart to prevent interference. All the transect were run in the early morning in a fixed direction using compass. The distance traversed were estimated by number of paces traversed (average pace length of the observer = 0.8 m.). On sighting animal(s), the group is counted and their position noted accordingly. The activity of animal(s) were also recorded.

4.2.2 Indirect evidences were also recorded for which sample transect of 80 m. (100 paces) length and 2 m. width at each 400 m. interval has been taken. This method was repeated once each month.

4.3 VEGETATION

4.3.1 Differences in tree species composition, cover and density in core and buffer area was estimated by using circular sample plot method. 30 sample plots each of 10m. radius were located systematically along each transect (Distance between plots were decided by dividing the total length of the transect by 30) out of which 10 plots (every third plot) were sampled systematically for species composition and density.

4.3.2 Differences in shrub layer (species composition, density and cover) was also estimated using the above sample plots. However the 10 plots (above mentioned) each were sampled systematically for estimating species composition and density.

4.3.3 Similarly using all the above 30 sample plots ground cover was estimated.

(The following ecological information was collected- Tree, shrub and ground cover were estimated using cover classes i.e, 0-25 %, 26-50 % and above 50 % in all the sample plots. Similarly each plot was surveyed for MFP trees and species i.e, Total number, plucked, unplucked, collection sign, lopping, cutting etc. Apart from these animal sign on trees, dead logs etc. were also recorded. Number of MFP collectors, number of cattle seen during transect survey, number of fire wood collectors were also recorded.

4.4 MINOR FOREST PRODUCE (MFP)

To estimate the actual MFP collection practices (including fire wood), with especial reference to Kendu (*Diospyros melanoxylon*) leaves, the above 30 sample plots were used. However, the radius of the plot was reduced to 1.78 m. The number of plucked and unplucked has been recorded. Data were also obtained on the number of total leaves and plucked leaves from different height of seedlings and saplings to estimate the quantity collected. Data from secondary sources were also obtained on MFP collection i.e, from the Bihar State Forest Development Corporation Ltd. MFPP Division Daltongonj, Bihar to obtain an overall picture of MFP collection.

For estimating the amount of fire wood collection, its

consumption head loaders were sampled. The consumption for 30 households were intensively sampled from different categories (i.e, local tribes, business class and service class people) as described by Maithane and Mishra (1986). Details of population of the village near the study area, mainly near the Buffer areas were also collected from the Block Development Office, Garu. In order to estimate the grazing pressure data on cattle population were also collected from the same.

4.6 DATA ANALYSIS

4.6.1 WILD ANIMALS

Data on sighting distances for each species were compiled from all transect within each area (i.e, core and buffer and a single mean angular sighting distance 'r' for each species was calculated because 'n' (number of sighting) was very low.

For simple calculation, all transect data have been summed, giving an over all transect length (L) for each area (Compartment wise) and total number of animals of each species sighted. Density per km² is then calculated by using the following formula of simple "King Census" (Eberhardt 1968, Sale & Berkmuller 1988):

$$D = \frac{n}{2 \times L \times r}, \text{ where } D = \text{Density of animal per km}^2$$

n = Total number of animals seen
 L = Length of the transect in km
 r = Mean Angular sighting distance in km.
 2 = For both side (left & right) of the transect.

Confidence interval for the mean density were calculated for five different months using a mean value for these each transect in the core and buffer areas. For example:-

DENSITY CALCULATION - Density/Km² of Wild animals were calculated by using following methods

Data from Appendix - 1 for Sambar in core area where,

TOTAL NUMBER OF ANIMAL SEEN $n = 30$
 Length of the transect in km $L = 21.07 \times 5$ (as Travelled five times)
 Mean Angular sighting distance $r = 0.029$ Km
 Then using the above formula calculated

$$\text{the density of Sambar/Km}^2 = 30 / (2 \times 21.07 \times 5 \times 0.029) / \text{Km}^2$$

$$= 4.909 = 4.91 / \text{Km}^2$$

CALCULATION OF CONFIDENCE LIMITS FOR ESTIMATING POPULATION SIZES

For calculating Confidence Limit, Variance, Standard Deviation, and Standard Error were calculated by using the following method-

Data from Table-2 for Sambar Density/Km² for core total

No. Counted in sampling units = 11.46, 2.45, 3.27, 2.45, 4.91.

No. of samples (n) = 5 (i.e, for five months)

$$\text{Mean } (\bar{X}) = (11.46 + 2.45 + 3.27 + 2.45 + 4.91) / 5$$

$$= 4.908 = 4.91.$$

$$\text{Variance } (S^2)$$

$$= [(4.91 - 11.46)^2 + (4.91 - 2.45)^2 + (4.91 - 3.27)^2 + (4.91 - 2.45)^2 + (4.91 - 4.91)^2] / (n - 1)$$

$$= 57.7 / 4 = 14.43$$

$$\text{Standard Deviation} = \sqrt{S^2} = \sqrt{14.43} = 3.798$$

$$\text{Standard Error (SE)} = S / \sqrt{n} = 1.698$$

Confidence Limits (L) at 95% Level; n = 5 hence (from t-values)

$$t = 2.57$$

$$L = t \times SE = 2.57 \times 1.698 = 4.36$$

$$\text{POPULATION ESTIMATE} = \bar{X} \pm L = 4.91 \pm 4.36.$$

t- values for Different Sample Sizes and Confidence levels

Sample size	5	10	15	20	25	30 or more
t- value, 95%	2.57	2.23	2.13	2.09	2.06	1.96
t- value, 99%	4.03	3.17	2.95	2.85	2.79	2.58
t- value, 99.9%	6.87	4.59	4.07	3.85	3.73	3.29

Source Sale and Berkmuller (1988).

TABLE-1

OVER ALL ANIMAL (WILD) DENSITY/ Km^2 FOR FIVE MONTHS IN CORE AND BUFFER AREA (6 TRANSECTS, 5 TIMES IN EACH AREA i.e, n= 30 FOR EACH AREA). MAD = MEAN ANGULAR SIGHTING DISTANCE IN Km.

AREA	TRANSECT LENGTH IN Km.	SAMBAR	CHITAL	BARKING DEER	INDIAN GIANT SQUIRREL	RHESUS MONKEY	COMMON LANGUR
MAD FOR CORE		0.029	0.023	0.025	0.019	-	0.022
CORE	21.07X5	4.91	9.29	1.14	3.75	0.0	26.97
MAD FOR BUFFER		0.032	-	0.018	-	0.021	0.02
BUFFER	19.45X5	0.96	0.0	0.86	0.0	25.95	3.6

TABLE-2

SAMBAR DENSITY/ Km^2 IN DIFFERENT MONTHS IN DIFFERENT ZONES OF CORE AND BUFFER AND MEAN OF FIVE MONTHS WITH 95% CONFIDENCE INTERVAL. C.I= CONFIDENCE INTERVAL

AREA	ZONE	TRANSECT LENGTH IN Km.	MAY-JUNE	JUL	AUG	SEP	OCT	MEAN OF 5 MONTH 95% C.I
CORE	1	13.01	2.64	4.0	1.3	2.67	4.0	2.92 ± 1.3
CORE	2	8.06	26.04	0.0	6.72	2.22	6.67	8.33 ± 11.86
CORE TOTAL		21.07	11.46	2.45	3.27	2.45	4.91	4.91 ± 4.36
BUFFER	1	10.11	0.0	0.0	1.54	0.0	0.0	0.30 ± 0.8
BUFFER	2	9.34	1.67	0.0	1.67	1.67	3.3	1.66 ± 1.34
BUFFER TOTAL		19.45	0.8	0.0	1.6	0.8	1.6	0.96 ± 0.77

NOTE-

- CORE ZONE 1 = RAMANDAG COMPARTMENT NO. 3 NEAR THE VILL.
 CORE ZONE 2 = BARE SAND COMPARTMENT NO. 9 FAR FROM VILL.
 BUFFER ZONE 1 = RAMANDAG COMPARTMENT NO. 1 FAR FROM VILL.
 BUFFER ZONE 2 = RAMANDAG COMPARTMENT NO. 2 NEAR THE VILL.
 (See Text for detail pp:)

4.5.2 VEGETATION

Tree species composition and number for each transect based on ten sample plots (i.e, each 3rd plot) was carried out by simply counting them. Then area wise has been done by combining 3 transect of each compartment and then finally for buffer and core area by adding 2 buffer areas (i.e, 6 transect) and two core (6 transect). Similarly it was done for shrub species. Details as follows:-

FOR TREE SPECIES

Total area sampled transect = 314.15 m²
 Compartment = 942.48 m
 Area = 1884.9 m

FOR SHRUB SPECIES

Total area sampled transect = 100 m²
 Compartment = 300 m
 Area = 600 m

FOR TREE, SHRUB AND GROUND COVER

Total area sampled transect = 9424.77 m²
 Compartment = 28274.33 m
 Area = 56548.66 m

Density of trees and shrubs were collected by using the following formula:

$$\text{DENSITY PER HECTARE} = \frac{\text{TOTAL No. of TREES or SHRUBS}}{\text{TOTAL AREA SAMPLED}} \times 10000$$

4.6.3 FOR MFP For MFP trees the similar method were followed as mentioned for trees.

FOR MFP SHRUB (SEEDLINGS)

Total Area sampled transect = 300 m²
 Compartment = 900 m
 Area = 1800 m

Thus data for plucked, unplucked has been compiled for transect wise, compartment wise and area wise. For further detail see result.

4.5.4 IMPACT ANALYSIS

As already mentioned that data on fire, weed, number of MFP collectors and cattle number were also recorded. These were analysed by summing up according to transect, zone and area.

5. RESULTS

5.1 WILD ANIMALS

Data (Appendix - 1) of animal sightings indicates that Chital, Jackal, Hyena, Tiger and Wild boar were not seen in the buffer areas. Carnivores sightings were obtained only in the core area. However there were indirect evidences of Chital, Jackal and Tiger found in buffer areas. Giant squirrel was totally not seen in the buffer areas not even the indirect evidences. Sambar were seen more in core and the density per km^2 (Table-1) is five times more in core than buffer. On the other hand Rhesus monkey were only seen in buffer areas. There is not much differences in Barking deer density/ Km^2 in both core and buffer. Langurs were seen in both the areas, but comparatively more in core and the density per km^2 is 7.5 times more than the buffer.

Data (Table-2 to 7) also gives an idea about compartment wise (in different zones of core and buffer area) animal density per km^2 . in different months. Data (Table-2) indicates that Sambar density is about five times more ($4.91/\text{Km}^2$.) than buffer ($0.96/\text{Km}^2$.). It is evident from the data that Sambar density is increasing from Ramandag 1, Ramandag 2, Ramandag 3 to Baresand 9. However data shows that core zone 1 and buffer zone2 show consistent in Sambar density where as core zone 2 and buffer zone 1 shows high variation in density. During MFP collection period (i.e, May-June) it goes up to $26.04/\text{Km}^2$ in core zone 2 and just after this it falls to zero. In buffer zone 1 where MFP collection activities (Table-13) are more sighting of Sambar is zero even

during and after collection period except during the month of August. Just after the advent of monsoon i.e, in July the Sambar density increases in core zone 1 where it became zero in core zone 2 and also in whole buffer area. During the month of October the density shows an increase with respect to the previous month i.e, compared to September's except in buffer zone 1.

When the number of MFP collectors seen and the sambar density per km² compartment wise has been correlated it was found that they were negatively correlated (Fig.5), which indicates that as the number of MfP collectors increases sighting of Sambar decreases.

It is evident from the data (Table-3) that the density of Chital is zero during MFP collection period (May-June) in core zone 1 which is near the village. Where as the density is largest (64.73Km².) in core zone 2 during May-June. The sighting show an increase after May-June in core zone 1 where as it shows a decrease in core zone 2. The density in core zone 1 shows some degree of consistent but it is highly variable in core zone 2. Even then the over all density in core zone 2 (16.18/Km².) is about 3.25 times that of core zone 1 (5.01Km².).

Barking deer density (Table-4) shows differences between zones, core zone 2 shows comparatively small density (0.5/Km².) even less than buffer zone 2 (0.55/Km².). Barking deer density is zero during May-June in buffer zones 1,2 and core zone 2, which indicates that it was not observed in these zones. Sighting in Core zone 1 is less variable where other zone have highly variable sightings.

Indian giant squirrel not showing much differences in different months. However sighting is more in core zone 2.

TABLE-3

CHITAL DENSITY/Km² IN DIFFERENT MONTHS IN DIFFERENT ZONES OF CORE AND BUFFER AREA AND MEAN OF FIVE MONTHS WITH 95% CONFIDENCE INTERVAL. C.I= CONFIDENCE INTERVAL.

AREA	ZONE	TRANSECT LENGTH IN Km.	MAY-JUNE	JUL	AUG	SEP	OCT	MEAN OF 5 MONTH 95% C.I
CORE	1	13.01	0.0	1.67	5.01	13.37	5.01	5.01 + 5.92
CORE	2	8.06	64.73	8.09	8.09	0.0	0.0	16.18 +31.54
CORE TOTAL		21.07	24.76	4.13	6.19	8.25	3.1	9.29 +10.2
BUFFER TOTAL		19.45	0.0	0.0	0.0	0.0	0.0	0.0

TABLE-4

BARKING DEER DENSITY/Km² IN DIFFERENT MONTHS IN DIFFERENT ZONES OF CORE AND BUFFER AND MEAN OF FIVE MONTHS WITH 95% CONFIDENCE INTERVAL. C.I= CONFIDENCE INTERVAL

AREA	ZONE	TRANSECT LENGTH IN Km.	MAY-JUNE	JUL	AUG	SEP	OCT	MEAN OF 5 MONTH 95% C.I
CORE	1	13.01	1.54	0.0	1.54	1.54	3.07	1.54 + 1.25
CORE	2	8.06	0.0	0.0	2.48	0.0	0.0	0.5 + 1.27
CORE TOTAL		21.07	0.95	0.0	1.9	0.95	1.9	1.14 + 0.91
BUFFER	1	10.11	0.0	0.0	0.0	2.75	0.0	0.55 + 1.41
BUFFER	2	9.34	0.0	2.97	2.97	0.0	0.0	1.19 + 1.87
BUFFER TOTAL		19.45	0.0	1.43	1.43	1.43	0.0	0.86 + 0.9

TABLE-5

INDIAN GIANT SQUIRREL DENSITY/Km² IN DIFFERENT MONTHS IN DIFFERENT ZONES OF CORE AND BUFFER AREA AND MEAN OF FIVE MONTHS WITH 95% CONFIDENCE INTERVAL. C.I= CONFIDENCE INTERVAL.

AREA	ZONE	TRANSECT LENGTH IN Km.	MAY-JUNE	JUL	AUG	SEP	OCT	MEAN OF 5 MONTH 95% C.I
CORE	1	13.01	2.02	2.02	2.02	2.02	0	1.62 + 1.04
CORE	2	8.06	3.26	3.26	6.53	13.06	9.79	7.18 + 4.84
CORE TOTAL		21.07	2.5	2.5	3.75	6.24	3.75	3.75 + 1.75
BUFFER TOTAL		19.45	0	0	0	0	0	0

TABLE-6

RHESUS MONKEY DENSITY/Km² IN DIFFERENT MONTHS IN DIFFERENT ZONES OF CORE AND BUFFER AND MEAN OF FIVE MONTHS WITH 95% CONFIDENCE INTERVAL. C.I= CONFIDENCE INTERVAL

AREA	ZONE	TRANSECT LENGTH IN Km.	MAY-JUNE	JUL	AUG	SEP	OCT	MEAN OF 5 MONTH 95% C.I
CORE TOTAL		21.07	0.0	0.0	0.0	0.0	0.0	0.0
BUFFER	1	10.11	124.82	28.26	28.26	11.78	4.71	39.57 + 56.04
BUFFER	2	9.34	0.0	0.0	33.14	0.0	22.94	11.22 +18.13
BUFFER TOTAL		19.45	64.88	14.69	30.60	6.12	13.47	25.95 +27.03

NOTE-

- CORE ZONE 1 = RAMANDAG COMPARTMENT NO. 3 NEAR THE VILL.
 - CORE ZONE 2 = BARESAND COMPARTMENT NO. 9 FAR FROM VILL.
 - BUFFER ZONE 1 = RAMANDAG COMPARTMENT NO. 1 FAR FROM VILL.
 - BUFFER ZONE 2 = RAMANDAG COMPARTMENT NO. 2 NEAR THE VILL.
- (See Text for detail pp:)

The sighting of Rhesus monkey in buffer zone 1 is more compared to that of buffer zone 2. But it shows high degree of variation in buffer zone 1. During May-June the density is the largest ($124.82/\text{Km}^2$), and the lowest during October ($4.71/\text{Km}^2$) in buffer zone 1 itself. After May-June density shows decrease in buffer zone 1.

Langur were not observed in buffer zone 2 (Table-7). The density is the largest in core zone 2, and during August. Density shows decrease just after the month of May-June in core zone 1 & 2 where as it shows increase in buffer zone 1 (Table-7). Over all density is 7.5 times more in core ($26.97/\text{Km}^2$) than of buffer ($3.6/\text{Km}^2$).

5.2 HABITAT AND VEGETATION

5.2.1 Tree species composition, density and cover

The less disturbed core area (zone 2) has larger number of tree species compared to that of other three compartments as it is also evident from the data (Table-8). This indicates that less disturbed areas have larger number of tree species. On the other hand, buffer area (zone 1) which is approximately far from the village but having increased biotic pressure (Table-13) in terms of MFP collection activities, has the lowest number of tree species. Data (Table-9) indicates that a difference of 17 tree species, but actually all total 24 tree species are absent from buffer area (Appendix -2, 3 & 4) depending upon sample plots (n=120).

However few shrub species such Antidesma diandrum, Holorhena antidysentrica, Helicteres isora and Woodfordia spp (mostly found as shrub) are also included in tree species due to their larger

girth class.

Similarly the tree density per hectare was found to be higher in the core. However, if we consider tree densities in each compartment, core zone 1 has the highest compared to other compartments. This indicates that trees, saplings are getting better chance to establish. Contrary to this in core zone 2 tree density was found to be low (Fig.9). This indicates that perhaps dense canopy cover in core zone 2 does not permit seedlings and saplings to establish them as trees or may be due to dense leaf litter and ground cover (including Bamboo) which is found more in this area (Table-8).

Similarly tree cover is higher in core area, highest in core zone 1 and lowest in buffer zone 1 among the four areas selected.

5.2.2 Shrub species composition, density and cover

Similarly, shrub layer species composition was found to be highest in core zone 2 and lowest in buffer zone 1. But density per hectare for most of the species of shrub layer was larger in core zone 1 (Appendix 5 & 6).

Over all, it appears that in buffer area, the shrub species composition as well as the density is low relative to the core area (Table-11).

It is evident from the data (Appendix 5 & Fig.6) that the shrubs of Sal (Shorea robusta) is more numerous in core (zone 1) than in buffer (zone 1). This indicates that light disturbance is favourable for Sal in core (zone 1), which is a climax species for this type of forest. But on the other hand shrubs of Kend (Diospyros melanoxylon) is more numerous in buffer (zone 1) and lowest in core (zone 2).

TABLE-7

COMMON LANGUR DENSITY/Km² IN DIFFERENT MONTHS IN DIFFERENT ZONES OF CORE AND BUFFER AND MEAN OF FIVE MONTHS WITH 95% CONFIDENCE INTERVAL. C.I= CONFIDENCE INTERVAL

AREA	ZONE	TRANSECT LENGTH IN Km.	MAY-JUNE	JUL	AUG	SEP	OCT	MEAN OF 5 MONTH 95% C.I
CORE	1	13.01	48.91	22.71	12.23	5.24	5.24	18.87 +20.98
CORE	2	8.06	50.76	31.02	101.51	0.0	16.92	40.04 +44.93
CORE TOTAL		21.07	49.62	25.89	46.38	3.24	9.71	26.97 +24.05
BUFFER	1	10.11	2.47	27.2	4.95	0.0	0.0	6.92 +13.24
BUFFER	2	9.34	0.0	0.0	0.0	0.0	0.0	0.0
BUFFER TOTAL		19.45	1.29	14.14	2.57	0.0	0.0	3.6 + 6.88

TABLE - 8

Tree species composition and density/ha in different zones of core and buffer (n=30 sample plots). Total Area sampled is 9428.55 sq m.

	Buffer		Core	
	Zone1	Zone2	Zone1	Zone2
Total No. of Tree species	31	32	34	41
Density/ha	282	361	392	338
Bamboo clump density/ha	32	18	47	73

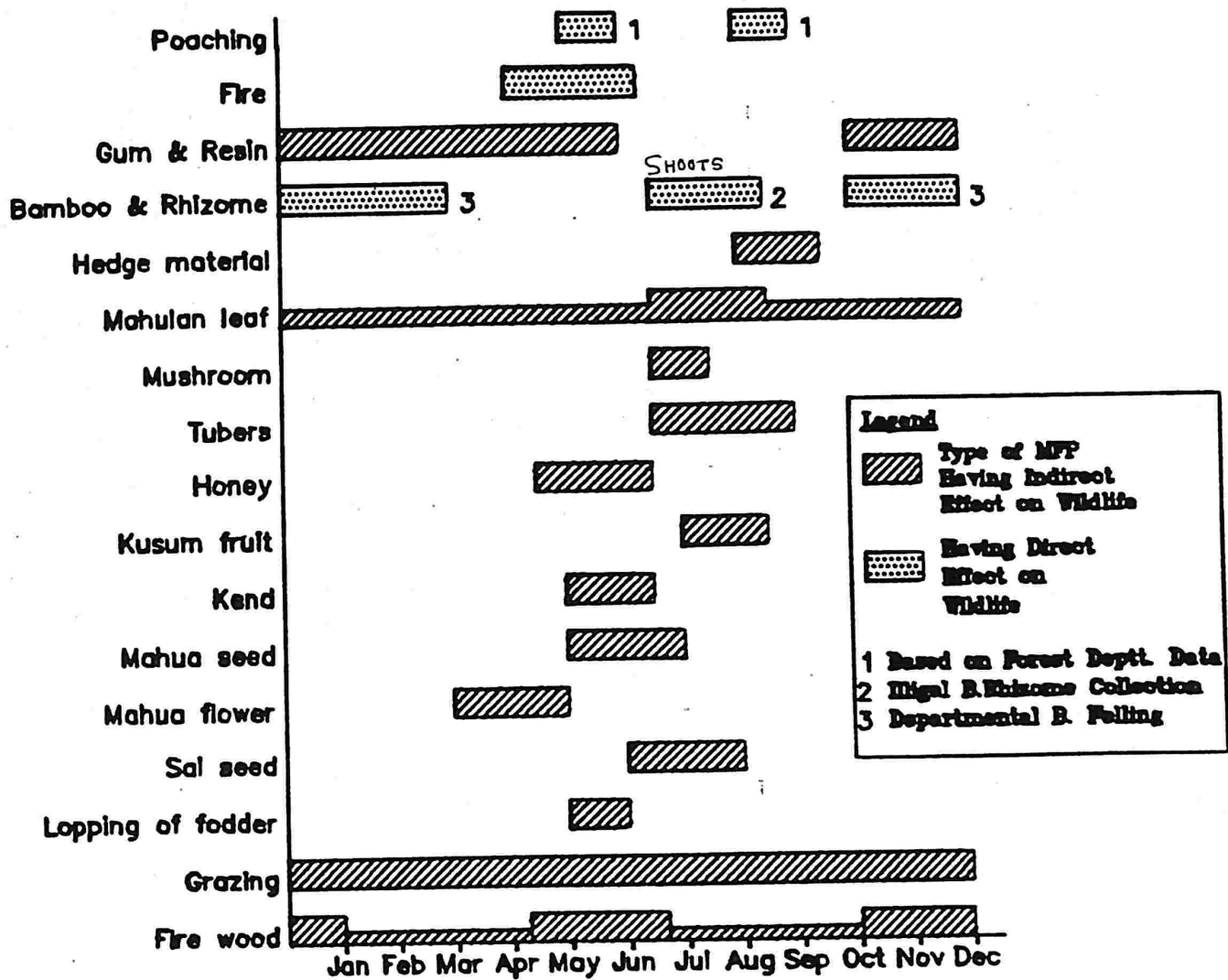


Fig. 3 Showing Types of Disturbances Including MFP Collection Activities in Buffer Area During Whole Year.

5.2.3 Ground cover - As in the case of tree and shrub layers, the ground cover was also found to be higher in core areas due to the presence of grassy blanks (Fig.4). It was found highest in core zone 2 and lowest in buffer zone 2, where grazing pressure is high (Table-13).

5.2.4 WEED AND SHRUBS - As the areas, especially buffer areas suffering from continuous grazing pressure (practically), and fire every year, shrubs of climax tree species (e.g, for Sal Fig.6) has been reduced drastically compared to that of core area. On the other hand shrubs of pioneer species (of secondary succession e.g, Kend, Fig.6 as well as weeds) getting more chance to establish themselves due to loss of canopy cover, and degraded condition. Weeds are also invaded those areas, due to their less prone to biotic influences and greater ability to colonize new degraded areas. Thus weed growth is also much higher in buffer (zone 2) compared to core (zone 1). But there is more weeds in core (Zone 2), compared to one buffer area (zone 1), possibly because of plantation activities during the past.

5.3 MFP - Out of total 59 tree species 8 were considered as MFP species due to their extensive use. In addition other species are also being utilized for collection of MFP. The 8 species are, Madhuca latifolia (Mahua), Diospyros melanoxylon (Kend), Buchanania lanjan (Piar), Embllica officinalis (Amla), Shorea robusta (Sal), Bauhinia vahlii (Mahulan), Schleichera oleosa (Kusum) and Aegle marmelos (Bel).

The utilization of these species for MFP collection in buffer and core areas is given in Tabular form (Table-12). The Data shows that altogether MFP collection is totally prohibited, Kendu leaf

collection was carried out in core (zone 1). Almost all leaves of Kendu were plucked from seedlings and very few from saplings and trees. Other such as poles and hedge material were also seen collected by villagers in fringe areas of this compartment, especially of Ramandag, Ladi, Luhutanr and Garu villages.

From the data it is found that 0.22 % of total trees were used for honey collection and out of which 75% were cut in buffer areas. In core areas it was comparatively less i.e, 0.1% and trees were not cut, however use of fire was there. More than 50% of honey collection caused forest fire as it was evident from the burnt area below the trees or from remained burnt splinter on the ground.

5.4 BIOTIC PRESSURES

Dead trees, logs were found in large numbers in core areas (2.65/Ha) compared to buffer areas (0.35/Ha). On the other hand cut trees were found in large numbers in buffer areas (Table-14). Data indicates negative relation. Cutting is done for particular purposes, such as fire wood, honey, poles, and timber requirement (needs selected tree spp).

Lopping was observed only in buffer areas, result indicates that 1.41 trees per hectare were lopped. Trees were generally lopped for fruit collection (e.g, Kusum).

Sal trees were ring barked for collection of resin exudates for which people starts blazing (Plate-5) from October upto the onset of monsoon, during June. Data indicates that 2.29 trees per hectare were ring barked out of total 96 (Table-14 & Appendix-2) trees per hectare, which is about 2.36% of the total Sal tree present in buffer areas.

TABLE - 9

Tree species composition and density/ha. in core and buffer area (n = 60 sample plot). Total area sampled is 18857.1 sq m. including bamboo clump density/ha.

	Buffer	Core
Total no. of tree species	35	52
Average density/ha	321.5	365
Average bamboo density/ha	25	60.5

TABLE -10

Result of tree species composition for core and buffer (n = 60 sample plots). Area sampled = 18857.1 sq m. Total tree species = 59.

	Total number of trees species found	Number of tree species found in common	Number of species not found
Core	52	28	7
Buffer	35	28	24

For list of tree species see Appendix 3A, 3B & 3C.

TABLE-11

SHRUB LAYER SPECIES COMPOSITION IN CORE AND BUFFER N = 60 PLOTS
TOTAL AREA SAMPLED = 600 m²

TOTAL SHRUB SPECIES=68.	TOTAL No OF SHRUB SPECIES	No. OF SHRUB SPECIES IN COMMON	No OF Spp. ABSENT
CORE	62	43	6
BUFFER	49	43	19

TABLE -12

Percentage of MFP species utilized for collection in core and buffer.

MFP species	Kend	Mahulan	Sal	Piar	Amla	Kusum	Mahua	Bel
Buffer	31	8	2	11	0	0	0	0
Core	1	0	0	0	0	0	0	0

TABLE - 13

Total number of MFP collectors and cattle seen during transect survey.

	Buffer		Core	
	Zone1	Zone2	Zone1	Zone2
MFP collector	88	24	7	0
Cattle	13	38	0	0

TABLE-14

BIOTIC PRESSURES SUCH AS CUT TREES, LOPPED TREES, TREES USED FOR HONEY, TREES RING BARKED AND DEAD TREES IN CORE AND BUFFER.

	CORE	BUFFER
CUT TREES	2	15
LOPPED TREES	0	8
USED FOR HONEY	0	6
RING BARKED TREES	0	13
DEAD TREES	15	2

Note- Area sampled = 56548.66 m²

5.4.1 MFP COLLECTORS AND CATTLE GRAZING ACTIVITIES

Data indicates high pressure of grazing in buffer zone 2 and high MFP collectors disturbances in zone 1 (Table-13 & Plate-1) and therefore buffer area contains less of large mammal evidences (Table-1 to 7) than the core area. Cattle were found only in buffer areas during transect survey and were more in number in zone 2. However indirect evidences as well as direct evidences of cattle grazing were also seen in core area (zone 1) out of transect and on fringe areas mainly. Total numbers of cattle of the villages near my study area is 1472 (Approximately 34.44 per km²), which totally depend on forest (i.e, study area and near by protected forests) for grazing. During summer they use many paths but during rains when river is full of water they use the main road, bridge and the forest road mainly to go inside study area.

5.4.2 FIRE

Study areas were also burnt during April to June, and the percentage of area burnt, out of total sampled area it is comparatively very large in buffer areas. It is 7.7 times more in buffer (Fig.7) area. Buffer zone 2 has the highest percentage of burnt area (71%) because it is more accessible to villagers and having also weed growth which dries up during summer season (Fig.7 & 8). Another possible reason may be burnt for fresh growth of grass to graze their cattle by the villagers including for MFP collection purposes.

6. DISCUSSION

6.1 ANIMAL IN GENERAL

Result on animal density support that most of the wild animals have a smaller densities in buffer than core i.e., of Sambar, Barking deer and Langur except Rhesus monkey which were only observed in buffer areas. However as it was already mention that animals like Chital, Giant squirrel were not observed throughout whole study period in the buffer zone. This indicate local extinction of these species from the buffer. Contrary to this, there were indirect evidences as well as forest department census (May 1989) figure indicate presence of Chital in the buffer zone also.

Regarding density in different months shows some remarkable changes as also dealt in result (Chapter 5), that the density of Langur in core shows decrease just after summer season while it shows an increase in buffer zone 1. It is not seen in buffer zone 2. Chital density shows an increase in core zone 1 after May-June which is near the village.

This indicates that due to MFP collection activities and other related disturbances such as fire and human movement, they flee away to other adjacent undisturbed forest area and came again to this area after the disturbance period is over. However Chital was seen out of the transect near one waterhole (Garudohar) of this zone. (Plate-12).

Regarding vegetation cover, result indicate reduced tree, shrub (except weed species) and grass cover. There is also reduced fodder availability (Appendix- 5 to 7). On the other hand invasion of weed is considerably more in buffer than core. There is also weeds in core zone 2. This is because there was teak plantation

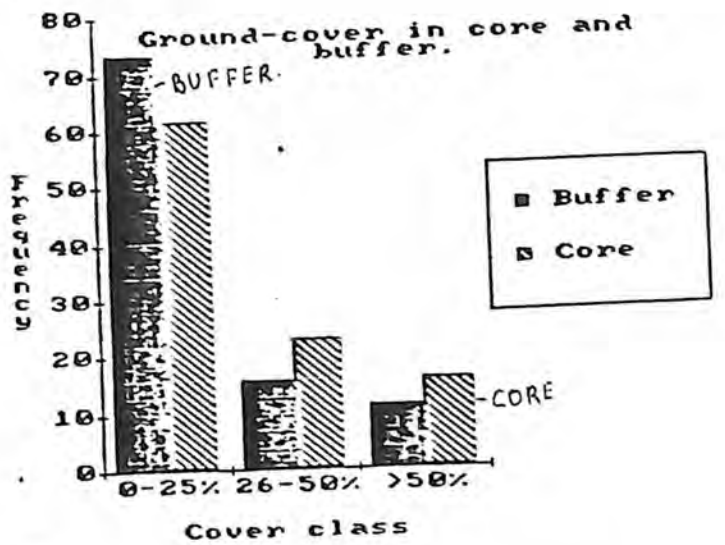
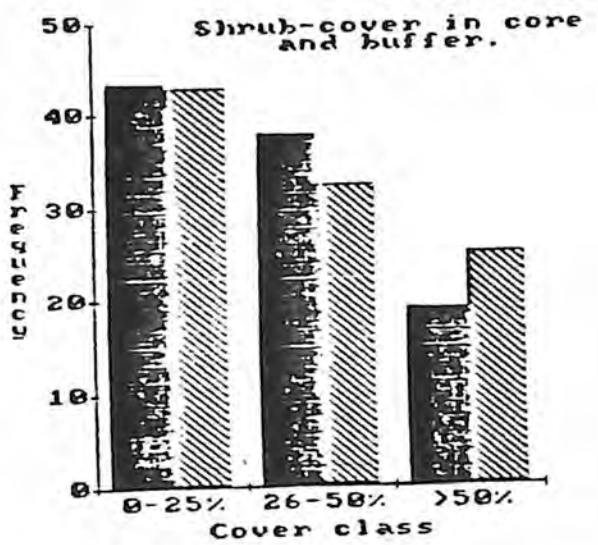
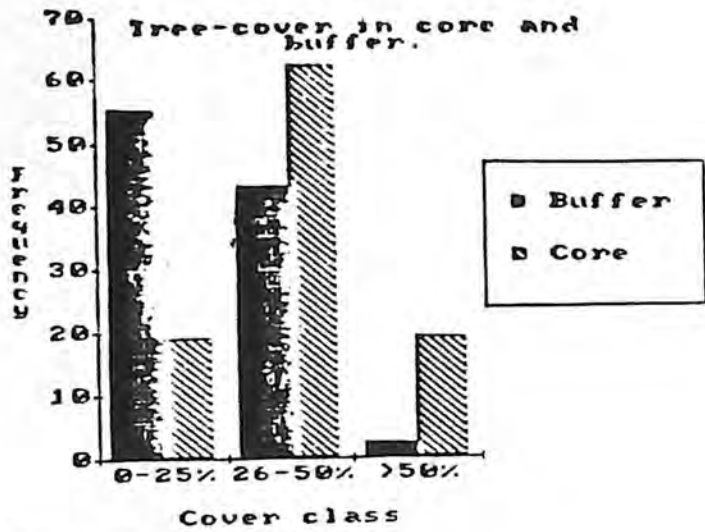


Fig. 4 Showing tree, shrub and ground cover in core and buffer areas in three cover classes i.e, 0-25%, 26- 50% and >50%.

during past as mentioned earlier.

Results indicate that tree density, species composition and cover is lower in buffer areas compared to that of core areas. Many studies have shown food as a key ecological variable, influencing social behaviour and population dynamics of wild animals (Malik et al 1986).

Likewise variety of factors are responsible to regulate animal population in an area (core as well as in buffer). MFP collection activities could bring about changes in many of these factors especially during summer season. Few of the main problems of our wildlife ranges during the pinch period, i.e. summer as summarized by Choudhary (1972) are (i) growing scarcity in fodder, often accentuated by forest fire as is also evident from data on fire that buffer areas considerably were burnt more relatively than the core area. Availability of grasses (i.e. ground cover) is also less. (ii) Forced localization of animal populations, limited by fewer watering places and disturbance by man (in the form of MFP collectors) and cattle in buffer areas, as it can also be seen from the result of animal densities (Table 1,2,3,4,5 & 7). However data is not significant to support this even then it can be seen that Chital density in core zone 2 (less disturbed) and Rhesus monkey density in buffer zone 1 (highly disturbed) is large during this period. (iii) Imported additional pressure of competition from domestic livestock as well as disturbances due to MFP collection activities. This can also be seen from the figure (Fig.3) that the type of disturbances during this period is comparatively more. Other impacts are also mentioned which can be summarized in the following broad categories.

6.2 HABITAT

There is reduction in available range of habitats due to MFP collection activities, especially during pinch period (i.e. summer), when much of the area was occupied by the grazing herds of cattle (Plate-10) and presence of human beings (MFP collectors) in buffer areas. Data on tree cover and the absence of Giant squirrel from buffer indicates that there is loss of areal pathways for these tree dwellers. Data on snags, dead logs, indicate that there is loss of suitable habitat for snag dwellers such as woodpeckers. Although data on birds were not collected but considering the fact that snags appear to be a limiting factor for breeding cavity -nesting bird population (Jille et al 1985) the density of snags is very less (0.35/ha) in buffer areas. Which is far below the recommended density (i.e, 9/ha - by Jille et al 1985). Situation is worse towards village side. Whatever snags found in buffer areas were found away from village and on hill slopes. The situation is also not very good in core the density (2.65/Ha) is 3.39 times less than the recommended.

FOOD RESOURCES

The species composition of core as well as the density of main fodder species is higher than the buffer (Appendix 5 to 7). Lopping and cutting (Plate-6) evidences are also more in buffer which may be affecting the production of the foliage (browse) and fruits. Short and long term successional changes may alter species composition of area due to heavy pressure of cattle and MFP collectors.

DISEASE : Grazing may influence the susceptibility of certain wild

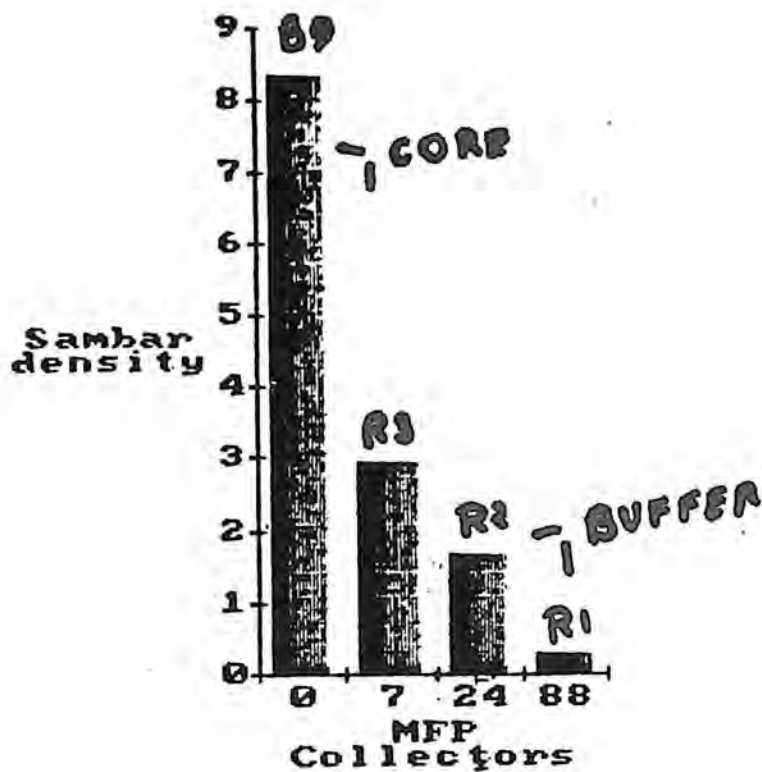


Fig. 5 Showing the relationship between number of MFP collectors and Sambar density in different zones of core and buffer.

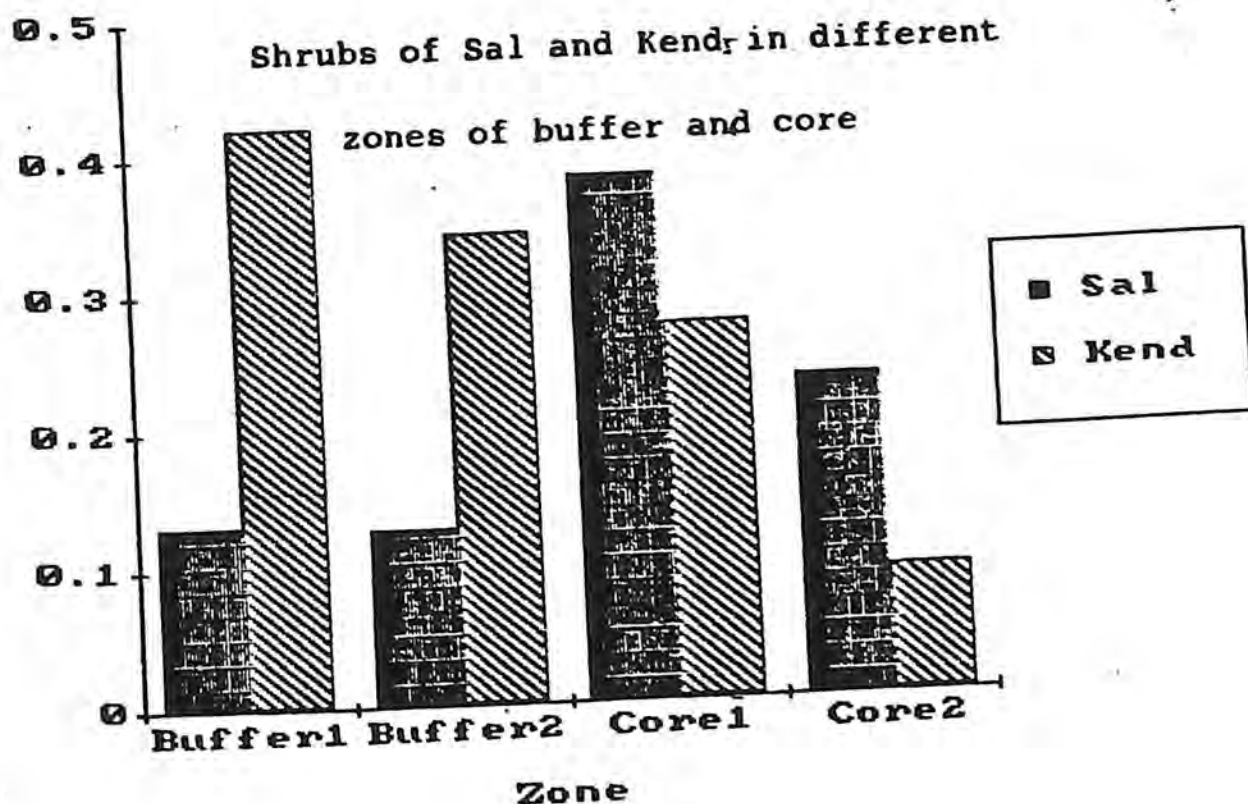


Fig. 6 Showing shrub layer of Sal (*Shorea robusta*) and Kend (*Diospyros melanoxylon*) in core and buffer.

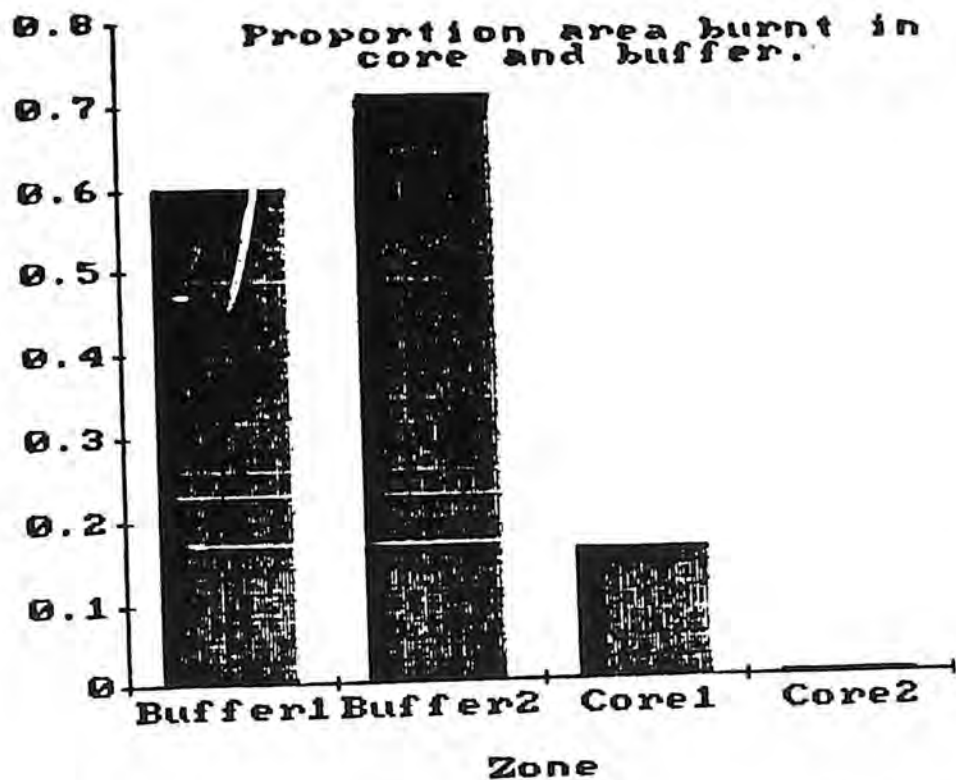


Fig. 7 Showing proportion of area burnt in different zones of core and buffer.

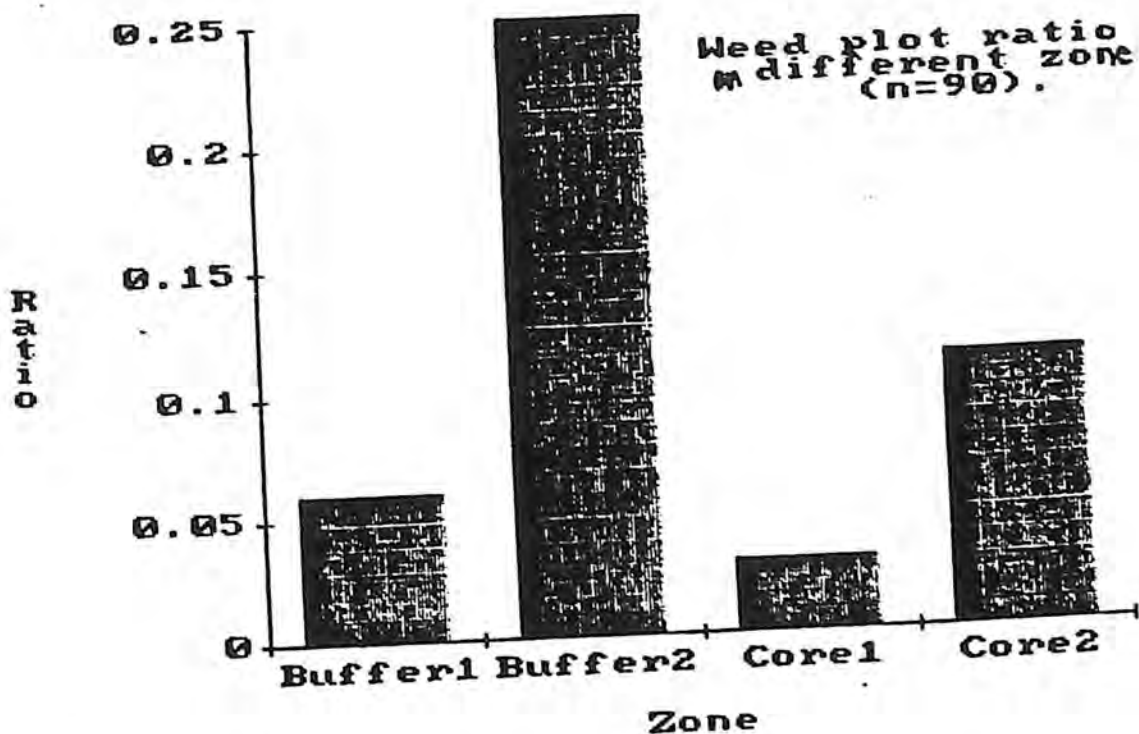


Fig. 8 Showing frequency of plots having weed in different zones.

animal species to disease. There were past records of foot and mouth disease and Anthrax, but now the situation has improved due to efforts of the management authorities. In the similar way presence of MFP collectors in large tract of forest area may influence the susceptibility of certain animal species to diseases - due to stress related lowering of general body condition; and alterations in the parasite and disease vectors present in the habitat and the probabilities of animals coming into contact with these (Johns, 1985a and Marsh et al. 1987) such as using the common water hole during the summer season inside the forest area. There is not such any evidences were seen but Rhesus monkeys and Chital were observed using water holes near the village on the river bed which was also seen used by the villagers. Productive valley areas are also occupied by the villages where water is more available (Plate-8).

MICROCLIMATIC CHANGES

No data has been collected on this aspect but as described by Johns (1985), Shelton (1985), that amphibians, reptiles, several birds and invertebrates are sensitive to changes in light, temperature and moisture associated with loss of canopy cover and may go into serious decline following disturbances.

OTHER FACTORS

MFP collection activities increases the accessibility in buffer areas which can lead to a greater level of human presence in the buffer areas with consequent increase in hunting for wildlife (both animal and plant) and greater habitat disturbances (Sawarkar, pers. comm.). This is also evident from the data on fire, weeds, MFP

collectors, cattle, tree cover and ground cover that disturbances are more in buffer.

Thus animals may respond to some or all the above changes in various ways. Some species may be highly sensitive and may become locally extinct (e.g. Chital and Giant squirrel). Others may manage to survive by modifying their feeding and ranging patterns and with alterations in their population dynamics (e.g, Sambar and Rhesus monkey), further discussion on how wild animals respond to these factors can be summarized in the following terms.

MOVEMENT PATTERN AND HOME RANGE

Most species flee from the disturbed area immediately, though many return after a time lag (Marsh et. al. 1987). Large animals with extensive home ranges can temporarily change their foraging area and return later when disturbance is over e.g. elephant. However no data is available to support this but there were indirect evidences that during summer elephants were in Baresand area and came to Ramandag area during monsoon (crop raiding evidences were also there). Elephant movement patterns in Palamau Tiger Reserve is described by Mishra (1971). During summer elephant remain in the southern part of the Reserve i.e, towards Baresand area but after the monsoon they come towards the northern side crossing the Garu range. Moreover, for any other species to recolonize its former range i.e. especially in buffer area, there has to be sufficiently large populations in the contiguous undisturbed forest i.e. core zone 1 - which is near the buffer zone 2, a condition rarely met with due to same condition of pressure increasing in this area (Table-13) in the shape of MFP collectors.

FEEDING AND RANGING BEHAVIOUR

The choice of tree, grass, bamboo, and fruit species (others like rhizome, mushroom, edible tubers and foliage etc), extracted may also affect the ability of wild animals to survive. For example elephants which may like mature flowering stage bamboo, bamboo felling may affect their feeding behaviour. Extraction of edible fruit may affect the frugivorous such as Rhesus monkey. Similarly bark foraging species like woodpeckers may be affected by a loss in foraging substrate and in insect food due to loss of snags (Jillè et al 1985). However frugivorous (e.g. Rhesus monkey) being better able to exploit the rapidly colonizing secondary species, show greater ability to survive in disturbed forest (Johns, 1985a. e.g, in buffer zone 1). As the disturbances on invertebrates is little known and no such data has been collected, nothing much can be said about this. But on considering the fact that most of the invertebrates of forest are highly specialized in terms of feeding and microhabitat requirements, such as light intensity, moisture condition and presence of leaf litter, one would expect a severe loss of species diversity in buffer areas following disturbances caused by MFP collection activities. This loss again may affect insectivorous vertebrates, carnivorous vertebrates and so on.

DEMOGRAPHIC CHANGES

Data support very little about demographic mechanisms which lead to decline in populations (both animals and plants) following MFP collection activities in the buffer areas. Even then it indicates that activities such as Kendu leaf, honey (Plate-7), fire wood, edible fruits (as supported also by data on lopped and cut trees),

and other forms of collection has severe impact on habitat i.e. in shape of fire (probable cause and effects of fire have been well documented by Rodgers 1986 and Johnsingh 1986), loss of cover, loss of ground cover, weeds, human presence and other disturbances such as grazing has also its own impact on habitat. Grazing may also cause reduction in fodder availability, resulting in reduced wild prey animals. Thus carnivore animal may be forced to shift towards domestic animal for their prey (Plate-9). In other word as soon as you leave the core area you notice the difference (Fatehally 1979).

Regarding loss of cover and fragmentation of habitat much evidence is now accumulating from a number of ecological studies to show that small fragmented habitats cannot in the long run sustain their original biological diversity, though they may continue to do so in the short run. It is therefore being stressed that maintenance of large contiguous areas should be a very important aim of all efforts at designing nature reserves (Diamond 1975 and Prasad 1978). According to Shelton (1985) opening up of 30% of the canopy can cause most of the ground vegetation to die off due to increased insolation and desiccation. This may lead to the invasion of weeds which are more liable to withstand this type of disturbances as well as pioneer species (e.g, Diospyros melanoxylon) of secondary succession will get chance to establish themselves more compared to that of climax species (e.g, in this case Shorea robusta and Terminalia species).

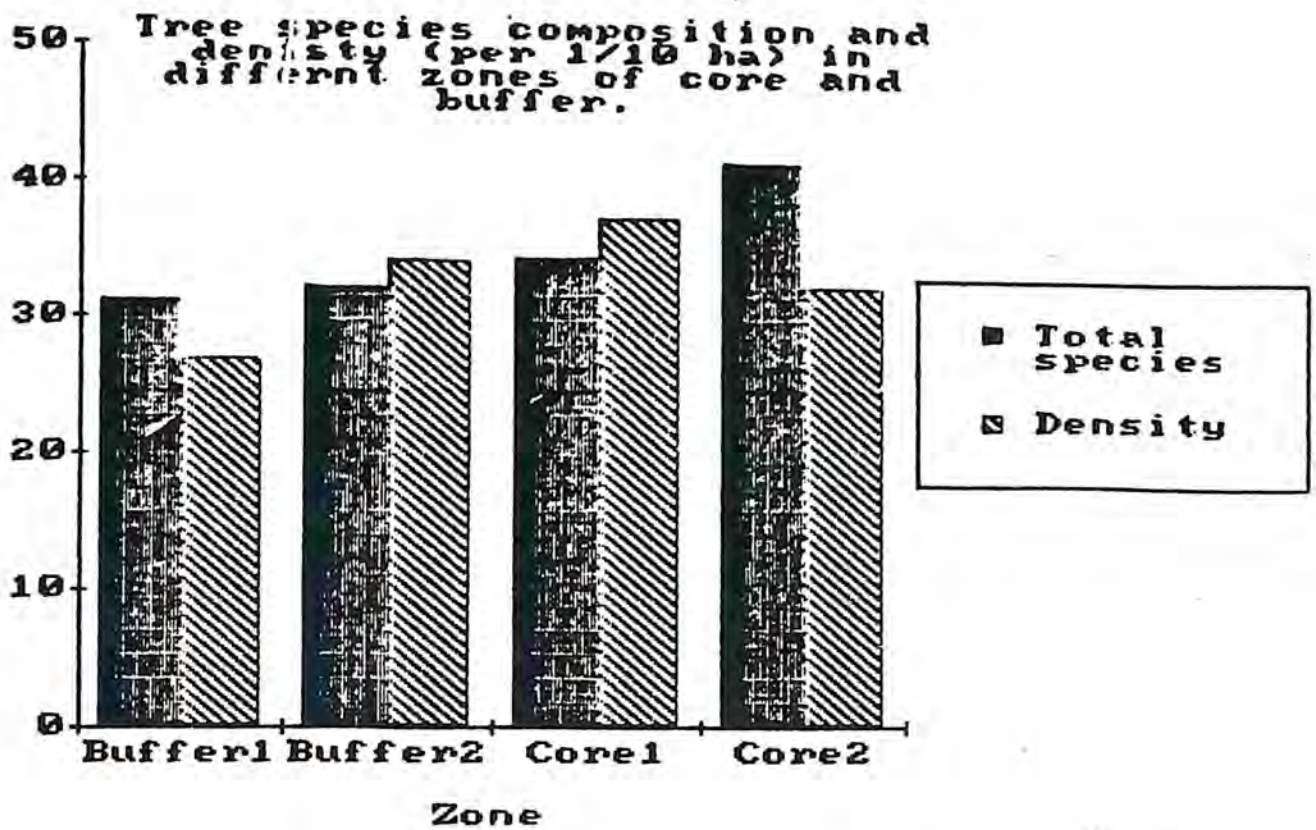


Fig. 9 Showing tree species composition and density in different zones.

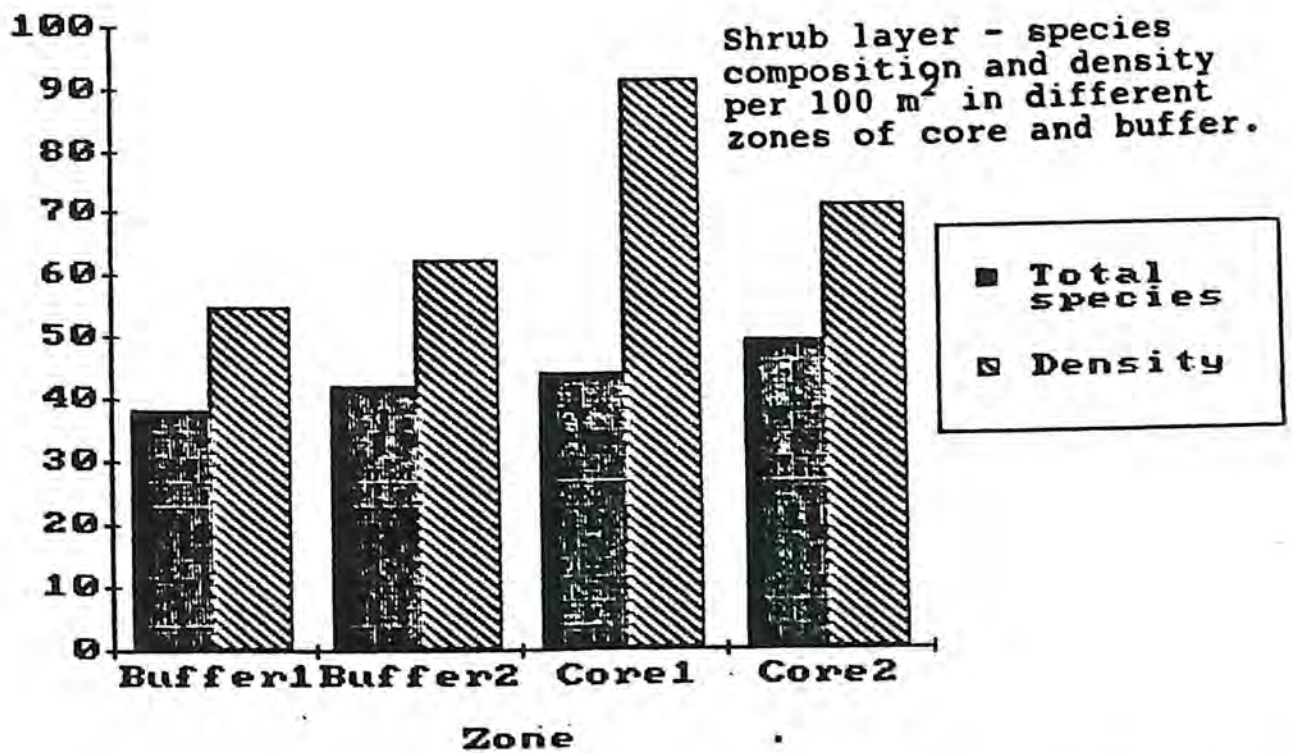


Fig. 10 Showing shrub layer - species composition and density in different zones of core and buffer.

7. CONCLUSION

From the above discussion it can be concluded that presence of MFP collectors is causing more disturbances directly to wild animals than indirectly affecting the long term sustainability of the area, by reducing species diversity, food, cover and water availability for wild animals. Removal of many MFP (e.g Kendu leaf, honey, gum and resin) does not directly affect wild herbivore mammals. But the activities related to the collection are detrimental to wild animals such as use of fire for honey and to some extent for Kendu leaf (now this practice stopped), girdling of mature individuals (eg. sal trees, Plate-5), cutting and lopping of trees.

Cutting and lopping of trees causes opening of tree canopy which lead to the invasion of weeds in open areas. As it was also observed in some part of Teak planted area in Core zone 2 which was clear felled. It can also be concluded that there is lack of information on the effect of MFP collection on wildlife. This needs assessment specially in and around protected areas. Therefore the work of MFP collection in or around protected areas should be done under the supervision of the trained personnel who must have the knowledge about the impact of these activities on wildlife. He must also be able to assess these impact on wildlife to help the management and the government by helping the rural people as well by utilising natural resources on sustained basis.

On the whole before starting any such type of developmental planning or scheme related to MFP collection activities in and around any protected area, assessment of the impact on wildlife should be carried out before beginning such a project.

As protective role of forests is gaining precedence over the productive role Siddiqi (1986), it is the responsibility of the forest manager, wildlife conservationists and researcher to find out balance between economic exploitation of forests, and wildlife conservation values.

It was also observed that unemployment and lack of awareness among rural people is the major problem. One of the best step which was taken by the state government is the nationalization of the MFP in the state. Even then to restore the degraded areas, remedial measures can be suggested such as reducing the effective period of MFP collection. Regularization of fund for other habitat restoration activities such as soil conservation, weed eradication, plantation, water development (i.e, during summer) and other protection activities may also be suggested. Involvement of private agencies or even the organizations should be avoided, who lack information on the impact or lack proper supervision. Collection on rotational basis in different areas in different years can also be suggested. This will be one of the better alternatives. Care should also be taken so that the reduction in the effective period of MFP collection may not increase the other impacts on wildlife due to unemployment.

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NOTE- * indicates references not seen in original.

APPENDIX - 1

DATA OF BIGHTINGS, TOTAL No. OF MAIN WILD HERBIVORE MAMMALS AND OVERALL DENSITY PER Sq. Km. (n = 30 FOR EACH CORE AND BUFFER)

WILD ANIMALS	AREA	SAMBAR	CHITAL	BARKING DEER	INDIAN GIANT SQUIRREL	RHESUS MONKEY	COMMON LANGUR	JACKAL	IYAENA	TIGER	WILDBOAR	GAUR
TOTAL No. OF BIGHTING	CORE	21	13	6	15	0	24	1	1	3	1	1
	BUFFER	6	0.0	3	0.0	14	4	0	0	0	0	1
TOTAL No. OF ANIMALS	CORE	30	45	6	15	0	125	1	1	3	1	2
	BUFFER	6	0	3	0	112	14	0	0	0	0	1
MEAN ANG. SIGHT.	CORE	0.029	0.023	0.025	0.019	-	0.022	0.015	0.021	0.023	0.020	0.020
Dist. Km. BUFFER		0.032	-	0.018	-	0.021	0.02	-	-	-	-	0.020

APPENDIX-2

THE COMMON TREE SPECIES WITH THEIR DENSITY / HECTARE IN DIFFERENT ZONE OF CORE AND BUFFER:

TREE SPECIES	DENSITY/HECTARE IN BUFFER		DENSITY/HECTARE IN CORE	
	ZONE 1	ZONE 2	ZONE 1	ZONE 2
1. <u>Shorea robusta</u>	67.88	125.15	154.85	57.27
2. <u>Madhuca latifolia</u>	12.73	26.51	27.58	--
3. <u>Buchanania lanjan</u>	20.15	16.97	26.52	11.67
4. <u>Diospyros melanoxylon</u>	7.42	12.73	3.18	4.24
5. <u>Embluca officinalis</u>	18.03	13.79	22.27	6.36
6. <u>Aegle marmelos</u>	2.12	3.18	4.2	4.06
7. <u>Butea monosperma</u>	3.18	--	--	3.18
8. <u>Terminalia tomentosa</u>	13.79	11.67	43.48	27.58
9. <u>Lagerstroemia parviflora</u>	27.58	14.85	8.48	7.42
10. <u>Anogeissus latifolia</u>	21.21	8.48	21.21	12.73
11. <u>Mallotus philippinensis</u>	6.36	23.33	4.24	21.21
12. <u>Boswellia serrata</u>	6.36	18.03	4.24	10.60
13. <u>Ailanthus excelsa</u>	3.18	--	5.30	12.73
14. <u>Saccopetalum spp.</u>	6.36	4.24	2.12	12.73
15. <u>Gmelina arborea</u>	1.06	2.12	2.12	4.24
16. <u>Pterocarpus marsupium</u>	11.67	9.55	14.85	2.12
17. <u>Bridelia retusa</u>	5.30	4.24	5.30	8.48
18. <u>Chloroxylon swietenia</u>	3.18	5.3	1.06	--
19. <u>Lannia grandis</u>	2.12	2.12	2.12	1.06
20. <u>Zizyphus jujuba</u>	8.48	7.42	10.60	--
21. <u>Symplocos racemosa</u>	1.06	--	2.12	--
22. <u>Bauhinia racemosa</u>	4.24	2.12	5.30	7.42
23. <u>Bombax malabaricum</u>	1.06	3.18	--	1.06
24. <u>Eugenia heyneana</u>	--	3.18	3.18	--
25. <u>Semecarpus anacardium</u>	--	1.06	2.12	--
26. <u>Flacourtia indica</u>	--	1.06	1.06	--
27. <u>Bauhinia retusa</u>	9.55	3.18	--	1.06
28. <u>Ougeinia oojenensis</u>	1.06	5.30	3.18	4.24

APPENDIX - 3

List of tree species only found in core and their density/ha in different zone.

Tree species	Core	
	Zone1	Zone2
1. <u>Schleichera oleosa</u>	0	2.12
2. <u>Spondias mangifera</u>	0	1.06
3. <u>Tectona grandis</u>	0	20.15
4. <u>Cordea macleodii</u>	1.06	0
5. <u>Cassia fistula</u>	1.06	0
6. <u>Bursera serrata</u>	1.06	3.18
7. <u>Bauhinia variegata</u>	1.06	0
8. <u>Grewia hainesiana</u>	0	3.18
9. <u>Terminalia belerica</u>	0	1.06
10. <u>Adina cordifolia</u>	0	4.24
11. <u>Mitragyna parvifolia</u>	0	1.06
12. <u>Cordea sp.</u>	0	1.06
13. <u>Eugenia jambolana</u>	0	2.12
14. <u>Zizyphus xylopyra</u>	0	1.06
15. <u>Z. rugosa</u>	0	1.06
16. <u>Dalbergia lanceolaria</u>	0	1.06
17. <u>Casearia tomentosa</u>	2.12	1.06
18. <u>Hollarrhena antidysenterica</u>	0	2.12
19. <u>Antidesna diandrum</u>	1.06	0
20. <u>Woodfordia sp.</u>	2.12	1.06
21. <u>Helicteres isora</u>	0	1.06
22. <u>Gardenia sp. (turgida)</u>	1.06	2.12
23. <u>Kydia calycina</u>	0	1.06
24. <u>Celastrus paniculata (scrub)</u>	1.06	0

APPENDIX - 4

List of tree species only found in buffer and their density/ha in different zone.

Tree species	Buffer	
	Zone1	Zone2
1. <u>Bauhinia malabarica</u>	--	2.12
2. <u>Acacia catechu</u>	8.48	5.3
3. <u>Ehretia laevis</u>	1.06	4.24
4. <u>Cochlospermum gossypium</u>	4.24	5.3
5. <u>Gardenia latifolia</u>	1.06	1.06
6. <u>Hymenodictyon excelsum</u>	1.06	1.06
7. <u>Stereospermum suavealens</u>	1.06	2.12

APPENDIX- 5

SHRUB LAYER- COMMON SPECIES COMPOSITION AND DENSITY/Ha IN DIFFERENT ZONE OF CORE AND BUFFER (i.e, found in both core and buffer).

Shrub species	Buffer		Core	
	Zone1	Zone2	Zone1	Zone2
1. <u>Shorea robusta</u>	3866	3833	11366	700
2.* <u>Terminalia tomentosa</u>	666.67	266.67	233.33	366.67
3.* <u>Anogeissus latifolia</u>	400	466.67	700	33.33
4. <u>Lagerstroemia parviflora</u>	166.67	433.33	-	133.33
5. <u>Pterocarpus marsupium</u>	300	66.67	433.33	300
6. <u>Buchanania lanjan</u>	633.33	666.67	566.67	-
7. <u>Semecarpus anacardium</u>	33.33	33.33	33.33	33.33
8. <u>Chloroxylon swietenia</u>	33.33	100	300	66.67
9.* <u>Embllica officinalis</u>	566.67	266.67	966.67	233.33
10.* <u>Bridelia retusa</u>	200	166.67	4000	866.67
11. <u>Madhuca latifolia</u>	133.33	466.67	300	-
12. <u>Diospyros melanoxylon</u>	4000	4166.67	4000	866.67
13. <u>Aegle marmelos</u>	66.67	33.33	233.33	333.33
14.* <u>Schleichera oleosa</u>	-	33.33	133.33	-
15.* <u>Acacia catechu</u>	-	33.33	133.33	-
16.* <u>Mallotus philippinensis</u>	66.67	633.33	333.33	-
17. <u>Boswellia serrata</u>	33.33	-	100	-
18. <u>Saccopetalum sp.</u>	-	100	1266.67	33.33
19. <u>Litsaea sebifera</u>	33.33	33.33	100	333.33
20. <u>Ehretia laevis</u>	33.33	33.33	100	166.67
21. <u>Cochlospermum gossypium</u>	100	66.67	-	33.33
22.* <u>Bauhinia retusa</u>	33.33	33.33	33.33	33.33
23.* <u>Zizyphus sp.</u>	1266.67	600	266.67	100
24. <u>Ougenea oogenensis</u>	100	366.67	533.33	100
25.* <u>Bauhinia racemosa</u>	33.33	33.33	33.33	400
26. <u>Gardenea turgida</u>	366.67	300	-	233.33
27.* <u>Bombax malabaricum</u>	-	66.67	100	-
28. <u>Euginea heyneana</u>	-	466.67	-	66.67
29.* <u>Bauhinia variegata</u>	33.33	-	33.33	-
30. <u>Gardenia latifolia</u>	33.33	33.33	-	33.33
31. <u>Cassia fistula</u>	133.33	300	-	133.33
32. <u>Woodfordia floribunda</u>	133.33	300	166.67	-
33.* <u>Helicteres isora</u>	533.33	600	766.67	-
34. <u>Hollarhena anti.</u>	333.33	666.67	133.33	-
35. <u>Albezzia procera</u>	-	33.33	400	-
36. <u>Lantana camara</u>	566.67	1833.33	333.33	4666.67
37. <u>Cassia tora</u>	-	3200	-	3766.67
38. <u>Indigofera pulchella</u>	1166.67	2133.33	2266.67	133.33
40. <u>Lea sp.</u>	100	-	400	-
41. <u>Flemingia sp.</u>	1166.67	1733.33	2266.67	133.33
42. <u>Phoenix sp.</u>	33.33	600	1166.67	500
43. <u>Careya arborea</u>	-	33.33	33.33	-

Note- Vegetation survey was carried out during the month of August and September 1989. Shrub include those tree and shrub species which have less than 20 cm girth at breast height.
* indicate some of the fodder trees.

PPENDIX - 6

SHRUB LAYER - SPECIES ONLY FOUND IN CORE AREA AND THEIR DENSITY/ ha IN DIFFERENT ZONE.

Shrub species	ZONE 1	CORE	ZONE 2
1.* <u>Bauhinia purpurea</u>	-		33.33
2.* <u>Cordia macleodii</u>	-		33.33
3.* <u>Grewia haineiana</u>	-		233.33
4. <u>Mitragyna parvifolia</u>	33.33		-
5. <u>Eugenia jambolana</u>	-		766.67
6. <u>Antidesma diandrum</u>	-		66.67
7.* <u>Dalbergia sissoo</u>	66.67		133.33
8. <u>Tectona grandis</u>	-		333.33
9. <u>Ventilago maderaspatana</u>	33.33		233.33
10.* <u>Ailanthus excelsa</u>	233.33		33.33
11.* <u>Lannea grandis</u>	33.33		-
12. <u>Casearia tomentosa</u>	133.33		133.33
13. <u>Grewia hirsuta</u>	166.67		66.67
14. <u>Flueggia obovata</u>	33.33		-
15. <u>Grewia tiliaefolia</u>	66.67		33.33
16. <u>Wrightia tinctoria</u>	-		100
17. <u>Kydia calycina</u>	-		533.33
18. <u>Celastrus paniculata</u>	33.33		-
19. <u>Cordia sp.</u>	-		66.67

APPENDIX - 7

SHRUB LAYER SPECIES ONLY FOUND IN BUFFER AND THEIR DENSITY/ ha IN DIFFERENT ZONE.

SHRUB SPECIES	ZONE 1	BUFFER	ZONE 2
1.* <u>Butea monosperma</u>	33.33		-
2. <u>Adina cordifolia</u>	66.67		33.33
3. <u>Stereospermum suaveolens</u>	-		66.67
4. <u>Hymenodictylon excelsum</u>	66.67		33.33
5.* <u>Terminalia belerica</u>	-		66.67
6. <u>Flacourtia latifolia</u>	-		33.33

Note- Shrub include those tree and shrub species which have less than 20 cm girth at breast height. * indicate some of the fodder species.

APPENDIX-8

LIST OF WILD ANIMALS OF PALAMAU TIGER RESERVE WITH CENSUS DATA

ANIMAL SPECIES	CENSUS DATA IN DIFFERENT YEAR		
	1987	1988	1989
TIGER (<u>Panthera tigris</u>)	54	55	59
LEOPARD (<u>Panthera pardus</u>)	46	52	48
CHITAL (<u>Axis axis</u>)	15358	14348	15226
SAMBAR (<u>Cervus unicolor</u>)	3623	3775	3022
GAUR (<u>Bos gaurus</u>)	625	682	734
WILDBOAR (<u>Sus scrofa</u>)	5636	6712	6811
ELEPHANT (<u>Elephas maximus</u>)	83	97	108
NILGAI (<u>Boselaphus tragocamelus</u>)	-	118	125
WILD DOG (<u>Cuan alpinus</u>)	77	521	468
HYENA (<u>Hyaena hyaena</u>)	-	31	-
PEA FOWL (<u>Pavo cristatus</u>)	2277	3689	3511
HARE (<u>Lepus nigricollis ruficaud.</u>)	699	864	851
BARKING DEER (<u>Muntiacus muntjak</u>)	1267	1590	1458
CHOSINGHA (<u>Tetracerus quadricornis</u>)	-	6	*3
RHESUS MONKEY (<u>Macaca mulatta</u>)	19463	23350	27482
LANGUR (<u>Presbytes entellus</u>)	17450	17239	18961
SLOTHBEAR (<u>Melursus ursinus</u>)	46	178	204
WOLF (<u>Canis lupus</u>)	59	-	-

Source - Census data of Palamau Tiger Reserve. * Found in Chhipadohar Block.

APPENDIX - 9

The term 'Minor Forest Products (MFP)' as defined by Mehta (1981), covers all products other than, 'Major Forest Products' which consists of timber, small wood and fuel wood. MFP specially include grass, fruit, leaves, bark, animal and mineral products found in forest and collected therefrom. They vary very much in kind as well as in value. The MFP of commercial importance may be divided into the following class Mehta(1981).

1. Fibres and flosses e.g, Bauhinia vahlii.
2. Grass, bamboo and canes.
3. Distillation and extraction products, including grass oils.
4. Oil seeds. e.g, Madhuca latifolia and Shorea robusta.
5. Tans and dyes e.g, bark of Shorea robusta.
6. Gums, resins and oleo-resins. e.g, Boswellia serrata and Shorea robusta.
7. Animal, Mineral and miscellaneous products
8. Drugs, spices, edible products and poisons. e.g, Holorrhena antidysenterica.

Main type of MFP which are mainly collected by villagers are as follows:

Seed and resin exudates of Shorea robusta, leaf and fruit of Diospyros melanoxylon, leaf and fibre of Bauhinia vahlii, flower and fruit of Madhuca latifolia, fruit of Terminalia chebula, T. blerica, Embllica officinalis, Schleichera oleosa, Buchanania lanjan, gum and resins, other edible products, honey, rhizome, tubers and other non edible products including medicinal herbs, grass and plant products.

APPENDIX - 10
 RAINFALL DATA FOR GARU RANGE (STUDY AREA)

RAINFALL IN mm and TEMPERATURE in ° C.	In general 1988	1989
GARU RANGE TEMPERATURE	1333*	801.35
Max.	41.5*	816.16 (Upto 28th Sep).
Min.	3.00*	
. Not year wise		
DALTONGONJ (Betla)	1285*	1009.00#
TEMPERATURE (Betla)		(Daltongonj)
Max.	44.00*	1035.50 (Upto 30 Oct.)
Min.	12.00*	

Note- * Data taken from the Project Report of Palamau Tiger Reserve (1979). # Data taken from Chinyanki Agricultural Research Centre, Daltogonj.



Plate 1. Kendu leaf collectors coming out of the buffer zone 1. Forest floor is invaded by weeds and foot paths.



Plate 2. Sal (*Shorea robusta*) seed collection by collectors, the degraded forest land with clear and burnt under surface.



Plate 3. Sal seed collection is difficult in core areas with thick leaf litter and shrub growth compared to that of above (Plate 2).



Plate 4. Mahua (Madhuca latifolia) fruit collection by collector. Difficult to quantify inside forest area, how much utilized by man or by wild animals i.e., by Rhesus monkey (Macaca mulatta).



Plate 5. Girdled (ring barked) mature Sal (Shorea robusta) tree for resin collection, collection sign also present there.

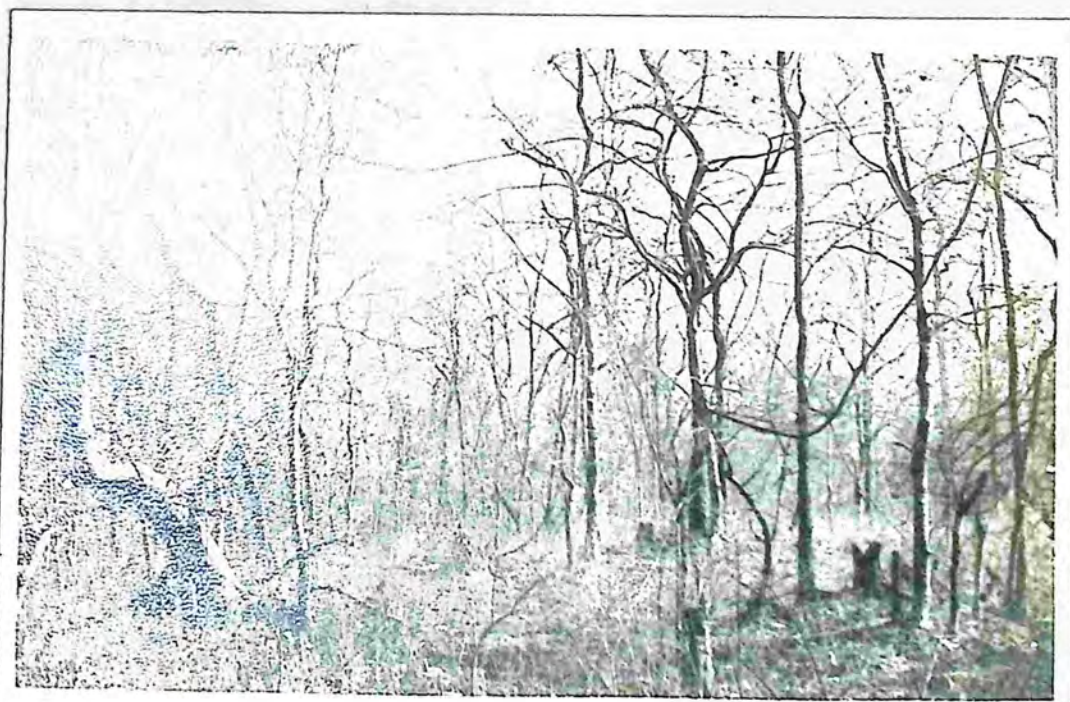


Plate 6. Tree and pole cutting pressure in buffer area.



Plate 7. Honey collection sign in buffer zone 2. Felled tree (*Anogeissus latifolia*) and sign of fire, indicate honey collection may cause forest fire during summer season. But it was in rains.



Plate 8. All productive valley areas are occupied by villages causing habitat fragmentation and heavy pressure to near by forest areas. Resulting some times man wild animal conflicts - see elephant trench.



Plate 9. Reduced wild prey, resulting cattle killing by tiger. Buffalo killed by tiger in Marchaiya P.F where situation is worse than the buffer, due to grazing and MFP collection activities.



Plate 10. Cattle grazing in buffer area (zone 2), resulting in barren ground and lack of regeneration.



Plate 11. One of the great expectations from the villagers - they should start cutting fodder, instead of grazing their cattle inside the forest areas - e.g, villagers near Mundu (Ladi village).



Plate 12. Undisturbed core area with Chital herd.