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STUDIES OF MAN - WILDLIFE CONFLICT IN PEPPARA WILDLIFE SANCTUARY AND ADJACENT AREAS

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ABSTRACT

Man-wildlife conflict in Peppara Wildlife Sanctuary and adjacent areas was studied during the years 1993 to 1996. Thirty species of larger mammals were recorded from the sanctuary which include the endangered lion-tailed macaque *Macaca silenus*, Nilgiri marten *Martes gwatkinsi*, Spiny dormouse *Platacanthornys lasirus* and Leopard cat *Felis bengalensis.* Of these five species of animals were recorded as destructive to 17 crops. Tapioca and plantain were destroyed by wild boar and elephant. Crop damage by wildboar can be considered as severe where as from elephants it was only moderate. Thirteen indigenous crop protection methods were recorded from the area, which are effective up to certain extent. Solar electric fence was effective with proper maintenance and it completely prevented animals like elephant, sambar and gaur.

Besides crop damage instances, four man slaughters were also recorded. Regarding man-wildlife conflict, tribals were experiencing only less of it where as local people are severely affected. Peripheral settlements have more educated people and the incidence of crop damage was also more. Local people heavily depended on the forest for thatching grass, reed and firewood. Kotoor tribal market was the main outlet for tribals to sell their NWFP collections and eight items were commonly brought to the unique auction market controlled by the Kerala Forest Department. Crop damage is linked to the cropping pattern and location of settlements and it is one of the problem which severely deprive the economic status of tribals

Key words: Man-wildlife conflict, Peppara Wildlife Sanctuary, Larger mammals, Kani tribals, Kerala, India.

1. INTRODUCTION

Conflicts over the forest resources were prominent in the late seventies and eighties. When the mode of utilization of natural resources got advanced, the disagreements became more and more complex. Between 1971 and 1984,51 clashes between people and officials were reported from national parks and 66 from sanctuaries, throughout India (Kothari *et al.,* 1989). Studies conducted in different parts of the world have revealed many factors behind these conflicts. The growth of human population, intensified land-use (Ngure, 1995), increase in population of animals (Smith *et al.,* 1995), human pressure on animals, modification of natural resources,habitat fragmentation (Sukumar, 1994) and lack of foresight in the implementation of policies are some of the factors behind the current disputes.

In the early years of forest conservation, neither forest policy nor forest laws paid any regard to wildlife (Sunder, 1995). From the ecological point of view, large mammals such as elephant or tiger play a dominant role in an ecosystem by virtue of their large biomass or position at the top of an intricate food web. Such large mammals come into hostility with human interests by destroying crops, live stock or property and sometimes by even killing people., The continuing progress of commercial forestry has greatly intensified the discontent between the commercial - industrial sector and the poorest section of the rural population.

Peppara wildlife sanctuary has diverse habitats like moist deciduous and evergreen forests and also plantations. The Kani tribals residing inside the sanctuary and the local people outside the sanctuary interact with it in a complex way. Crop raiding by wild animals is a serious problem in and around the sanctuary. Similarly many man-wildlife conflicts also happened. Though several studies on these problems have been carried out elsewhere, the crop raiding pattern and human-wildlife interaction in Kerala have not been studied in detail. Kani tribals were described anthropologically, culturally and sociologically, but their role in a tropical forest ecosystem has not been elucidated in detail. Data on the status of larger mammals in the sanctuary is also scanty.

The objectives of the study were,

1. To document the status of wild animals in the area.
2. To record the nature and extent of crop raiding by animals.
3. To document the socio-economic status of people inside and adjoining areas with special emphasis on native tribals.

1.1. Review of Literature

1.1.1. Vegetational and faunal studies

Henry *et al.* (1978) emphasized the importance of Agasthiamalai region for medicinal plants. He further reported the potential for declaring the Agasthiamalai region as a Biosphere Reserve (Henry and Chandrabose, 1984). Vegetational studies carried out in the area, mainly centered on the taxonomy of flowering plants (Mohanan and Henry, 1994). A list of rare and medicinal plants found in the sanctuary has been reported by Binoy *et al.*(1991), while describing the rare and threatened flowering plants of South India. Only few faunal studies were carried out in the sanctuary previously. In an earlier study, Ellerman (1961) had reported the occurrence of spiny dormouse *(Platacanthomys lasirus)* from Bonacord. Management plan prepared for the sanctuary mentions about 10 species of larger mammals and also listed few species of birds (Vighnarajaq, 1990).

1.1.2. Socio-economic status of tribals

Early life style of Kani tribals was described by Thurston (1909) and Iyer (1937). Recently, Mathur (1977) also reported their way of life in the forest areas. Kerala Forest Department has carried out a survey of socio-economic status of tribals in the State and in this survey the Kani tribals of Peppara Wildlife Sanctuary was also included (Anonymous, 1994). Sebastian (1990) had described the cultural practices and social customs of Kani tribals. Apart from these no detailed studies were conducted on the socio-economic status of tribals in this region.

Many studies have been reported from the neighbouring States on the interaction of tribals with the forest. A report on the tribal community of the western coast of Maharashtra

(Munshi, 1995) examined the changes over time of their attitudes and behaviour towards forest resource. According to Sathya Kumar (1989) local people have left no place unexplored and no resource unexploited in the Kedarnath Wildlife Sanctuary. In Karnataka, Singh (1994) has made an attempt to analyse, how the development and changed perception of people have threatened the very existence of wild animals. Since local co-operation is essential for the long term success of conservation efforts, it is usually advisable to undertake a socio-economic survey of the communities affected by projects that involve controlling the use of biological resources in order to determine what resources are used, how they are harvested, the degree of awareness about controlling regulations and possible alternative source of income (Mc Nealy *et al.*, 1990).

1.1.3. Man-wildlife interaction

Crop damage: No extensive studies were carried out in Kerala on the problem of crop damage. Many such works were published from other States and also from the Asian and African countries. A recent survey on crop depredation by wild animals in Kerala revealed that crop damage is heavy (Veeramani and Jayson, 1995). A study conducted in 10 villages along the Karnataka, Tamil Nadu border estimated that the total loss to agricultural crops by elephants was about Rs.1.5 lakhs per year (Sukumar, 1989; Sukumar, 1990). Similarly man-wildlife interaction in Karnataka has been reported by Appayya (1992). Mishra (1971) and Datye and Bhagwat (1993 a) have reported the economic loss due to the crop raiding elephants in Bihar. Balasubramanian *et al.* (1993) and Ramesh Kumar and Sathyanarayana (1993) also carried out identical works in the Nilgiris. In Peninsular Malaysia the economic loss to a single agency from destruction of oilpalm and rubber plantations by elephants was estimated to be US $20 million per year (Blair *et al.*, 1979). Similarly many studies were reported from African countries (Tchamba, 1995 and Ngure, 1995).

Man- slaughter and cattle lifting

Although no systematic study has been carried out in Kerala on the human casualties by wild animals, Veeramani *et al.* (1996) have recently reported instances of cattle lifting and human casualties from Kerala. But many works were published from other States. It

was estimated that 618 heads of cattle were killed by tigers in Bandhargarh National Park (Dwivedi, 1982). Banerjee (1994) and Thosre and Mahajan (1994) reported the cattle lifting by carnivores in North India, Datye and Bhagwat (1993) and Santhiapillai and Jackson (1990) recorded the severity of human deaths by wild elephants. From Garhwal area Mohan (1994) and Tiwari (1994) reported the injury to human beings by wild animals. In Sanjay Gandhi National Park, when the wild prey animals became scarce, the leopards survived by shifting to more or less exclusively on domestic dogs (Daniel, 1995).

Increasing human population and agricultural land use have considerably reduced the area available to wildlife in general resulting in conflicts (Santhiapillai, 1996). The pressure for wild lands to be made available for livestock grazing and the close proximity of the cultivation to forest areas cause considerable animosity between wildlife and man in India (Sale and Berkmuller, 1988). The massive network of wildlife sanctuaries widely hailed as examples of successful conservation have often had a negative impact on the lives of the surrounding human population (Guha and Gadgil, 1992).

1.2. Study Area

Location:

Situated in the southern tip of Western Ghats in the Agasthiamalai ranges in the extreme South to the Aryankavu pass, Peppara Wildlife Sanctuary comes under Nedumangad Taluk of Thiruvananthapuram District, Kerala State (Fig.1). It is located between 8^{o} 34' to 8^{0} 42' N latitude and 77^{o} 7' to 77^{o} 14' E longitude. The State capital is 50 km away from the sanctuary. The extent of the sanctuary is 53 km^2 and is under the control of Assistant Wildlife Warden stationed at Peppara Dam site and the Wildlife Warden stationed at Thiruvananthapuram. The altitude varied from 98 to 1594 m above M.S.L.

All the sides of the sanctuary is surrounded by forests. On the northern side lies the Bonacord estate and eastern side borders with the Mundanthurai-Kalakkad Tiger reserve of Tamil Nadu. Southern portion adjoins with the Neyyar Wildlife Sanctuary and western portion borders with the eucalyptus plantations of Trivandrum Division. The highest peak is Athirumudi Peak (1594 m) and the entire area is the catchment of Karamana river which originates from the Chemmungi peak.

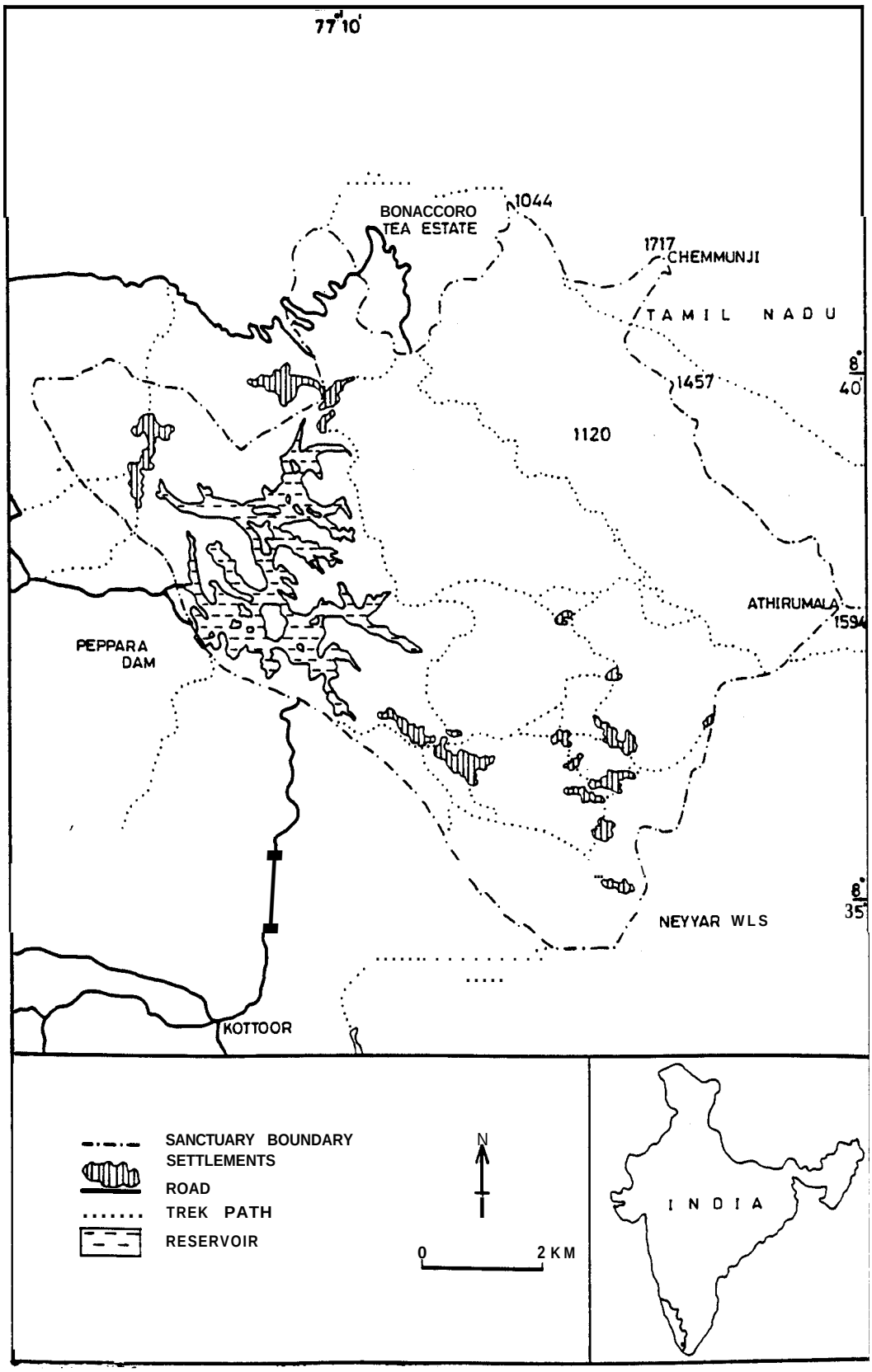

Fig. 1 Location and settlements in Wildlife Sanctuary.

Climate

. Sanctuary has a tropical hot and humid climate with a dry summer. Even during this period the high ranges maintain a cool and dry climate. Daily temperature varied from 32° C to 20° C in plains whereas it varied from 25° C to 16° C in high altitude. Average rainfall was around 4810 mm in the catchment area of Peppara Dam (Table 1).

Table 1. Mean rainfall at Peppara Wildlife Sanctuary (1993-95)in mm.

Months	Peppara	Bonacord
January	7.47	8.30
February	22.71	8.87
March	15.51	5.24
April	17.32	21.49
May	29.22	59.06
June	21.32	92.11
July	21.10	96.60
August	18.71	78.56
September	17.96	48.37
October	17.41	74.63
November	24.61	45.36
December	13.10	7.75

Source: Kerala Water Authority and Bonacord Estate

Vegetation

The Peppara wildlife sanctuary has all typical vegetation types found in tropical areas like tropical moist deciduous forests (29 km^2), tropical evergreen forests (10 km^2), tropical semi evergreen forest (14 km^2), shola forests (0.79 km^2), reed brakes (2 km2), bamboo areas (0.5 km^2) and grass lands (2 km^2). Nair (1991) has also described the vegetation of the area in detail. A recent floristic study by Mohanan *et al.* (1997) documented 1084 species of flowering plants from the area. *Terminalia paniculata, T. bellerica, Carea arborea, Dillenia pentagyna, Pterocarpus marsupium, Phyllanthus*

emblica, Lannea coromandelica, Lagerstroemia microcarpa, Hopea parviflora, Olea dioica, Buchanania longan, Bombax insigne and *Wrightia tinctoria* were seen in the moist deciduous forest.

Common trees in the evergreen forests were *Cullenia exarillata, Dimocarpus longan, Mesua nagasarium, Diospyros candolleana, Bischofia javanica, Cinnamomum verum, Vateria indica, Xanthophyllum arnottianum, Syzygium caryophyllatum, Palaquium ellipticum, Garcinia gummi-gutta* and *Holigarna arnottiaria.* Semi evergreen forests have trees such as *Aporusa* sp. *Artocarpus hirsutus, Mesua nagasarium, Persea macrantha, Terminalia paniculata, Vitex altissimia, Mangifera indica, Madhuca neriifoliu, Alstonia scholaris, Bridelia retusa* and *Calophyllum apetalum.*

Tribals

There are seventeen Kani tribal settlements inside the Peppara Wildlife Sanctuary. They are distributed in the buffer zone as well as in the core area of the sanctuary. The Kani tribes of Thiruvananthapuram and Kollam Districts contribute to the major part of the total tribal population found in the forests of Kerala (Anonymous, 1994). Like the other aboriginal hunting and gathering tribes, Kanis also have the primitive history of hunting, gathering and shifting cultivation. Long back, the Kanikkars were employed by the Travancore Government to collect honey, wax, ginger, cardamom, dammar and elephant tusks (Thurston, 1909). Many anthropologists highly regarded their adventurous honey collection from the highly rugged rock cliffs and tree tops, which can be seen even today. Though the insidiously spreading modern civilisation polluted the tribal culture, some Kani settlements still preserve their ancient traditions.

2. METHODS

The study was mainly based on observational methods. This was mainly done by gathering data by engaging in a social scene, experiencing it and seeking to understand and explain it (May, 1993). For a specific purpose the method of Lofland and Lofland (1984) was followed. It is defined as the "process in which an investigator establishes a many sided and relatively long term relationship with a human association in its natural settings, for the purpose of developing a scientific understanding of that association."

2.1. Status of Larger Mammals

Status of larger mammals were assessed by direct and indirect methods. In addition to this preferred habitats of gaur and elephants were recorded to understand the habitat use.

2.1.1. Direct sightings

To record the presence of larger mammals different trek paths in the sanctuary and adjacent areas were surveyed by walking. Observations were made in the morning and evening and whenever an animal was sighted the species, sex, group size, activity, time and vegetation type were recorded.

Line transect method: To document the status of larger mammals six transects were laid through different vegetation types. The first transect was in a moist deciduous forest starting from Podium and Cherumangal settlements (2 km). The second was in an evergreen forest, between Athirumalai and Natchiar Kunnu (1.7 Km). The third transect from Bonacord picket station to Chemmankala settlement, covered mixed vegetations such as deciduous, moist deciduous and semi evergreen forests (2 Km). Fourth transect was laid between Bonacord picket station to Pachani thual, which is again a moist deciduous and semi evergreen forest (2 Km). The fifth transect was laid between Peppara dam to Enna kunnu through the moist deciduous and semi evergreen vegetation (1.6 Km). The sixth transect was laid between Sunnarimukku and Podiakala settlement (1.7 Km). This was also through the moist deciduous and semi evergreen forest.

Out of these six transects, three were of two kilometer in length and others were not having 2 km length because of the reservoir and the undulating terrain. Due to heavy rainfall, growth of grass was rapid and both the direct and indirect sightings became rare in the transects. In the subsequent surveys, it was found that sufficient sighting of large mammals was not available and the data could not be processed, using the program DISTANCE. hence after an year this method was abandoned.

2.1.2. Indirect evidences

As an alternative to the line transect method, quadrates of the size of 10m x 10 m were laid for assessing the indirect evidences of large mammals. These quadrates were taken randomly on both sides of major trek paths. At every 50 m, quadrates were laid on the opposite side of the trek path. The quadrates were made in all the vegetational types such as moist deciduous, semi-evergreen and evergreen forests and also in eucalyptus plantation. Samples were taken from each vegetation type depending on the extent of vegetation. From these quadrates, indirect evidences left by the wild animals such as scats, droppings, diggings, feeding signs and scratching marks were identified. In doubtful cases, scats, hair and other materials were taken to the laboratory and compared with the known samples for identification.

2.2. Socio-economic Status of Tribals

Since the tribal population inside the sanctuary was in 160 families and in 13 settlements, the survey method was followed to study the socio-economic condition. A detailed interview schedule was prepared to gather information on demography, settlement details, educational status, migration patterns, family constellation, cropping pattern, infrastructure and animal conflicts.

Pre-test: A pre-test was carried out to assess the validity and reliability of the questionnaire. The questionnaire prepared initially for this pre-test was used to collect data from the Chemmankala settlement. This settlement was selected purposely due to the low intensity of outside influence. Based on the preliminary survey, necessary modifications were made in the interview schedule and the final schedule was formulated.

2.3. Dependence of People on the Sanctuary

2.3.1. Local people

The interaction of tribals and local people was studied using different methods. To study the dependence of local people on the sanctuary the major entry points to the sanctuary were identified, considering the flow of people to the sanctuary. One entry point was at Kuttappara through which people from Meenagal, Theviarkunnu, Parandode, Aryanad, Karipalam, Kottaikaham and Kilpaloor entered into the sanctuary. The second point was at Adivarambu, where people from Maruthamalai, Tholikode, Vithura, Aryanad entered the sanctuary for NWFP collections. These two entry points were observed from 6.00 hours to 18.00 hours and the group size of people, time of entry and leaving, items collected and the quantity of items collected were recorded in a data sheet. Observations were made twice in a month and a few cases were analysed in detail by participating in the collection trips.

2.3.2. Tribals

To quantify the gathering of NWFP items, Kotoor tribal market was visited every week. Following details were collected from the market.

1. Quantity of each item and its sale price.
2. Name of person who has bought the item.
3. Settlement from which it was originated.

2.3.3. Human pressure on forests

To analyse the impact of human pressure on forests the disturbances were quantified in plots of the size 10m x 10 m. Number of trees and poles cut, firewood collection, signs of lopping, bamboo and cane collection, grass collection etc. were recorded. To quantify the impact of humans, the distance to the nearest trek paths and to the nearest human habitation from the plots were assessed. Hundred and twenty two plots were made in the moist deciduous forest, 27 in the semi evergreen forest, 35 in the evergreen, 19 in the hill top evergreen and 73 in the eucalyptus plantations. Number of plots were fixed based on the extent of different vegetation types.

2.4 Crop Damage

All the settlements inside the sanctuary were visited for recording the crop damage during the initial period of the study and Chanthakode tribal settlement was selected for regular and systematic observation by purposive sampling. Three households were selected, based on the location of the cultivated fields. One was in the periphery of the settlement and the other was in the middle of the settlement. The third one was near the reservoir. Members of each house were met once in a week and data were collected on the species of crop damaged, quantity, phenology of crops and the species of animals. Animals were identified from the indirect evidences left during the raid and also from the report of members who have sighted or chased the animals. The terrain of the area and the distance from the forest border were also recorded.

In addition to this, all the other settlements were visited once in a month and information on crop damage was collected from the settlers. If any severe crop damage was reported from any other settlement, it was visited immediately and detailed information was collected in a format. Data on various indigenous techniques for preventing crop damage by wild animals used by the tribals were also recorded.

2.4.1. Phenology and vegetation

To find out the relationship between the tree phenology and crop raiding patterns, two settlements were selected and phenology of the trees was studied. One was the Chemtnankala and the other Pattamkulichapara which is outside the sanctuary. In each settlement, ten common moist deciduous tree species were selected and 3 individuals were marked in each species. The marked trees were observed in all months and the phenological status of each individual tree was recorded.

Evaluation of solar electric fence

To study the efficiency, a five strip solar electric fence of 1.7 km was installed around the Chemmankala Kani settlement. The area was selected considering the accessibility, extent of the settlement, history of crop raiding and also the co-operation of the inhabitants. It was installed with the technical support of ANERT (Agency for Non Conventional Energy and Rural Technology), Thiruvananthapuram. Of the five strips, the lowest one

was the power line to prevent smaller mammals such as blacknaped hare, porcupine and mouse deer which was at a height of 15 cm from the ground. The second line was laid 10 cm above the lower one and was a negative line to prevent the jumping of animals above the lowest supply line. The third line was at a height of about 45 cm with power supply. This was meant to prevent sambar and other ungulates. The fourth one was again a negative line which was connected to earth. The fifth line was the top most line drawn at a height of 130 cm. This was directly connected to the energizer kept in the the control room with a power supply of 9000 volts. The electricity stored in a 12 v battery generated by the solar panel was supplied to the fence through the energizer which magnified the DC current. The top most line prevented the larger mammals like elephant and gaur.

To observe the effect of fence on crop raiding animals, plots with the size of l0cm x 10 m were systematically laid along both sides of the fence at every 100 m. By recording the indirect evidences observed in these plots, the animals which have passed through the fence and those which were prevented by the fence identified. These plots were visited every week and data collected.

2.5. Wildlife Attacks

Case studies: Detailed studies on wildlife attacks were carried out by visiting the place of incidents and recording details, regarding the animal involved, location, mode of attack and the social and economic background of the victim.

3. RESULTS

3.1. Larger mammals

Thirty species of larger mammals were recorded from the sanctuary (Table 2). Mammals above the size of mouse deer *(Tragulus meminna)* are considered as larger mammals for the purpose of study.

Table 2. Larger mammals recorded from the Peppara Wildlife Sanctuary

Common name	Scientific name
Primates	
1. Bonnet Macaque	*Mucaca radiata* (Geoffroy)
2. Nilgiri Langur	*Presbytis johni* (Fisher)
3. Lion-tailed Macaque	*Macaca silenus* (Linnaeus)
4. Slender Loris	*Loris tardigradus* (Linnaeus)
Cats	
5. Leopard or Panther	*Panthera pardus* (Linnaeus)
6. Junglecat	*Felis chaus* Guldenstaedt
7. Leopardcat	*Felis bengalensis* Kerr
Civets	
8. Small Indian Civet	*Viverricula indica* (Desmarest)
9. Common Palm Civet or Toddy Cat	*Paradoxurus hermaphroditus* (Pallas)
10. Brown Palm Civet	*Paradoxurus jerdoni* Blanford
Mongooses	
11. Common Mongoose	*Herpestes edwardsi* (Geoffroy)
12. Rudy Mongoose	*Herpestes smithi* Gray
Canids	
13. Wild Dog	*Cuon* (Pallas)

Contd.....

Common name	Scientific name
Bear	
14. Sloth Bear	*Melursus ursinus* (Shaw)
Weasels	
15. Common Otter	*Lutra* sp.
16. Nilgiri Marten	*Martes gwatkinsi* Horsfield
Rodents	
17. Malabar Giant Squirrel	*Ratufa indica* (Erxleben)
18. Threestriped Palm Squirrel	*Funambulus pulmaram* (Linnaeus)
19. Large Brown Flying Squirrel	*Petaurista petaurista* (Pallas)
20. Small Travancore Flying Squirrel	*Petinomys fuscocapillus* (Jerdon)
21. Spiny Dormouse	*Platacanthomys lasirus* Blyth
22. Indian Porcupine	*Hystrix indicu* Kerr
23. Blacknaped Hare	*Lepus nigricollis* F. Cuvier
Elephant	
24. Asian Elephant	*Elephas maximus* Linnaeus
Wild oxen	
25. Gaur or Indian Bison	*Bos gaurus* H. Smith
Deer	
26. Sambar	*Cervus unicolor* Kerr
27. Mouse Deer	*Tragulus meminnu* (Erxleben)
28. Barking Deer	*Muntiacus muntjuk* (Zimmermann)
Pig	
29. Wild Boar	*Sus scrofa* Linnaeus
Pangolin	
30. Indian Pangolin	*Manis crassicaudata* Gray

Occurrence of larger mammals

Among the larger mammals, elephant, wild boar and Malabar giant squirrel were sighted in all months (Table 3). During the months of monsoon sightings were few.

Primates

Four species of primates were recorded from the sanctuary. Nilgiri Langur were recorded from Ponkalappara, Athirumalai, Kovilteri, Bonacord and Exhumadangutheri. Mean troop size was 5 individuals (N = 7). Thirty eight Nilgiri langurs were detected in seven sightings. All of them were spotted from evergreen forest. They were feeding on *Cullenia exarillata* and *Eugenia hemispherica*.

Bonnet macaques were sighted at Bonacord, Peppara dam, Podiakala, Anjumoorthi Thodu and Vazapazutha. Fifty one Bonnet macaques were detected in five sightings. Mean troop size was 10 individuals (N = 5) and they were recorded from semi evergreen and moist deciduous forests. They were feeding on the shoots of *Schumanianthus virgatus*, *Gmelina arborea* and *Butea parviflora*. Lion-tailed macaques were seen thrice, in the evergreen forest. Mean troop size was 7 and the locations were Kovilteri, Natchiarkunnu and Athirumalai. They fed mainly on the fruits of *Cullenia exarillata*.

Slender loris, a nocturnal primate was recorded twice and both times it was a loner. It was located at Bonacord and Chathankode areas where the vegetation is of moist deciduous type. This species was found feeding on tender shoots and leaves of *Bambusa arundinaceae*.

Cats

Among the cats, direct or indirect evidence of tiger was never recorded. Leopard was sighted four times in moist deciduous forests from Chemmankala, Podiakala, Anjumoorthi Thodu and Kunnatheri as lone animals. Jungle cat was sighted twice from Ottakudi and Pothode. Leopard cat was recorded from Ennakkunu (Jayson and Christopher, 1996).

Table 3. Sighting of larger mammals in different months at Peppara Wildlife Sanctuary (February 1993 - March 1996).

Animals	J	F	M	A	M	J	J	A	S	O	N	D
Bonnet macaque	P	P	P	-		P	-	P	P	-	-	-
Lion-tailed macaque	P	-				-	-	-	-	-	-	-
Nilgiri langur		-	P	-		-	-	-	P	P	-	-
Jungle cat	P	-	-			-	-	-	-	-	-	P
Leopard	P	-	-	-	P	-	-	-	-	-	-	-
Leopard cat	P	-	-	-	-	-	-	-	-	-	-	-
Small Indian civet	-			-	P	-	-	-	-	-	-	-
Palm civet	-	P	P	P	P	-	-	-	-	-	P	-
Wild dog	P	P	P	-	-	-	-	-	-	-	P	-
Sloth bear	P	P	P	-	P	-	-	-	P	-		-
Nilgiri marten	P	-	-	-	P	-	-	-	-	-	-	-
Blacknaped hare		-	-	P	P	-	P	P	P	-	-	-
Malabargiantsquirrel	P	P	P	-	P	-	P	P	P	-	-	P
Flying squirrel		-	-			P	-	-	-	-	P	-
Elephant	P	P	P	P	P	P	P	P	P	P	P	P
Gaur	-	P	-	-	P	-	-	-	P	P	P	P
Sambar	P	-	P	-	-	-	P	-	-	-	-	P
Barking deer	P	-	P	-	-	P	-	P	P	P	P	P
Mouse deer	-					-	-	P	-	P		-
Wild boar	-	P	P	-	P	P	P	P	P	-	-	P
Porcupine		-	P	-		-	P	-	-	P	-	-

P = present, - = Not recorded.

Civets

Common palm civet was seen five times during the period of study. They have been sighted from evergreen, semi evergreen and moist deciduous forests. Bonacord,

Nellikappara, Koviltheri and Chemmankala were the places where they were recorded. Small Indian civet was recorded six times between Ottakudi to Kathipara.

Mongoose

Common mongoose was located 10 times in Kathipara in an eucalyptus plantation and also from Bonacord and Cherukad,

Canids

Wild dog was recorded from Kuttiar, Kallupara, Cherukad and Ennakunnu. Mean pack size was three members and they mainly feed on sambar as evidenced from the scat analysis.

Sloth bear

Sloth bear was sighted thrice from the sanctuary as loners. The locations were Vazhukkampara, Kottamala and Medicinal Plant Conservation Area.

Weasels

Two species of weasel family were sighted. Otter was seen at Thodayar, Podiakala and Kaithapara and a dead specimen was sighted at Chemmankala. Nilgiri marten was sighted at Vazhukkampara (450 m above msl) near Bonacord estate and also near the Chathankode Kani settlement (120 m above msl). Kani tribals call this animal as "Koduvallil". In one instance the animal was feeding honey from a tree hole *(Dillenia pentagyna)*, 5 m above from the ground. The habitat was rocky with moist deciduous forest (Christopher and Jayson, 1996). Nilgiri marten is well known to the Kani tribals and they believe that a disturbed Nilgiri marten (Koduvallil) will call other members of its kind and may attack an unarmed man.

Rodents

Seven species of rodents were identified from the sanctuary. Of these the Malabar giant squirrel was detected fifteen times. It has been recorded from Bonacord, Athirumalai, Ennakunnu, Vazukkappara, Koviltheri, Velamalai, Podiakala, Muthipara, Kunnatheri, Chemunji and Atayar. This squirrel was sighted from all the habitats. It fed on *Persea macrantha*

and *Artocarpus hirsuta* shoots, *Buchanania lanzan* and also on the fruits of *Dimocarpus longan, Artocarpus hirsutus, Madhuca* sp., *Sarcostigma kleinii, Mangifera indica* and *Persea macrantha.*

The Large brown flying squirrel was located on three occasions from Bonacord and Chemmankala. The spiny dormouse locally known as "Mutteli" was collected from the sanctuary after a spell of 30 years (Jayson and Christopher, 1995). It lived in colonies on live trees and the nests were found on *Terminalia bellerica, T.paniculata, Persea macrantha, Dilleriia retusa* and *Careya arborea.* The animals were feeding on Pepper *(Piper nigrum),* Cashew nut *(Anacardium occidentale)* and Cassava *(Manihotesculenta).* To some extent they are considered as pests of the above species. Rajagopalan (1968) reported the presence of this species in Shimoga in Karnataka State. Recently this species has been recorded from the Kariyanshola of Indira Gandhi Wildlife Sanctuary (Prabhakar, 1997).

Kani tribals caught these animals from the nearby forests when they needed them for medicinal purposes. The nests of these animals were identified by observing the water oozing out of the holes on trees. For catching the animals they either cut open the trees or blow smoke into the holes. They believe that the flesh and spines of this species are a cure for respiratory diseases. Another rodent commonly found in the area was the Indian Porcupine. Since it was nocturnal, direct sighting was rare. But indirect evidence like fallen quills was sighted in tnany places. Blacknaped hare was found at Sunnarimukku, Chemmankala and in the eucalyptus plantations near the Peppara dam.

Elephant

Elephants were located 73 times during the period of study. Altogether 217 elephants were seen and the male to female ratio was 1:6 (N = 217). Mean herd size was 10 individuals per herd (Fig. 2) and maximum were sighted in the moist deciduous forest followed by eucalyptus plantation, swampy areas, semi evergreen forest and evergreen forest (Table 4). They were recorded from Sunnarimukku, Chemmankala, Kuttiar, Mudakki, Kaviar, Nellikkapara, Cherukad, Bonacord, near the dam site, Podiakala, Chembuthangi and Kathipara. Elephants uprooted trees like Eucalyptus, *Careya arborea, Dillenia pentagyna, Emblica officinalis, Helicteres isora* and *Terminalia paniculata.* Food species of elephants recorded from Peppara Wildlife Sanctuary is given in Table 5. This was done to identify the natural food of elephants when they were not involved in crop raiding.

Table 4. Habitats where elephants were sighted in Peppara Wildlife Sanctuary

Month	EG	SEG	MD	Swamp	EP
January	7	0	35	52	11
February		8	21	0	41
March		8	17	1	1
April			28		22
May	-	-	8		15
June			11		11
July			23	11	23
August		22	12	1	11
September	9		27		14
October			44	1	14
November	-	-	8		1
December	-	8 -	22	9	11
Total	16	46	256	75	175

- = No sighting; EG= Evergreen; SEG=Semi evergreen;
MD = Moist deciduous; EP= Eucalyptus plantation.

Table 5. Food plants of elephants in the Peppara Wildlife Sanctuary

Plant species	Part of tree used	Remarks
Erythrina variegata	Lower bark	After pushing down
Pandanus sp.	Tender shoots	
Pennisetum polystachyon	Leaf blades	Extensive feeding
Careya arborea	Tender shoots	
Bamboo	Shoots	
Helicteres isora	Leaf, tender shoots bark	
Ochlandru ebracteata	Leaf, shoots	
Ochlandru travancorica	Shoots	Feed extensively
Artocarpus hirsutus	Fruits	Bark and tender shoots
Ficus glomeratas	Tender shoots	
Shuminianthus virgatus	Leaf and shoots	
Pinanga	Shoots	

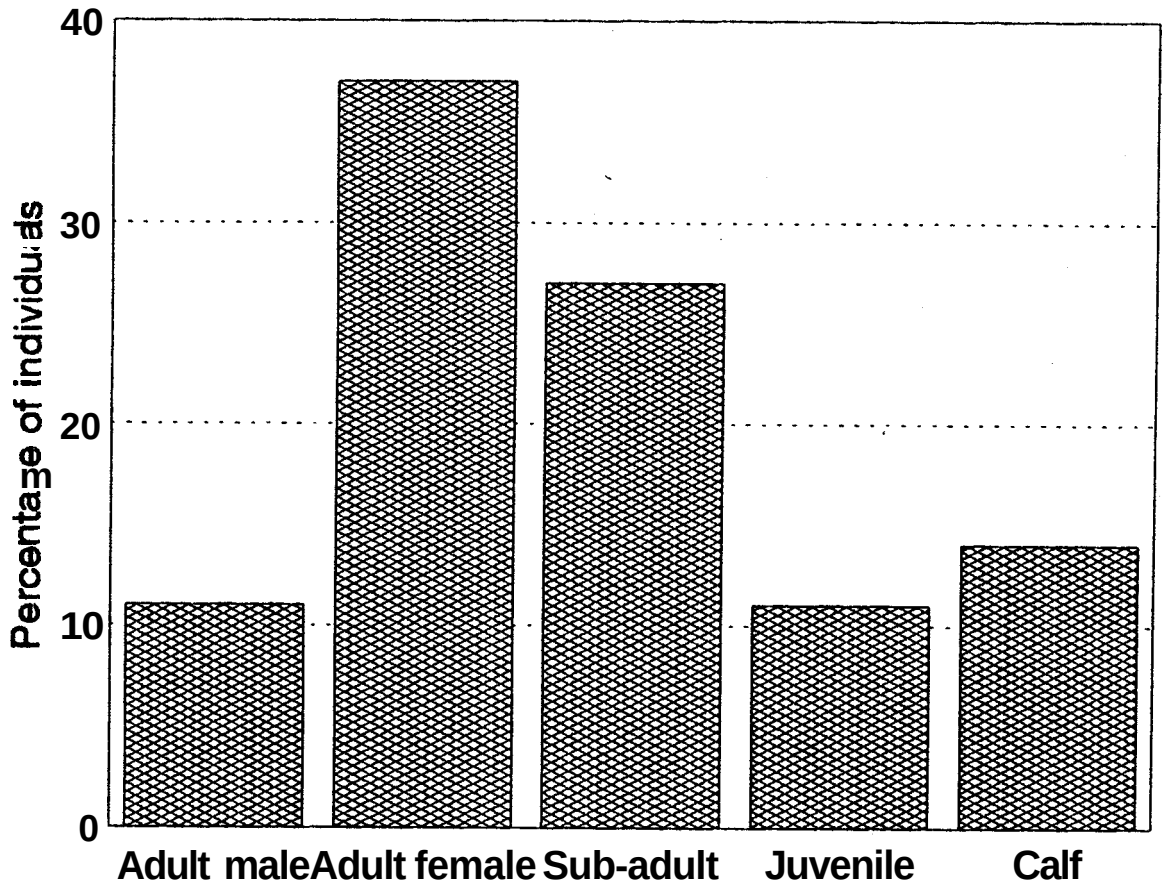

Fig. 2 Population structure of elephants sighted

Gaur or Indian bison

Altogether 29 gaur were sighted and male to female ratio was 1:12. Sightings were from moist deciduous forests followed by swampy areas and eucalyptus plantations (Table 6). Mean herd size was six individuals. Mukkothi vayal, Chembuthangi, Podiakala, Peppara Dam, Chembuthangi, Cherukad, Podium and Athirumalai were some of the places where they were found. It feed on grass species namely *Themeda triandra, Ochlandra travancorica, Pernnisetum polystachyon, Ophiopogon intermedius* and *Calamus brandisii.*

Table 6. Habitats where wild boar and gaur were sighted in Peppara Wildlife Sanctuary

Species	EG	SEG	MD	Swamp	EP
Wild boar	-		**33**		2
Gaur	6		50	5	***2***

EG = Evergreen; SEG = Semi evergreen; MD = Moist deciduous,
EP = Eucalyptus plantations.

Deer

Spotted deer was absent in the sanctuary. Sambar and barking deer were sighted in the sanctuary. Sambar was maximum in the moist deciduous forest. Other than moist deciduous forests, barking deer was sighted in Bonacord estate as loners. Mouse deer was seen only once near Chathankode in a moist deciduous forest. Barking deer feed on *Helectres isora* flowers. Sambar was feeding on *Ophiopogon intermedium, Calamus brandisii, Ruellia* sp., *Octotropis travancorica, Helicteres isora* flowers, *Pennisetum polystachyon* and *Synedrella* sp. Male to female ratio was 1:7 and mean group size was 6 individuals.

Wild boar

Direct sighting of the wild boar in day time was rare. It was recorded 10 times during the period of study. Most of the sightings were in and around the tribal settlements.

They were feeding on *Dioscorea* sp. roots, *Dillenia pentagyna* and *Mangifera indica* fruits.

Indian pangolin

It was never seen directly but tribals reported the presence of it from many sites. Scales were recorded from tribal settlements.

3. 2. Socio-economic status of tribals

Socio-economic status of tribals was collected using the questionnaire as described in the methods. Response from all the households were pooled and the results are given below.

3.2.1. Demography and habitation

A total of 726 tribal people live inside the sanctuary in 17 settlements. Among them 337 were males and 389 females showing a sex ratio of 6 : 7. When the population is classified into children, juveniles and adults, 54.03 % were in the adult category (above 20 years). The children (below 14 years) constitutes 35.3% of the total population whereas the juveniles (15-19 years) represent 10.7 % of the community. Hundred and sixty nine houses were found in the sanctuary and an average of 4 people live in each house. Nuclear family pattern was predominant in the area (Table 7). Among them two families are in scheduled caste list and all others (169 households) are tribes. All these people practice tribal religion, in which they worship nature based deities and ancestors. Signs of Hinduism were found in certain aspects of their ceremonies especially in those who are staying closer to the periphery of the sanctuary. Pothode settlement has been following Hindu worship methods due to the influence of a voluntary education unit functioning during the past ten years.

Table 7. Settlements, households and number of individuals in Peppara Wildlife Sanctuary.

Settlements	No. of households	No. of individuals
Chemmankala	6	27
Chemmankala II	3	12
Podiakala	24	99
Kuravampara	20	70
Podium	19	79
Kamalakam	22	100
Paranthode	07	25

Contd.

Settlements	No. of households	No. of individuals
Kombodinjal	07	29
Pattinipara	07	25
Pothode	09	40
Cherumangal	08	34
Mlavila	09	58
Erumbiyad	10	46
Amode	05	22
Kunnatheri	06	25
Thondankal	01	08
Pattampara	06	27
Total	169	726

Settlement

Fifty three houses are along the periphery of the sanctuary, whereas 116 are in the interior. Vegetation type around each settlement is given in the Table 8. Pattampara is the most interior settlement in the sanctuary and no outsiders were settled there. All the tribals were following the traditional way of life. Women were very shy and even some of the men. Main occupation of the people was gathering NWFP which were sold in the Kotoor tribal market. Necessary grocery was also purchased from the Kotoor. Women are efficient in cane basket weaving and cultivation was only marginal.

Out of the seventeen settlements, thirteen are located in the southern part of the sanctuary (Fig. 3). In each settlement, houses were distributed in a spread out manner with sufficient space for cultivation. If the settlements are viewed as geographical islands, only 12 settlements are known to exist in the sanctuary. As per the records, there should be 13 settlements in the sanctuary. But in the present study four more settlements were recorded near the existing ones. Kuravampara was found together with Podiakala. Cherumangal is a west extension of Pattinipara. Kombodinjal was found along with Podium. Panniyamkadu was another settlement identified along with Chemmankala. Kannankunnu (Thondankal) was an abandoned settlement but now which is again occupied by a family. Except Pothode,

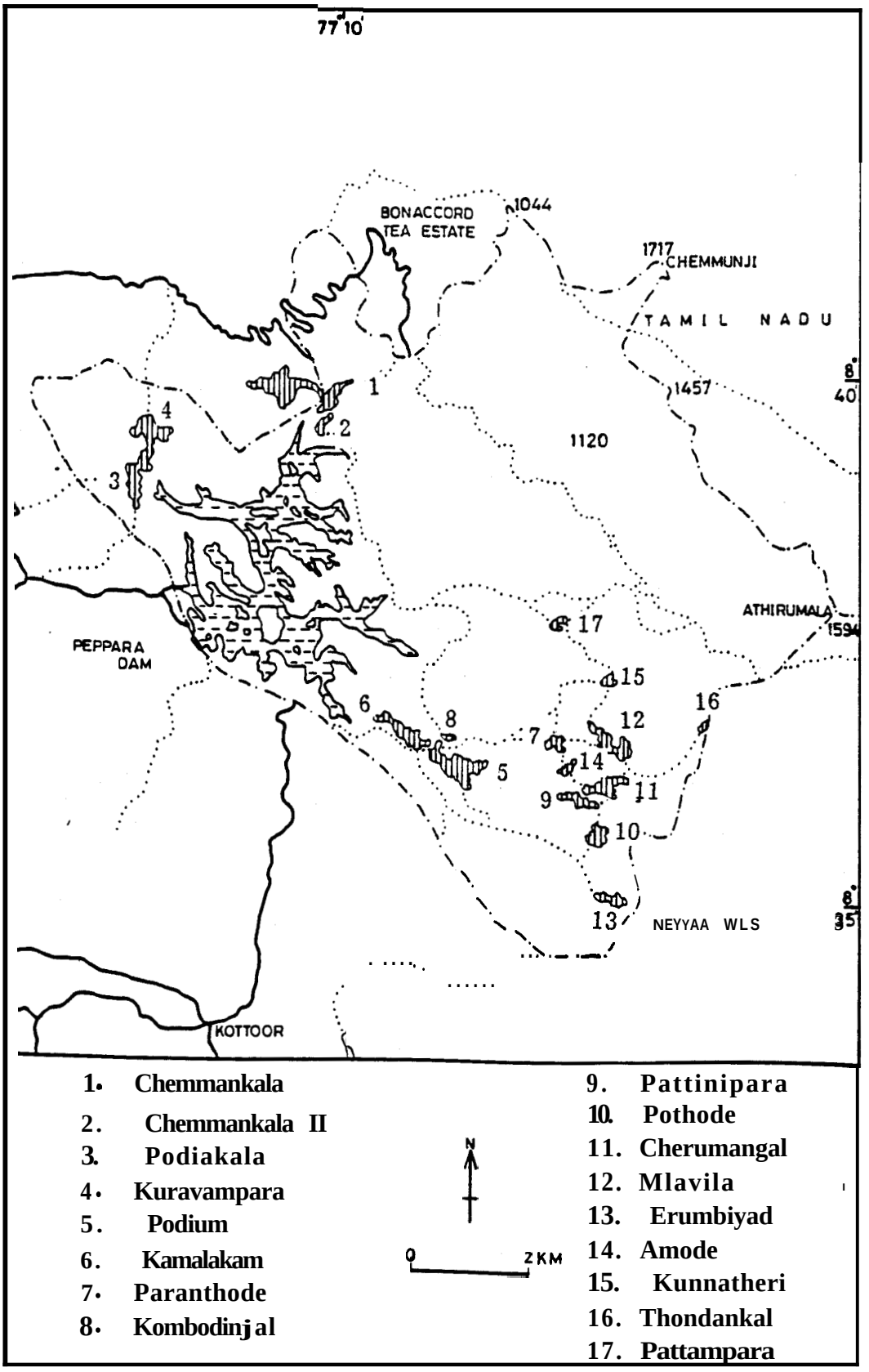

Fig. 3 Tribal settlements in Peppara Wildlife Sanctuary.

all the settlements were situated along the banks of major or minor streams. Podiakala, Kuravampara and Chemmankala are the three settlements situated along the north west boundary of the sanctuary. All the other settlements were located in the interiors of the sanctuary. Kannankunnu and Pattampara are the two remote settlements 18 km away from the black topped road.

Table 8. Type of vegetation near the settlements.

Type of vegetation	Number of houses
Moist deciduous forest	131
Semi evergreen forest	02
Evergreen forest	16
Riverine	06
Moist deciduous and riverine	07
Moist deciduous and others	01
Semievergreen riverine	01
Evergreen riverine	01
Others	04

3.2.2. Education

In the total population of 726 people 47% were literates. This include both the educated adults (29%) who discontinued their education at various levels and also the students (18%) who are still continuing the education. Children below five years (10.6%) were not included (Table 9)Around 43 % the tribals were illiterates who had never been to school. Eighty two individuals of the adult population (38.9%) were taught alphabets and non-formal education through the "Saksharatha" (State Literacy Program) conducted by voluntary organizations. Among the adult literates, majority stopped education at the High School level. This was mainly due to the long distance to the high school from the settlements. The settlement Pattinipara has the maximum illiterates (70%). Pothode and Karuvanpara have the high literacy rates among the adults and also among the women (Tables 10 and 11).

Table 9. Educational status of people in the Peppara Wildlife Sanctuary.

	Lower primary	Upper primary	Vocational H. secondary	High school	Illi-terates	Others
Male	62	36	0	23	183	33
Female	71	35	3	27	204	49
Total no. of people	133	71	03	50	387	82

Table 10. Literacy rates in Peppara Wildlife Sanctuary.

Name of settlements	Adults						Students				Below 5years	Total
	III	N.F.	LPS	UPS	HS	PDC	LPS	UPS	HS	PDC		
Thondakal	2 (25)	2 (25)	-	-	-	-	2 (25)	-	-	-	2 (25)	8
Pattampara	17 (63)	3 (11)	3 (11)	-	-	-	1 (4)	-	-	-	3 (11)	27
Kunnatheri	7 (28)	3 (12)	3 (12)	1 (4)	2 (8)	-	6 (24)	-	-	-	3 (12)	25
Mlavila	34 (59)	10 (17)	2 (3)	-	-	-	2 (3)	-	-		10 (18)	58
Paranthode	17 (68)	4 (16)	-	-	-	-	-	-	-	-	4 (16)	25
Erumbiyad	25 (54)	1 (2)	-	-	1 (2)	-	9 (20)	9 (20)	-	-	1 (2)	46
Amode	12 (55)	5 (23)	1 (4)	-	1 (4)	-	-	-	-	-	3 (14)	22
Pothode	11 (28)	5 (2)	5 (12)	1 (3)	-	-	10 (25)	3 (8)	-	-	5 (12)	40
Cherumangal	23 (70)	3 (6)	5 (15)	- (3)	1 (3)	-	1			(3)	1	34
Pattinipara	18 (72)	1 (4)	1 (4)				4 (16)	-			1 (4)	25

Name of settlements	Adults						Students				Below 5years	Total
	Ill.	N.F.	LPS	UPS	HS	PDC	LPS	UPS	HS	PDC		
Podium	29	1 0	7	3	5	-	12	5	-	-	8	79
	(37)	(13)	(9)	(4)	(6)		(15)	(6)			(10)	
Kombodinjal	12	6	-	1	-		4	1	-	-	5	29
	(41)	(21)		(3)			(14)	(3)			(18)	
Kamalakam	65	13	1	1	2	-	2	3	-		13	100
	(65)	(13)	(1)	(1)	(2)		(2)	(3)			(13)	
Kuravampara	10	9	10	9	8	-	6	6	1	1	10	70
	(14)	(13)	(14)	(13)	(11)		(9)	(9)	(1)	(1)	(5)	
Podiakala	16	4	14	14	18	1	1	3 9	5	-	5	99
	(17)	(4)	(14)	(14)	(18)	(1)	(13)	(9)	(5)		(5)	
Panniankadu	4	1	-				3	1	2	-	1	12
	(3)	(8)					(26)	(8)	(16)		(8)	
Chemmankala	8	2	3	2	2	1	3	2	2	-	2	27
	(31)	(7)	(11)	(7)	(7)	(5)	(11)	(7)	(7)		(7)	
Total	310	82	55	32	40	2	78	39	10	1	77	726

Ill - Illiterates, 'N.F. - Non formal, - = Nil, LPS-Lower Primary School,
UPS - Upper Primary School, HS- High School, PDC- Pre Degree, Percentage in brackets

Table 11. Female literacy of tribals in Peppara wildlife sanctuary

Name of settlements	Adults						Students				Below 5 years	Total women
	Ill.	N.F.	LPS	UPS	HS	PDC	LPS	UPS	HS	PDC		
Thondakal	1	1	-		-						1	3
	(33)	(33.3)									(33.3)	
Pattampara	7	3	3	-			1	-			3	17
	(41)	(18)	(18)				(5)				(18)	
Kunnatheri	5	2	2	-	1	-					2	13
	(39)	(15)	(15)		(8)		(8)				(5)	
Mlavila	19	6	1	-	-	-	-	-	-	-	6	32
	(59)	(19)	(3)								(19)	

Contd.....

Name of settlements	Adults						Students				Below 5 years	Total women
	III.	N.F.	LPS	UPS	HS	PDC	LPS	UPS	HS	PDC		
Paranthode	8 (67)	2 (17)	-	-	-	-	-	-	-	-	2 (18)	12
Erumbiyad	11 (48)	-	-	-	-	-	6 (26)	6 (26)	-	-		23
Amode	8 (53)	4 (27)	-	-	1 (7)	-	-	-	-	-	2 (13)	15
Pothode	3 (13)	5 (22)	3 (13)	-	-	-	6 (26)	1 (4)	-	-	5 (22)	23
Cherumangal	12 (60)	2 (10)	3 (15)	-	1 (5)	-	1 (5)	-	-	-	1 (5)	20
Pattinipara	9 (56)	1 (6)	1 (6)	-	-	-	4 (26)	-	-	-	1 (6)	16
Podium	14 (31)	7 (16)	6 (13)	1 (2)	3 (7)	-	5 (11)	3 (7)	-	-	6 (13)	45
Kombodinjal	5 (28)	5 (28)	-	-	-	-	3 (17)	1 (5)	-	-	4 (22)	18
Kamalakam	32 (69)	5 (11)	1 (2)	1 (2)	2 (5)	-	-	-	-	-	5 (11)	46
Kuravampara	5 (14)	5 (13)	4 (11)	6 (17)	3 (8)	-	2 (6)	3 (8)	1 (3)	1 (3)	6 (17)	36
Podiakala	11 (21)	1 (2)	6 (12)	7 (13)	7 (13)	1 (2)	7 (13)	5 (10)	5 (10)	-	2 (4)	52
Panniankadu	3 (42)	-	-	-	-	-	2 (29)	-	2 (29)	-	-	7
Chemmankala	5 (45)	-	1 (9)	-	1 (9)	1 (9)	2 (19)	1 (9)	-	-	-	11
Total	158	49	31	15	19	**2**	40	20	8	1	46	389

Ill - Illiterates, N.F. - Non formal, - = Nil, LPS-Lower Primary School,

UPS - Upper Primary School, HS- High School, PDC- Pre Degree,

Percentage in brackets

Marital status

Most of the adults (94.8%) were married (313) and living with their spouses and 394 were unmarried. Sixteen persons live either as widow or widower. There is no formal/legal divorce reported from any family. Separation of spouses and separation on mutual understanding were noticed in three families. There were three unwed mothers among the population. Among the 167 households three accommodated a non-tribal as their spouse.

3.2.3. Occupation

Kanikkar living in Peppara Wildlife Sanctuary have a range of employment pattern. Their occupations can be broadly classified into two major headings namely self and paid employment.

a) Self employment

This category can be again classified into two sections as main and subsidiary employment. Major self employment were cultivation of edible and cash crops in and around their homesteads and performing their own domestic works (Table 12). Primary occupation of many male members was cultivation (159), whereas, women were looking after the domestic chores and also supporting in the farming activities. Many years before women used to weave household articles using reed, which had good demand from outside. People from Nedumangad and Aryanad came and exchanged clothes, chilies and salt for these items. They used to do this activity with only known people. Now as the availability of reeds was low and due to the competition from the non-tribals these crafts became limited.

Table 12. Occupation of tribal people in Peppara Wildlife Sanctuary

	Culti-	Forest labour	Fire watchmen	Others	Students	Children
Number of people	218	09	02	283	132	76

School going students (132) and children below five years (76) were not considered for the main employment category. The students spend, considerable time either in the near by school or they were placed in tribal residential schools. There were 142 persons who did not have any primary occupation and they engaged themselves in assisting the farming and depended upon other subsidiary activities such as NWFP collection, fishing and hunting, forest labor, tree cutting , loading and basketry. NWFP collection was performed by males and females. However the distance traveled and the items collected often varied from men to women. These occupations were seasonal. Few persons worked as blacksmith, doctor cum priest (Plathi). However they did not obtain much benefits out of these jobs. Thirty one persons were unable to work due to old age or long-term diseases.

b) Paid employment

This can be again classified into main and subsidiary based on the duration of the employment. Permanent employment in Government Departments, long term labor works such as forest watchers, aya in noon meal scheme, voluntary teacher and boat driver were the main paid employment. There were six persons having permanent Government employment. Four of them were employed as watchers and sweepers in the Kerala Water Authority. Of the remaining, one has joined the CRPF and another in the health Department. Subsidiary employment were as wage labor in the Forest Department for the seasonal weeding, planting, nursery developing and fire line works. These works were available mostly during December to March on an average of 40 days per year. During the summer months, the male youth members avail the opportunity of employment as fire watchers. In recent years there was a high competition for these temporary posts. This was due to the increase in the number of unemployed youth (142 individuals) in the settlements. Because of this competition, the availability of employment of 90 days was reduced to 30 to 15 days per person.

Heavy Competition was observed from Podiakala and Podium settlements for the temporary job as fire watcher/guide. Tree cutting and loading was another subsidiary activity available to those who are living near the plantations of territorial Forest Divisions. The eucalyptus plantations of Paruthippally Range and the *Albezzia* plantation of the

KFDC provided such opportunities. However, there was heavy competition for the coup work with the non tribals, who were more skilled and experienced than the tribals.

Gathering

Wild fruits were collected by 160 families. Groups consisted of men, women and children (76), men and women (30) and women and children (19). Three families told that they did not collect. Tubers of various species were collected by 163 families and 5 families did not do any tuber collection. In addition to this they gathered green leafy vegetables (146) and mushrooms (162). Among the nuts and seeds *Entada scandans, Cycas circinalis and Artocarpus hirsuta* were the preferred items. In addition to this *Ochlandra* sp., *Caryota urens*, *Sarcostigma kleinii, Sterculia* sp. and *Erythrina indica* were also collected by the family groups. In the opinion of the majority (100) even if sufficient food grains are available they will do these collections. But few (69) did not view the collection of these items as necessary if sufficient food grains are available.

NWFP was collected in family groups (78) and also along with friends (26). This was mainly carried within a distance of 10-15 km (84) or 5-10 km (27). This items were sold in the market (42) and few items were for their own use (6). They denied taking any advance from the bu'yer (157) but a few admitted it (8). *Phyllanthus emblica,* honey, *Canarium strictum, Garcinia gummi gutta* were some of the items used by themselves. Majority of them felt no competition in collection of these items (150), whereas a few reported such competition (16), and most of them felt that the availability of NWFP is not declining.

Honey was one of the preferred item and 111 families reported that they were collecting it, whereas 58 families denied it. Four different types of honey was collected by them namely dammar honey or "Cheruthen" *(Trigona* sp. and *Mellipona* sp., "Thookuthen" *(Ayis dorsata)* ,"Thodu then" (honey from *Apis indica)* and "Kothen" (honey from *Apis* floria). Damer honey was collected by maximum (102 people) followed by honey from *Ayis indica* (90) and *Apis dorsata* (36).

Another item collected by them was medicinal plants (76 families) and 93 families reported no medicinal plant collection. Most of these were sold in the local herbal medicine shops (71) and the availability was only moderate (60), where as 9 families consider it as

bad. A few families know that the items gathered by them is the fodder of wild animals (13) while majority does not know anything about it. But none of them (168) stated that wild animals caused problems to the medicinal plant collection, except one family in Chemmankala.

Hunting

An effective method by which tribals controlled the crop damage was by hunting. Many of them have country guns. Along with this, they employ pellet bow also which was very effective for killing smaller mammals. Kani tribals were practicing hunting from time immemorial. They have a traditional prayer also before the start of the hunting, which is called 'Nayatu chattu'(Sasi, 1996). This is performed for removing problems in hunting. This is done before going to hunt animals, which came for crop damage. -- Manthras" meant for stopping the counter attack of animals are included in this "Chattu" (magical songs).

Hunting and fishing were the major activities of men and most of the families were non-vegetarians (167). They consumed meat once in a month (105) or once in a week (22) or fortnightly (18) or twice in a week (8). It was reported that meat mainly came from wild animals and domestic animals (150). Hunting was usually done in groups namely personal hunting, group hunting and community hunting. Among this, personal hunting was around the settlement individually. In group hunting, males of same age group will participate and in community hunting men of all age group participated. They hunted and consumed Nilgiri langur (Kurangu), lion-tailed macaque (Vava kurangu), bonnet macaque (Chokan), Malabar giant squirrel (Veluthi), flying squirrel (Pavan) and palm civet (Marapatti or Pazamunni). Preferred animals were mouse deer (105), barking deer (98), flying squirrel (53), Malabar giant squirrel (50), sambar (25), porcupine (26), wildboar (27) and blacknaped hare (12). Nilgiri marten (109), elephant (88), brown palm civet (65), tiger (107), snakes (3), wild dog (3), panther (8) and jackal (2) were not preferred. Reason for not consuming these species was on the presumption that meat of these animals contain poison. Occasionally Kanis go for bat hunting in selected caves. Members of youth belonging to the same age group and women also participated in it. Initially bats were stirred out from the caves. At this time others will stand guard outside the entrance of the cave with tree branches having thorns with which they will hook the bats.

Hunting groups were formed mostly with friends of same age (73), relatives of same age group (l0), relatives (15) or elders (3). They have specific territories for hunting (33) where as others did not (133). Availability of game was considered as poor (132), good (12) or moderate (19). Regarding the past availability of the game many considered it as good (136), moderate (4) and poor (1). Nobody was aware of the Wildlife Protection Act and its importance. Most of them collected bird eggs (149) and very few disliked it (20). Hill myna, hornbill, parakeet and owl were kept as pets by them (118). They restricted hunting within 10-14 km (32) and others may go varying between 3 km (5), 5-9 km (4), 15-19 km (4), 20-24 (6) and more than 25 km (3). A few people admitted that they were selling or presenting pet animals to the outsiders (27), but majority denied this practice (141). Hill myna and different species of parrots were either sold or presented to the outsiders.

Health

The health of tribals settled in the interior areas such as Kunnatheri, Pattampara and Cherumangal was poor. Health of people in the Cherumangal settlement was very bad. Children, men and women were using betel nut and smoking tobacco wrapped in cuva leaf. Many of them have oral diseases. Only two families in the sanctuary reported tuberculosis, while one member of a family has leprosy. Allopathy was the preferred method (83) followed by allopathy and tribal medicine (38), ayurveda and allopathy (16) and tribal medicine alone (16). They visited private nursing homes and Govt. hospitals almost equally. Most of them visited hospital once in a month (74), or twice in a month (11). Public health centre was 10 to 15 km away in the case of 93 families and 5 to 10 km in 52 cases.

No births were reported in 93 families, whereas one birth has occurred in 41 families and two births in 14 families during the last years. Childbirth was predominantly carried out in home (113) and only 21 went to the Govt. hospital and 11 to the parents home. Nine families reported child death during the last five years and 16 adult members also passed away during the past 5 years. Family planning was adopted by half of the families (82) and in most of the cases (77) females took the precaution with the modern methods (82). Immunisation of children was far from effective and only 55 families were immunised out of the 169. Many medical camps were held near the settlements during a year.

Festivals

All the settlements were particular in celebrating "Podithi" festival. Gods were named as "Kadanthamburan" (Male), Remadithamburan (Male) and Ponnaruvi (Female). Most of the Kani youth, below 20 years have two names. First name is based on a god, given by the Priest or head of the settlement. The second or modern name was often given by the school teachers to avoid the confusion of the same name.

3.2.6. Movement of the families

Movement of the families in the sanctuary was determined by many factors. Forty two families were moved to the present location because their old settlements were inundated by the Peppara reservoir. Availability of good, plain land prompted most of the settlements (72) in the current localities. Epidemic caused one family to move to the present place, whereas myths forced four families to the present positions. Marriage was another factor which caused the families movement and 25 families moved to the present location due to other factors.

During the past 10 years, people moved outside to the sanctuary in 34 cases. Kanis mainly lived in thatched huts made of reed and some of them have modern houses made of bricks and asbesto's (Table 13). Source of drinking water varied in settlements. Wells were used as source of drinking water in 15 households whereas springs (120) and streams (34) in others. They stayed in a place on an average of 3 to 5 years depending on the fertility of the soil and the availability of game or other forest products. Epidemics, myth, marriage, conflict, problems of wild animals were the other factors behind their migration. During the course of migration, they use to return to their abandoned settlements after giving sufficient time for regeneration of plants and soil fertility.

a) Migration within the forest

Individual members or occasionally a nuclear family moved from one settlement to another permanently. During the decade, 46 members were moved into a new household within their settlements. Of which, marriage accounted for 90 % of the individual migration. In recent times irrespective of sex, members move towards the economically viable household of the spouse. Apart from these, individual members and rarely families migrated to other settlements.

b) Outward migration (Emigration)

Fifty seven members from 34 households moved out of the settlements during the past decade. Twenty four men and 33 women contributed to the emigration for reasons such as job opportunity, marriage and educational facility. At present the thought of settling outside the forest was increasing among the youth members. Out of the 169 households, youth from 34 households were interested in staying outside of the forest.

Table 13. Housing of tribal settlements in Peppara Wildlife Sanctuary

Roof type	Reed hut		142	
	Grass hut		02	
	Asbestos		23 (Podiakala)	
	Reed hut + asbestos		02	
	Total		169	
Types of wall	Mud	07	Mud + brick	05
	Brick		Mud, brick, reed	02
			Bamboo	
	Reed	19	Mud, reed	14
	Bamboo	05	Mud, reed + bamboo	09
	Plastered	23	Reed+ bamboo	85
	Total	169		
No. of rooms	One room		21	
	Two rooms		43	
	Three rooms		55	
	Four rooms		37	
	Five rooms		13	
			169	

Govt. and NGO schemes

Most of the families were beneficiaries of either the Govt. or NGO schemes. Integrated Rural Development Programme (IRDP) and Western Ghats Tribal Development Project (WGTDP) were the main programmes operating in the area. These agencies mainly

worked in the field of medicinal plant cultivation, distribution of bee hives, goats, crop seeds and agricultural implements.

Savings and debts

Only few people could purchase any assets during the past one year (31). Main items purchased were gold (8), radio (4), watch (11) and most of them have some debts (82). The additional income was from the daily wage labour provided to the Forest Dept. (127). They rarely served non-tribals as daily wage laborer. Another source of income was from the sale of agriculture products to outsiders. Plantain was the main item (105), followed by tapioca (52), pepper (3), cashew (3) arecanuts, rubber, chilies and other tubers. Market for these items were Kotoor (91), Vithura and Meenagal (21), Vithura and Kotoor (12), then Maruthamalai and Nedumangad. Provisions were bought from these markets. They went for shopping once in a week (93) or twice in a week (62). Markets were situated over 9 km in most of the cases (106), or 6-9 km in 46 cases. Household decisions were made by the head of the family and in the matters concerned with the settlement the head of the settlement (Moopan). Smoking was prevalent in 119 families among 139 people, betel chewing in 142 families and 274 people, alcohol, 99 families and 109 people and tea is relished by most of them (163 families).

3.3. Dependence of people on the sanctuary

Kani tribals inhabiting the sanctuary and the local people outside the sanctuary depend on the forests for many of their daily needs. They collected thatching grass, fire wood. bamboo poles, reeds and many other NWFP from the sanctuary.

3.3.1. Local people

Workers of Bonacord estate, people of Vithura, Meenagal, Adivarambu, Kotoor, Nedumangad, Kottakakam and Aryanad depended on the forests of the sanctuary for many of their requirements. Many items were collected by the local people from the sanctuary (Table 14). Thatching grass was the main item followed by reed and fire wood (Fig. 4). It was estimated that 28 species of trees and shrubs were commonly used as fire wood. Bonacord estate bordering with the sanctuary, encouraged many illegal activities in the sanctuary. Laborers from the estate collected fire wood from the forest. Smuggling of timber was also reported occasionally through the estate.

Table 14. NWFP collected by local people from the Peppara Wildlife Sanctuary

Common name	Scientific name	Use
Firewood	Various species (28)	Cooking
Thatching grass	*Thimida triandra*	Roofing, hut making
Bamboo poles	*Bamboosa arundinaceae*	House construction
Reed	*Ochlantdra ebracteata*	House construction Household articles
Gooseberry	*Emblica officinalis*	As food
Cane	*Calamus* sp.	Household items and furniture
Black Dammar	*Canarium strictum*	Incense
Vayana bark	*Cinnamomum* sp.	Incense
Gamboge	*Garcinnia* sp.	Spices
Wild pepper	*Pepper* sp.	Spices
Cardamom	*Elettaria cardamomum*	Spices
Cuva leaf	*Shumiannianthes virgatus*	Packing material
Pandanus leaf	*Pandanus* sp.	Mat making

Another unauthorised entry into the sanctuary was for mining the precious stones. Miners camped inside the sanctuary and dug for diamonds. Abandoned pits could be seen on the way from Bonacord picket station to Chemmankala. Apart from the mining they occasionally indulged in hunting also.

3.3.2. Human pressure on the forests

Trek paths facilitates various types of human activities in a forest. Number of trek paths through which people approached the forest area can be taken as an indication of human activity. Nine trek paths leading to the forest were identified in the sanctuary. People exerted various types of pressure on the forest namely cutting of trees, fire wood collection and NWFP collection. Maximum disturbance was recorded in the eucalyptus plantations adjacent to the sanctuary. This was mainly due to the grass collection. Collection of poles was maximum in the evergreen forest (Table 15).

In the case of trees no relationship was obtained. But in the case of tree poles, it was seen that poles were mainly cut from the areas close to the human habitations. As the distance from the habitations increased, the number of poles cut were reduced. Collection of bamboo, cane and grass etc. also showed a similar trend. As the distance from the habitations increased the intensity of collection also came down (Fig. 5 and 6).

Presence of larger mammals was higher near the human habitations. This relationship was found in the case of elephant, wild boar, sambar, gaur and sloth bear. This may be due to the fact that as most of the settlements were situated in the moist-deciduous forests where, large mammal density will be high. Settlements near the tea estate were the only one in the vicinity of evergreen forest (Fig. 7).

Local people depended heavily on the forests for thatching grass and reeds. Collection of these two items in huge quantities will affect the large herbivores like elephant, gaur and deer because these items form part of their food. Further studies will be needed to quantify sustainable utilization of these items with out adversely affecting the wild herbivore populations.

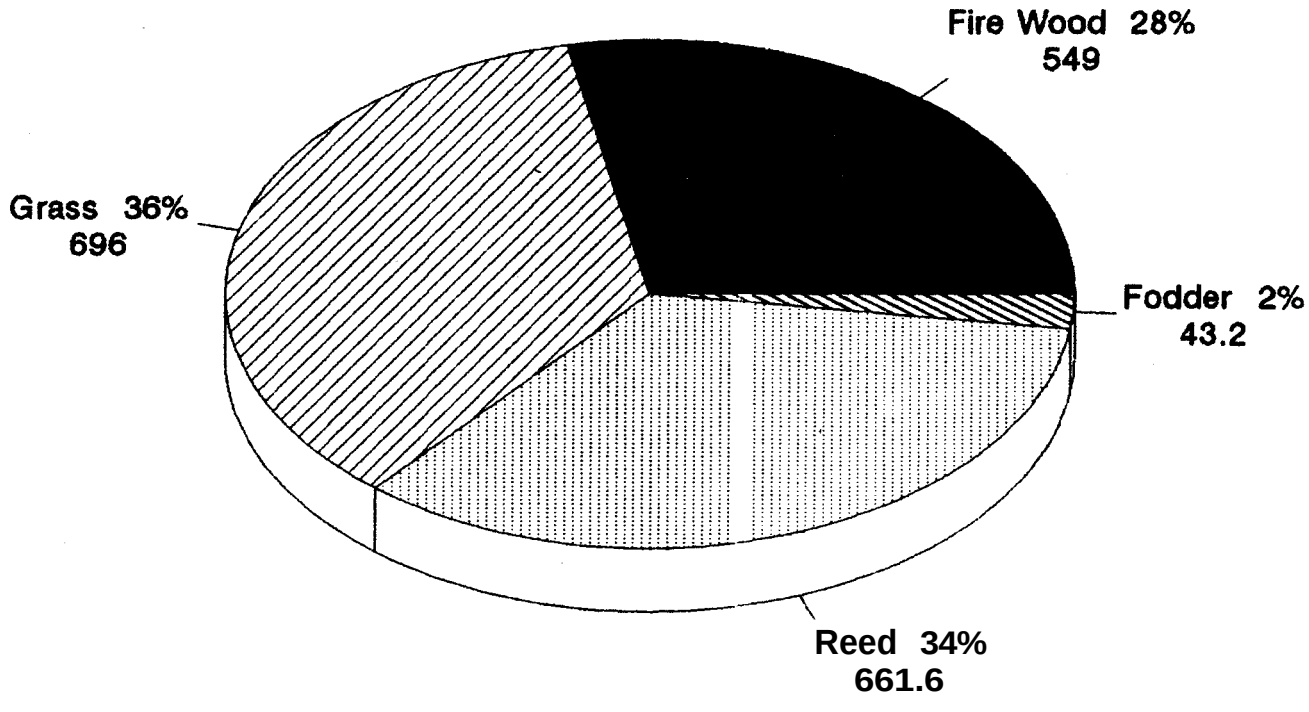

Fig. 4 Weight (Kg) of materials collected by the non tribals from the Peppara Wildlife Sanctuary.

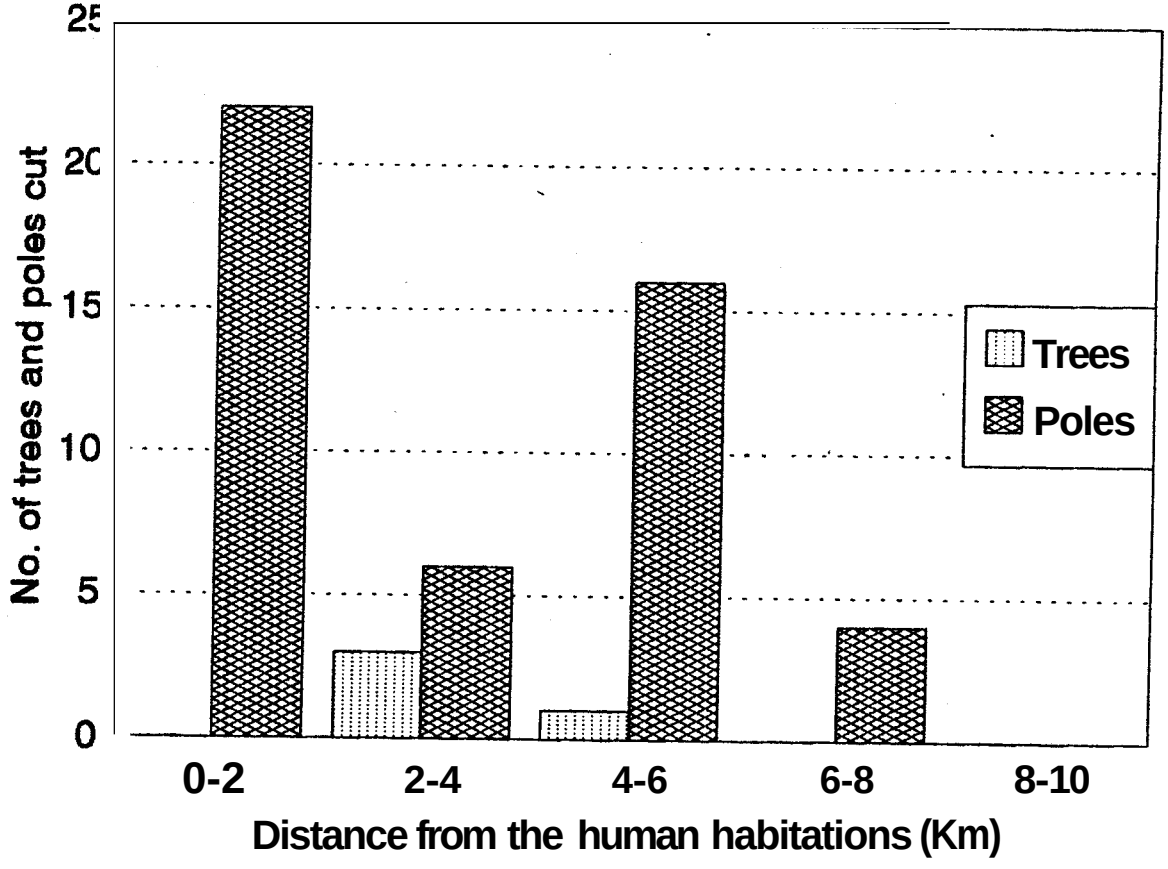

Fig. 5. Influence of distance on the removal of trees in Peppara Wildlife Sanctuary

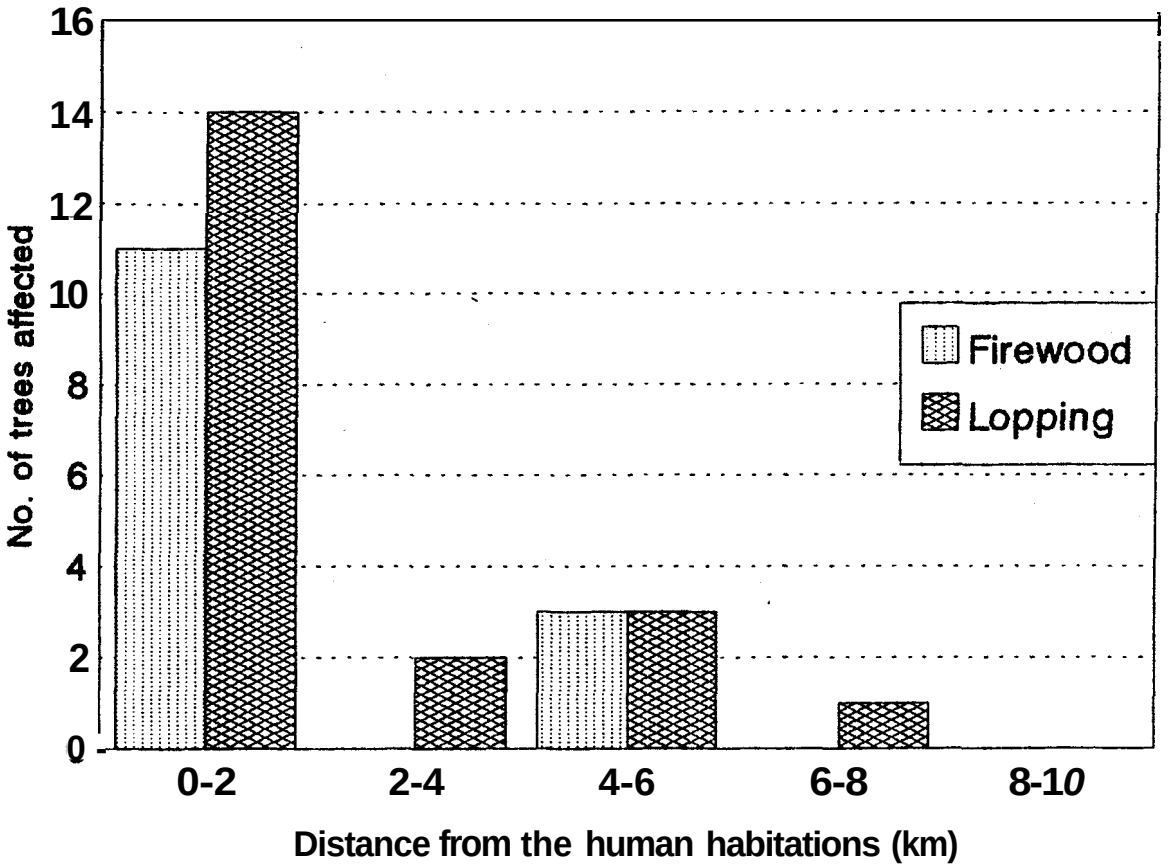

Fig. 6. Influence of distance on fire wood collection and lopping in Peppara Wildlife Sanctuary (N= **276).**

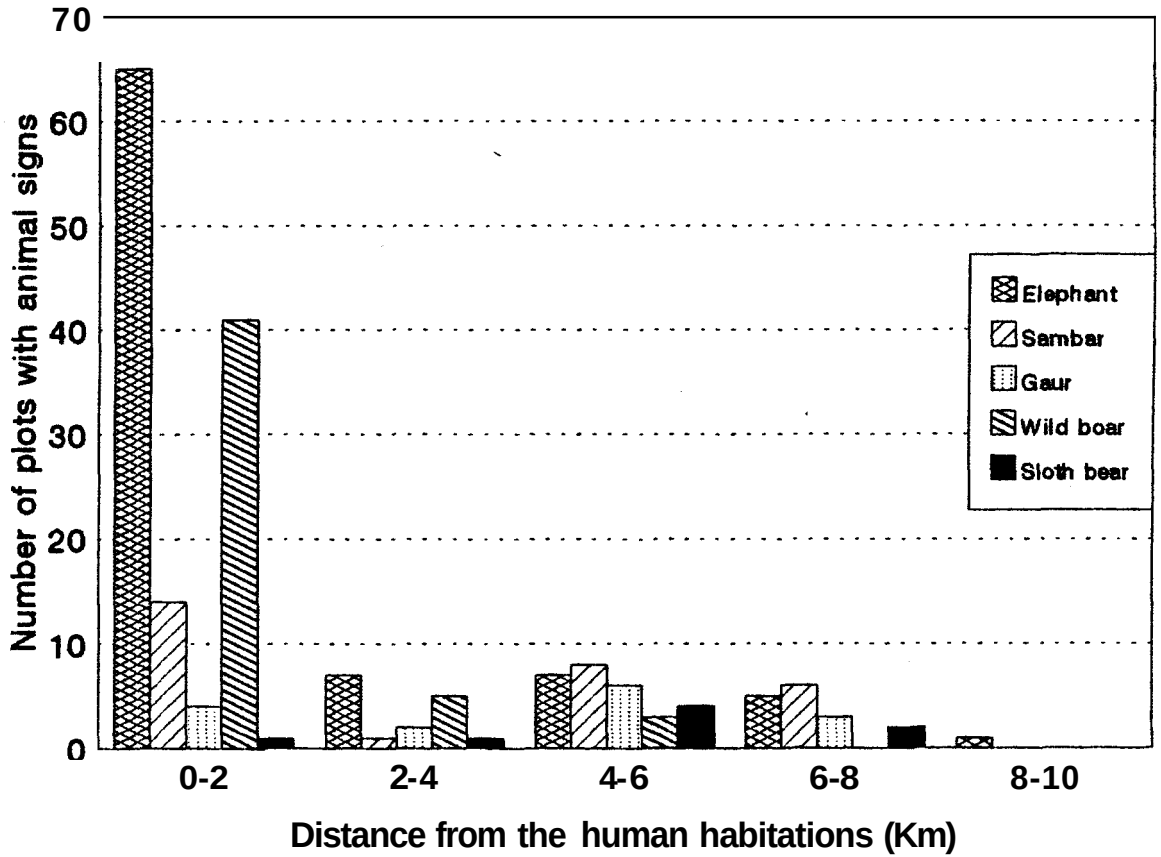

Fig.7. Influence of human habitations on animals in Peppara Wildlife Sanctuary.

Table 15. Human activities recorded from the different vegetation types.

Vegetation	Cutting		Firewood collection	Lopping	Bamboo, cane & grass collection	Un-disturbed plots	Total plots
	Trees	Poles					
Moist deciduous	4 (3.3)	17 (13.9)	12 (9.84)	10 (8.2)	2 (1.64)	77 (63.1)	122
Semi evergreen	0	7 (25.9)	0	1 (3.7)	2 (7.4)	17 (62.96)	27
Evergreen	0	16 (45.7)	1 (2.86).	3 (8.57)	2 (5.7 1)	13 (37.1)	35
Hill top evergreen	0	2 (10.53)	0	0	0	17 (89.47)	19
Eucalyptus plantation	0	9 (12.3)	0	4 (5.48)	18 (24.66)	42 (57.5)	73

(% in brackets)

3.3.3. Tribals

Kani people collect various NWFP from the forest. They also collect their food, medicine and materials for shelter from the forest. These materials were sold in the Kotoor tribal market, which is a unique experiment initiated and supervised by the personnel from the Kerala Forest Department.

Kotoor tribal market

Kotoor tribal market is situated 8 km South of Peppara Dam. History reveals that the tribals used to bring the NWFP and exchange it with non-tribals for salt, tobacco or clothes. Local vendors and villagers were participating in this early method of barter

system. Later, due to some conflict between the vendors and tribals, the market was closed for a period. It started functioning again with the initiation of the Forest Department after adopting a new system of open auction. In this method, the interaction of non-tribals and intermediaries with tribals is very low. All the NWFP and agricultural produces were brought to the market exclusively by the Kani tribals. Only the vendors locally called as "Kachodakkar" came from outside. Occasionally, few nearby villagers also attended the market for particular items such as 'lamy' (Filter pan made of cane) or pure honey, when these items were not available elsewhere.

The market functioned twice in a week, on Wednesdays and Saturdays. It is held near the Kotoor Forest Station and two forest staff supervised the market transactions (Christopher and Jayson, 1996). The auctioneer was also a tribal. Due to the presence of the forest staff, disputes and exploitation of tribals were controlled. Tribals brought their products to this market from a distance of 5 to 15 km. Both men and women took part in this process. Auction was on the basis of first come first served and the amount was disbursed immediately. This type of open-auction system of sale enable the producer-seller to fetch fair prices for his produce eliminating malpractices . Total atnount obtained by tribals in a month from the market varied between Rs. 31,000 to Rs.40,000. This included the income from the agricultural products also.

Eight items were common in the auction (Table 16). Flowers of Bryophyllum, wild ginger, fruits of *Elaecarpus glendulosum,* Gamboge, wild turmeric and "Cuva leaves" *(Shumannianthes* sp.) were brought only rarely in small quantities. This was due to the limited and seasonal availability of these products. Local indigenous medical practitioners also collected these items directly from the settlements. In the case of honey, two varieties were collected and the cost also differed. The 'Cheruthen'(honey from *Trigona* sp. and *Mellipona* sp.) cost around Rs.100 for 750 ml where as the common variety cost only Rs.50. The 'Cheruthen' has high medicinal value and there was always high offer and demand for it, in the market.

Table 16. NWFP items marketed in the Kotoor Tribal Market

	Local name	Common name	Species name	Part used
1.	Chural kutta	Cane basket	*Calamus* sp.	Stem
	Chural kooda	"	"	'
	Lamy	Cane filter pan	"	"
2.	Eera kutta	Reed basket	*Ochlandra* sp.	
	Eera kooda	"	"	"
3.	Kadukka	Myrobalan	*Terminalia chebula*	Fruits
4.	Kadukka poovu	Leaf galls	*Terminalia* sp.	Leaf
5.	Panam poovu		*Myrestica dactyloides*	Aril of fruits
6.	Thakali poovu	Bryophyllum flower	*Kalanchoe lascineata*	Flower
7.	Thooku thenu	Honey	-	
	Cheru thenu	"		
8.	Kunthirikam	Black Damer	*Canarium strictum*	Bark resin
9.	Nellika	Gooseberry	*Emblica officinalis*	Fruits
10.	Chittaratha (Kolinji)	Wild ginger	*Alpinia galanga*	Rhizome
11.	Manja valli	-	*Cocciniumfenestratum*	-
12.	Karakka	-	*Elaecarpus glandulosum*	Fruits
13.	Cuva ela	Cuva leaf	*Shumannianthes virgatus*	Leaf
14.	Kodampuli	Gamboge	*Garcinnia cambogia*	Fruits
15.	Kasthoori manjal	Wild turmeric	*Curcuma aromatica*	Rhizome

Cuva leaves were collected by tribal women and children. Most of the leaves were sold directly to the nearby hotels. These leaves were brought in bundles and a bundle weighed about 20 to 30 kg. A large bundle composed of 15 to 30kg which was made up of 15 to 20 smaller ones and in each small bundle 8 to 120 leaves were included. These

smaller bunches weighed around 1 kg. Thus an average 20 to 30 kg, head loads of cuva leaves were sold at a rate between Rs.25 to Rs.30. Due to the demand from the local tea shops and hotels, the amount of cuva leaves brought to the auction market was less.

A total of 4330 observations were taken from the market and among them male members were 2946 and females 1384. Total amount of auction in each month comprising both NWFP and agricultural products is given in Table 17.

Table 17. Total, month wise auction amount and average recorded from the Kotoor tribal market for two years.

Months	Total amount (1994)	Total amount (1995)	Mean sale/ market day
January	35*	13,045	769.41
February	3,164*	18,169	1333.31
March	18,008	8,450	1469.89
April	22,413	22,424	2490.94
May	16,094	-	2011.75
June	15,894	11,837	1631.24
July	22,199	10.110	1794.95
August	22,093	—	2454.78
September	31,135		3891.88
October	4,593	—	510.34
November	27,012	—	3001.34
December	9,306		949.10

* Not complete, - No data collected

In the case of NWFP, cane products attracted higher amounts followed by gooseberry, honey and gall-nuts (Table 18). Availability of Gal nuts was only seasonal. Raw cane and reeds were not usually brought to market. Tribals collected these items from the forest

and made baskets out of it and only baskets were sold in the market. A cane basket fetched Rs.20 to Rs.40 and for a reed basket it varied between Rs.4 to Rs.10.

Table 18. Total auction amount of NWFP items brought to the Kotoor tribal market (2 years).

NWFP items	Market price (Rs.)
Cane products	59720
Gooseberry	33015
Honey	12078
Gall-nut	10041
Leaf gall	9832
Reed baskets	4529
Myrestica	4137
Gamboj	2733
Wild banana	1849
Wild mango	1849
Dammar,	1697
Cinnamom flowers	1348
Bryophyllum flowers	1153
Elaecarpus fruit	555
Roots	35
Fruits of *Hydnocarpus*	28
Cardamom	18
Total	1,44,617

Agricultural products

Agricultural products were also brought to the market in equal quantities like the NWFP. Major products were banana, betel nuts, pepper, pineapple, tapioca, lemon, jack fruit, chilly and yam. These crops were cultivated throughout the year and tribals received

better remuneration for these items. Flow of different products marketed and collected by the tribals and local people from the Peppara Wildlife Sanctuary is shown schematically in the Fig. 8. The diagram illustrates that major collections of NWFP from the sanctuary were carried out by tribal people. Total auction amount of agricultural products alone is given in Table 19.

Table 19. Total auction amount of agricultural products brought to the Kotoor tribal market (2 years).

Agricultural products	Market price (Rs.)
Banana	59086
Areca nut	27542
Goat	19688
Cashew	15863
Turmeric	2149
Ginger	1473
Domestic fowl	1322
Pepper	1248
Other vegetables	1200
Tapioca	1094
Jack	878
Lemon	741
Chilly	299
Colocassia	270
Pineapple	133
Curry leaf	121
Cocoa	76
Tubers and yam	67
Total	1,33,250

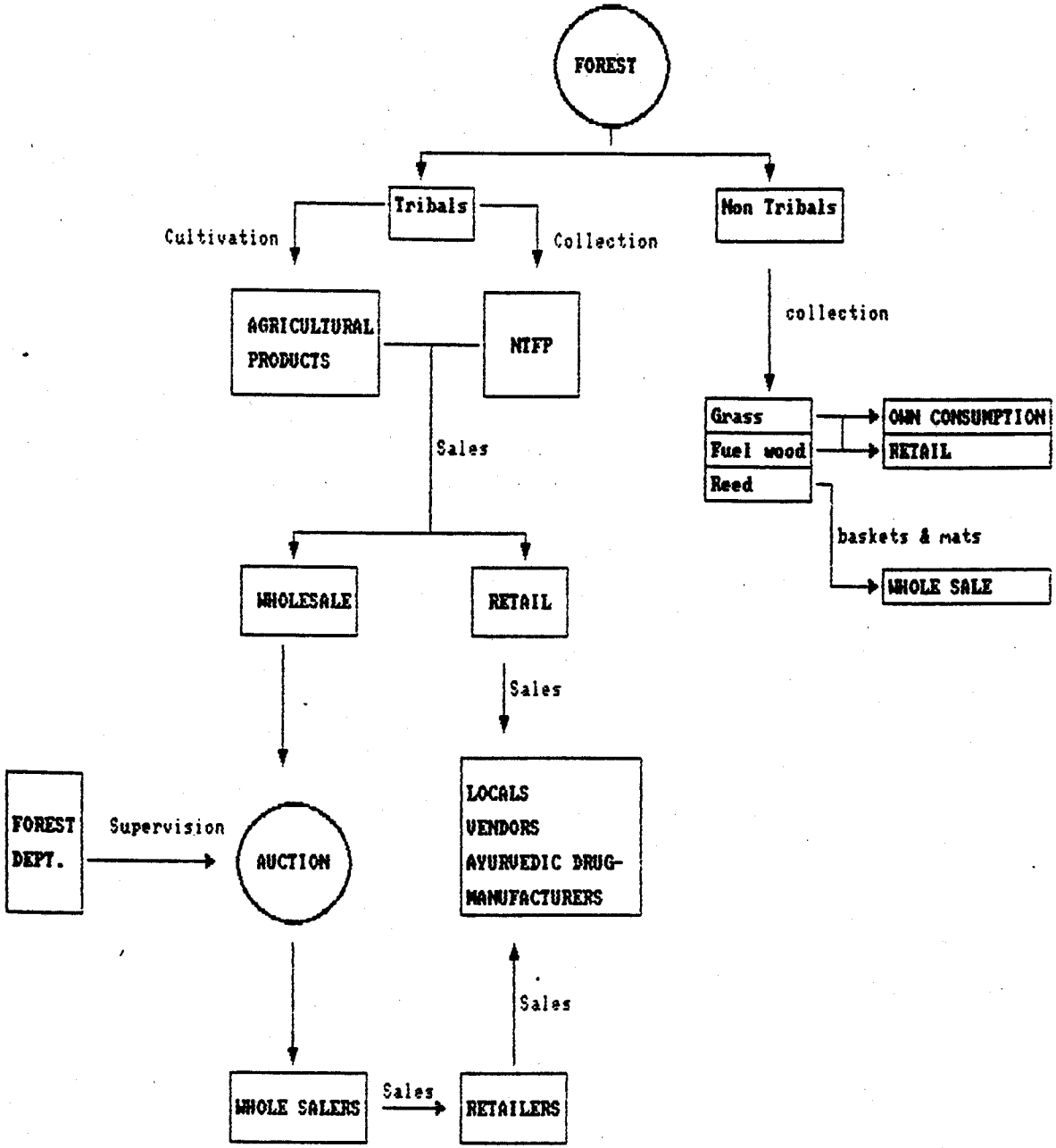

Fig. 8 Flow of products from Peppara Wildlife Sanctuary.

Tribal co-operative societies

The nearest tribal co-operative society is Gnaruneeli Tribal Service Co-operative Society Ltd. It has extension centres at Kallar, Kotoor and Amboori. All these centres were situated around the sanctuary area. Out of which only the Kallar centre received products from the tribals. All the others were stopped operation due to the non-availability of NWFP because of their nearness to the Kotoor market. From the discussion with the tribals and the society staff, it was obvious that the tribals obtained fair prices from the auction market when compared with the rates offered by the Society.

3.4. CROP DAMAGE

3.4.1. Cultivation

All the families own land and most of them acquired it initially by clearing the forest (91). Some of them got it as dowry (24) and others as compensation from the Govt. when they were evicted from the original settlements. Tapioca, dry land paddy, cereals like Italian millet, common millet, Indian corn and plantain were the main crops. But at present most of them have abandoned the traditional cultivation and were practicing a mixed cultivation or in a transitional stage (153). Only four families practiced the traditional cultivation and others preferred modern cultivation (149). Due to various reasons most of them did not utilise the whole area for cultivation (108). Main problems were the destruction of crop by wild animals and the absence of working people. Only few families (10) used pesticides, fertilizers or seeds from the outside.

Cultivation pattern

In the yester years Kanis practised shifting cultivation. But due to various reasons, they have abandoned this form of agriculture. At present they cultivate in lands adjacent to their settlements only. In habitations which are along the periphery of the sanctuary, modern methods of agriculture were practised. Perennial crops were more extensively cultivated than the seasonal crops. Paddy was cultivated in the monsoon season. This was mainly done in Podiakala, Chemmankala, Mlavila, Kamalakam and Paranthode. Slash burning was carried out in April -May and sowing in June - July.

One peculiarity noticed in the cultivation of cassava was that, two methods were adopted in its production. If the crop was meant for their own consumption, all the plants were not harvested simultaneously. In this method whenever a culm was removed, the stumps were again planted in the same place. Due to this method, they were able to harvest crop at any day of the year. Intermittent rain obtained in all the months, supported this mode of cultivation. When wildboar attacked such an area, the crop loss was minimum.

Crop Damage

All the families reported crop damage problems due to wildlife (Table 20).

Table 20. Mode of crop damage by different animals in Peppara Wildlife Sanctuary.

Species of animal	Crops damaged	Mode of damage
Wild boar	Tapioca, tubers, paddy	Digging
Elephant	Coconut, tubers, paddy	Trampling
Porcupine	Tapioca	Browsing
Blacknaped hare	Tubers, paddy	Cutting & feeding
Bonnet macaques	Tapioca	Pulling out
Mouse deer	Tubers, tapioca	Browsing
Barking deer	Tapioca, tubers	Browsing
Palm civet	Pineapple	Feeding
Bandicoot rat	Tubers	Digging

Most of the people were aware of crop damage compensation, but rarely applied for it. Only six families so far applied for compensation. Majority of the families have some livestock and poultry was main (116) followed by goat (73), cow (6) and buffalo (1). Hundred and thirty people reported that their livestock were attacked by wild animals. Maximum of the attacks were on fowl followed by goat and dog.

Table 21. Crops damaged by wild animals in Peppara Wildlife Sanctuary

Common name	Scientific name
Cassava	*Manihot esculentu*
Paddy	*Oryza sativa*
Plantains	*Musa sp.*
Rubber	*Hevea brasciliensis*
Pineapple	*Ananas comosus*
Coconut	*Cocos nucifera*

Contd.. ...

Common name	Scientific name
Taro	*Colocasia esculenta*
Elephant foot yam	*Anorphophallus companulatus*
Sweet potato	*Ipomea batatus*
Arrow root	*Maranta arundinaceae*
Ginger	*Zingiber officinale*
Cocoa	*Theobroma cacao*
Jack tree	*Artocarpus heterophyllus*
Mango tree	*Mangifera indica*
Lesser yam	*Dioscorea esculenta*
Black pepper	*Piper nigrum*
Areca nut	*Areca catechu*
Medicinal plants	many species

But, when the yield was meant for market, simultaneous harvesting and planting was practised. In this mode of cultivation, if an attack of wild boar occurs at the time of maturity, the economic loss was heavy. In the past, Kanis cultivated crops for their consumption only, but now they cultivate crops for sale as well.

3.4.2. Animals involved in crop damage

Crop depredation has been recorded in all the 17 tribal settlements. Seven species of animals were damaging 18 crops. Main crops destroyed were tapioca, plantain and coconut (Table 21). Maximum occurrence of crop damage was recorded in the month of June followed by May (Table 22).

Table 22. Incidence of crop damage during different months.

Months	Tapioca	Plan-tains	Coconut	Betal nut	Pine-apple	Rubber	Paddy	Tuber crops	Others	Total
Jan.	16	1	1	1	2	3	-	5	1	30
Feb.	10	1	-		2		-	3		16
MU.	13	2	-	-	-	-	-	-	1	16
Apr.	4	1	1	-	-	-	-	-		6
May	31	1	1		3	-	-	-		36
Jun.	19	6	6	1	2	3	2	1	1	41
Jul.	27	-	-	2			3	3		35
Aug.	25	-	1	1	-	-		-	-	27
Sep.	8		-	-	-	-	-	1	1	10
Oct.	23	-	-	-	1	-	-	1	-	25
Nov.	23		-		1	-	-	1	-	25
Dec.	6	1	-	-	-	-	-	-	-	7
Total	205	13	10	5	11	6	5	15	4	

- = No raids recorded

Similarly wild boar attacked crops more, than any other animals. This was followed by elephants and hare(Table 23).

Nine settlements experienced highest crop damage and in other settlements it was negligible. Chemmankala, Podiakala, Chantankode, Podium, Ottakudi, Cherumangal, Valiakala and Kunnatheri were the settlements, which have maximum crop damage. And among them, Chemmankala recorded the highest number of attacks by wild animals. Major animals engaged in crop damage were wild boar and elephant. Apart from these, the Indian porcupine, barking deer, sambar, blacknaped hare and bonnet macaque also destroyed crops. The settlements, Erumpiad, Pothode, Amode, Cherumangal, Mlavila, Pattinipara and Paranthode is in a cluster and the agriculture was also not much advanced. Due to these reasons, crop damage was less (Table 24).

Table 23. Number of raids recorded for each animal from the Peppara Wildlife Sanctuary.

Months	Animals					Total
	Wildboar	Elephant	Hare	Deer	Others	
Jan.	11	8	4	6		29
Feb.	16		-	-	-	16
Mar.	15	-				15
Apr.	2	4		-	-	6
May	30	4	1		1	36
Jun.	14	22	1	-	4	41
Jul.	31	3	-	3		37
Aug.	21	3	-	-	-	24
Sep.	8	2	-	-	-	10
Oct.	3	8	3	-	-	14
Nov.	17	3	3	-	-	23
Dec.	4	3	-	-	-	7
Total	172	60	12	9	5	

- = No raids recorded.

Table 24. Incidence of crop raiding recorded from the Peppara Wildlife Sanctuary during the period of study.

Name of settlement	No. of raids	Animals involved	Time
Chemmankala	87	El, WB, P BD, BNH	Midnight, morning, evening, day time

Contd..

Name of settlement	No. of raids	Animals involved	Time
Podiakala	47	El, WB, BNH	night, midnight evening morning
Chathankode	27	El, WB	night late evening early morning
Podium	15	El, WB BD	Night evening
Ottakudi	19	El, WB	night
Kochukilikodu	5	El, WB	night
Cherumangal,	4	El, WB	night
	4	El, WB	night
Kunnatheri	1	El	night

El - Elephant; WB - Wild boar; BD - Barking deer
P - Porcupine; BNH - Blacknaped hare

The quantum of money claimed by the tribals was higher than the actual loss calculated from the field observations (Table 25).

Table 25. Economic loss claimed by the tribals in the different settlements for crop damage

No.	Name of settlement	Economic loss claimed (Rs.)	Economic loss assessed (Rs.)
1	Amode	11,000	-
2	Chathankode		9,000
3	Chemmankala	9,050	6,563
4	Chemmankala II	6,300	
5	Cherumangal	23,670	1,300
6	Erumbiyad	18,865	-
7	Kamalakam	45,540	-
8	Kochukilikode		1,800
9	Kombodinjal	12,850	-
10	Kunnatheri	22,325	700
11	Kuravampara	38,675	9,000
12	Mlavila	25,575	-
13	Ottakudi	-	6,000
14	Paranthode	11,410	
15	Pattampara	19,255	
16	Pattinipara	11,650	
17	Podiakala	44,450	8,332
18	Podium	39,765	3,400
19	Pothode	16,325	
20	Thondankal	1,640	
21	Valiakala		1,400

- = No data

3.4.3. Mode of damage

The animals involved in crop damage were mainly lone males, in the case of elephants and most of the raids were at night (Table 24). It was observed that more quantity of

crop was damaged than, what was consumed by the animals. In the case of tapioca, a preference was shown for tender shoots and tubers. Wild boar damaged ginger while searching for the earth worms.

Coconut was mainly damaged by elephant and was confined to the trees below 20 years (Plate 1). Trees below 10 years were pushed down and the central rachis and shoots were consumed. Plantains were also attacked by elephants and discarding the leaves, the central portion of the stem was consumed. Paddy was lost due to wild boar, elephant, blossomheaded parakeet and jungle fowl. Matured inflorescence was consumed by the wildboar. More waste was due to trampling and rolling by the animals in the field. Elephant also destroyed paddy by trampling. Matured paddy was cut and removed by blossomheaded parakeet and jungle fow1.

Pineapple was destroyed by elephant, wild boar, palm civet and palm squirrels. Elephant and wild boar preferred fruits and central rachis of the pineapple, where as palm civet and squirrel consumed only the fruits. Cassava was mainly destroyed by wildboar but bonnet macaque, porcupine, mouse deer, barking deer, sambar, blacknaped hare and bandicoot rat also damaged it. Wildboar dug up the tender tubers and discarded the mature ones. Bonnet macaques unearthed the tubers with their fingers and consumed it. Porcupine also dug up the tubers and in some instances took away the whole bunch. Mouse deer, barking deer and sambar browsed the leaves and bark. Blacknaped hare fed on the young sprouts.

Elephants trampled and uprooted rubber samplings and they fed on the basal portion of the plants. Black pepper was destroyed by spiny dormouse and palm squirrel by feeding on the fruits and inflorescence. Coco fruits were eaten by palm civet, squirrels and other rodents. Lesser yam was destroyed by rodents by feeding on the tubers. Wildboar and porcupine were consuming arrow root and sweet potato was damaged by barking deer, mouse deer and blacknaped hare by browsing the leaves. Cashew trees and betel nut trees were not damaged by any of the animals. No distinct pattern was observed in crop raids. While damage by wildboar was recorded through out the year, the attack from elephants were related to the species of crops cultivated. Whenever palatable crops like, plantain, coconut and arecanut were planted, elephants attacked them.

3.4.4. Phenology

Phenology of trees was recorded as described in the chapter on methods. No specific pattern in flowering and fruiting was revealed from these studies. Phenology of selected species of trees at Chemmankala and Pattenkulachippara is given in Fig. 9. 'An attempt was made to correlate the incidence of crop damage with the phenology of trees in the forest, but no relationship emerged from the analysis.

3.4.5. Preventive measures for crop damage

3.4.5.1. Indigenous methods

Indigenous and modern methods were employed by the tribals and local people for the protection of crop. Thirteen indigenous preventive measures were identified from the area which are listed below.

Bar soap: Small pieces of toilet soap was placed in the field on reed poles. The smell originating from the soap gave the false feeling of the presence of human beings in the field which acted as a deterrent to the wildboar and deer. This method was only effective for few days. This method can be applied in field for a short time when the crops are in ripe condition.

Kerosene: Kerosene was used by soaking it in old cloth and placed on the vantage points on long poles. The smell of kerosene discouraged animals like deer and wild boar.

Human dummies: Human dummies in different size were prepared by stuffing the old clothes and it was displayed in the path of animals. The method was effective against wildboar and barking deer.

Reed poles: Reed poles and reed lines were laid in the field. This lead away the animals from the vicinity of crops.

Watch and ward: The best method to keep away the animals from the crop was to have watch and ward at night. Watch towers were built on lofty trees to keep vigil over

Plate 1. A coconut palm destroyed in elephant attack.

Plate 2. A cracker assembly for early warning of animal intruders.

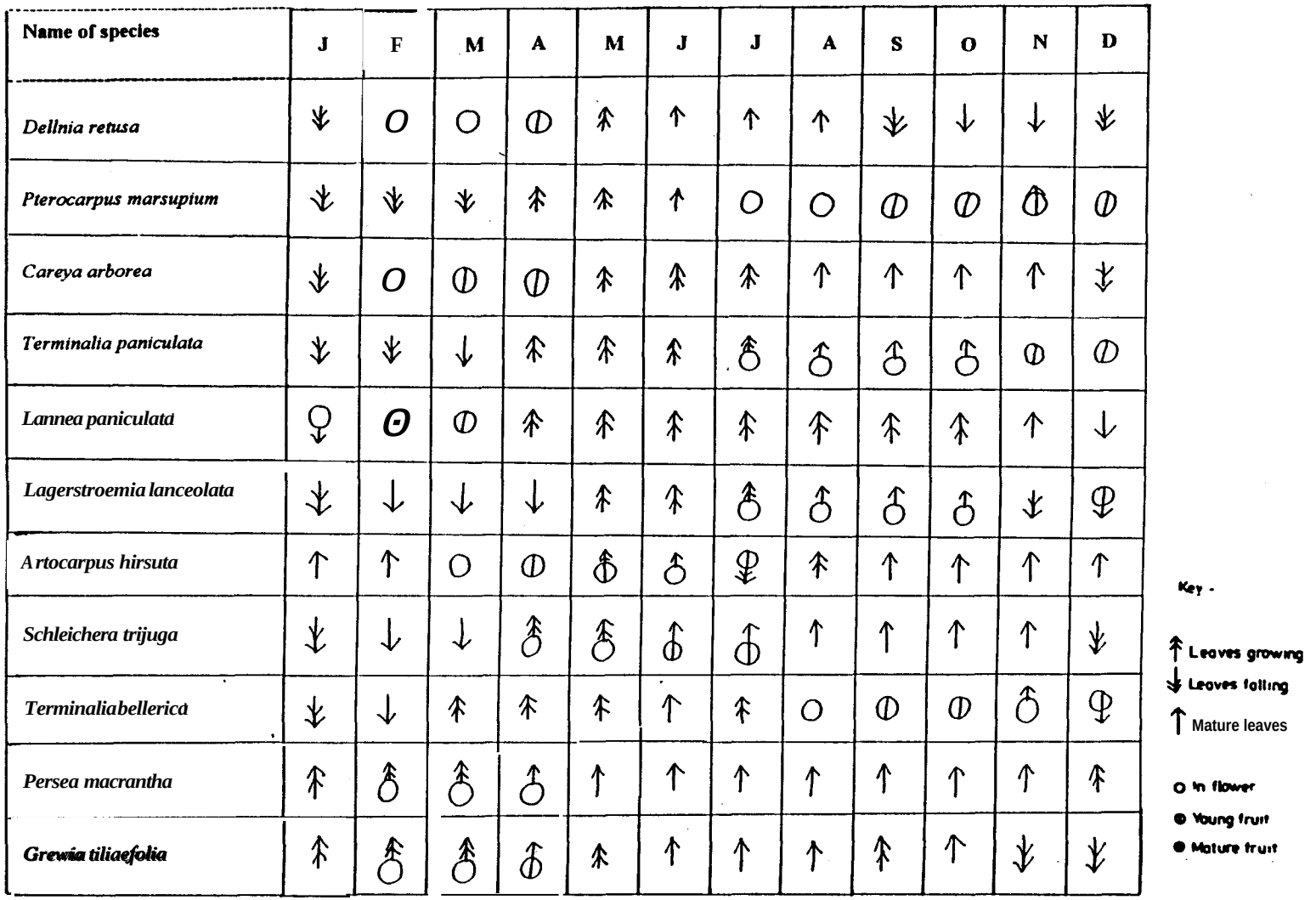

Fig. 9 Phenology of moist deciduous species in Peppara Wildlife Sanctuary.

the crop fields. Whenever an animal was sighted, sound was produced by beating drums and by firing crackers.

Cloths and plastic bags: Old and used clothes were placed in certain prominent parts of the field to scare away the incoming crop raiders. Colour and the sound produced by the plastic carry bags, when the wind blows through it was used to threaten wild boar and deer.

Arecanut sheaths: Arecanut sheaths were dried and hanged on bamboo poles, along with stones tied near to it. When wind blew, both will strike together and a low volume noise was produced, which kept away the animals from the crop. In addition to this a long line was extended to their homes from where they will operate it, when the presence of animals was detected. All the above described methods were practiced only for a short period after which they will change the method. In some instances a combination of methods were practiced.

Traps

They trap the animals which come to the vicinity of settlements; for which many death traps are designed by them. Locally available materials like stone, bamboo, reed poles and plant fibers are utilized for making these traps. Kanikkar had a history of trapping, snaring, capturing or poaching elephants, tigers and wild pigs. Long ago, Kanikkar used to supply live animals to the Trivandrum Zoo (Thurston, 1909). The skills of hunting and trapping of wild animals are still utilized by them to control the crop raiding animals.

a. Mouse trap (Rat trap)

This was operated for trapping field rats and mice and was constructed using a piece of bamboo. A noose and trigger tnechanism is placed inside the bamboo trap. When the rat touches the bait kept in the bamboo, the noose is tightened by the release of trigger mechanism killing the rat instantly. Important feature of this trap is its simplicity and efficiency. Since this type of trap contained no metallic parts, bait shyness was less (Fig, 10). Usually the noose was made of fibre from *Helicteres sterculia* and dried tapioca or dry fish is used as bait.

b. Pit trap

This is basically a pit dug in the ground and camouflaged with twigs and branches of trees. After studying the movements of an individual wildboar, a pit is dug on its path which was then covered with branches and leaves and sprinkled with loose soil. When an unsuspecting animal has fallen in the pit, it is caught and killed for meat. Pit traps are mainly used to catch wild boar, barking deer, mouse deer and blacknaped hare. On an average, the pit may have a depth of 150 cm to 180 cm and a width of 60 cm to 90 cm. Rotten intestine of fish or chicken is used as groundbait in the concealed pit to attract wild pigs.

c. "Dalle" and "Parippu" (Deadfall trap)

These traps were made of rock stones with one side flat as deadfall. Smaller version is called "Parippu" and the bigger one "Dalle". In "Parippu" a single stone was precariously placed in a standing position with the support of a stick (Fig. 11). Whenever an animal picks up the bait placed below the stone it will slide from the stone and will fall on the victim crushing it, Bandicoot rat and other small rodents were generally caught in this trap, which are highly relished by the Kanis.

A bigger version of the deadfall trap known as "Talle" is complicated and can kill any species up to the size of barking deer. The mechanism of the trap is shown in Fig. 12. Bamboo fences were made as leads into the trap and when the trigger is activated, while the animal is trying to pass through a fine cobweb mesh kept below the rack of bamboo, with heavy rock pieces, the stones will fall on the victim and the animal will be crushed. They used to set the trap only when they were in need of meat. Animals like, wild boar, barking deer, mouse deer, blacknaped hare and porcupine were caught in this trap.

d. Tree traps

These traps were set on trees and operated only when particular tree species were in flowers or with fruits. Palm civets coming for feeding on the fruits of *Bridelia retusa* were killed by this method. An individual tree was isolated, by cutting and removing the neighbouring ones. A path way was then provided to the tree top, through a long log

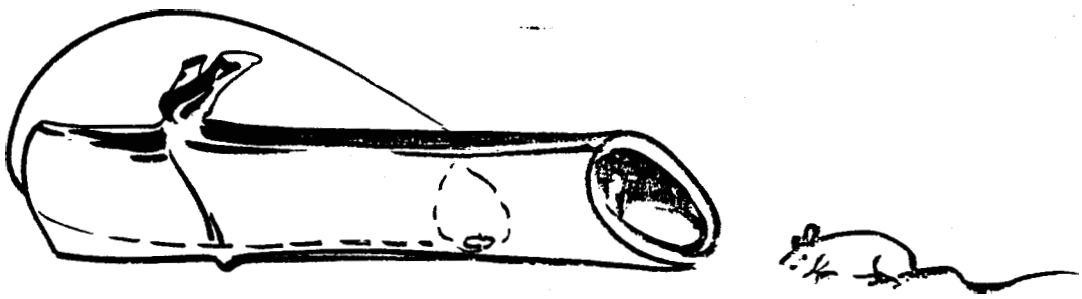

Fig. 10 Mouse trap.

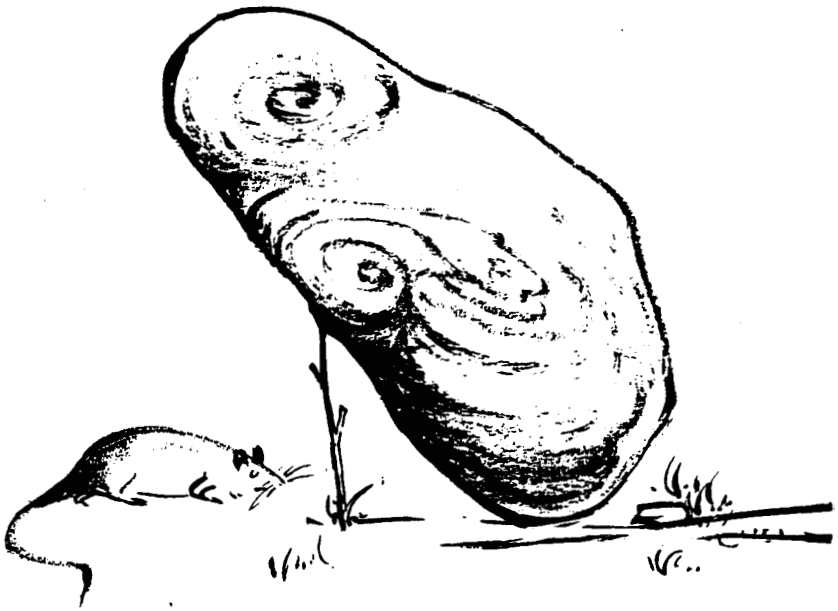

Fig. 11 Deadfall trap.

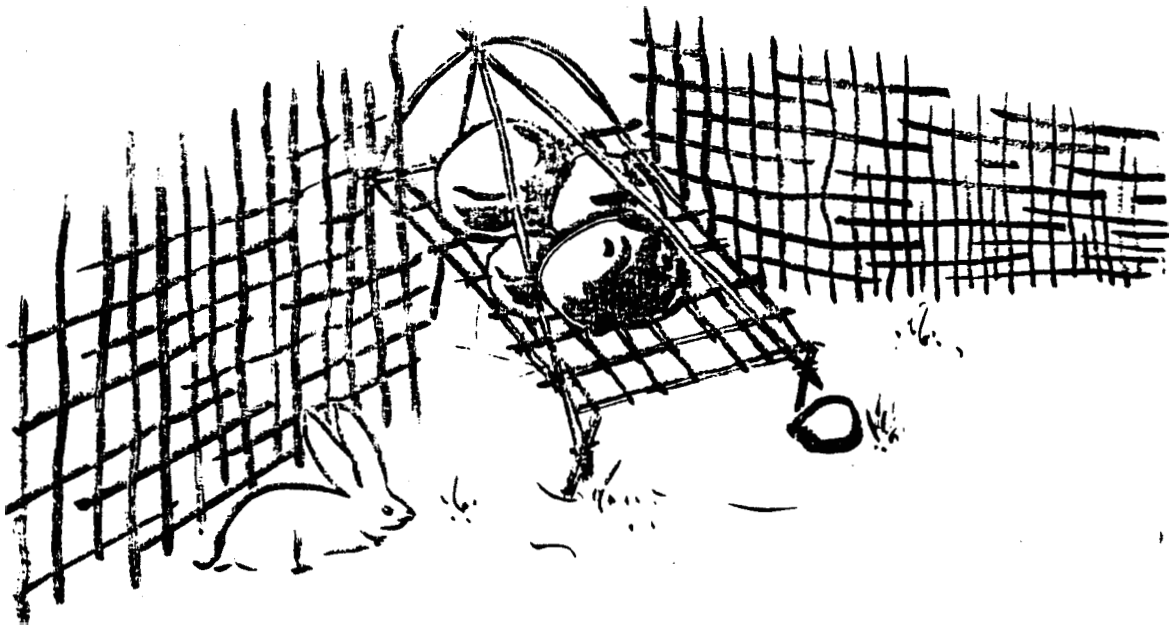

Fig. 12 A different variety of deadfall trap.

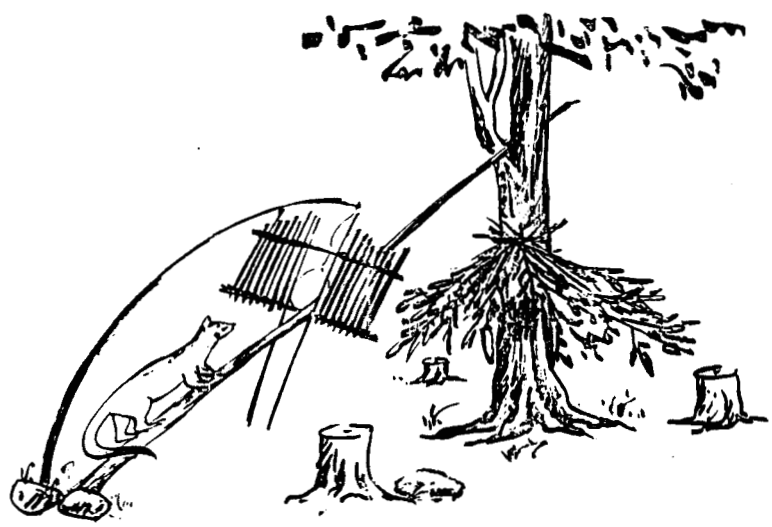

Fig. 13 A tree trap.

placed in a slanting position on the ground. Approach to the top of the tree through the base will be denied by placing thorns and branches with leaves on the main trunk of the tree. A noose was then kept on the log, leading to the trunk (Fig. 13). When the animal passes through the wooden log the noose will close on its neck and the animal will be killed instantly.

One of the peculiarities of these deathtraps is that these traps kill the animal while trapping it. Since the aim of Kanis is to consume the animals, it serves their purpose. These traps are highly efficient and fare well with any other commercially available models.

e. Pellet bow

Instead of arrows, Kanis shoot stone pellets using the bows. These pellet bows are highly accurate and are said to be very effective even against the lone tuskers. A single hit on the forehead will stun the animal and it may retreat from crop raiding. They used to kill smaller mammals like giant squirrel and mouse deer using the pellet bow. In one incident they could kill a king cobra using the pellet bow. Pellet bows are rarely found among other tribals of Kerala.

Fire crackers

Another method, used by the tribals to get rid of wildboar is by firing crackers. Gun powder was packed as bomb and covered with food materials especially with animal fat. And this was placed, where the disturbance from the wildboar was severe. When the wild boar bites the bait thinking it as food, it will burst, killing the animal instantly or injuring it. By using this method, a dual purpose is served. One was the requirement of meat and another is getting rid of the crop raiding animals. Preventive measures used for crop damage is given in Table 26.

Table 26. Preventive measures used against different animals

Preventive measures	Animals
Bamboo fence	Wild boar
Bush fence	Barking deer
Line fence using banana fibre	Wild boar
Reed line	Wild boar
Cracker line	Wild boar
Cables	Wild boar
Sound from bamboo pieces (Kottumula)	Barking deer, Mouse deer
Sound from old metallic parts	Wild boar
Cover	Wild boar
'Dalle'(Deadfall trap)	Palm civet, Porcupine, Mouse deer
Trap	Blacknaped hare, porcupine
Dogs	Wild boar
Fire line	Wild boar
Kerosene	Wild boar
Plastic bags	Wild boar
Cloths	Wild boar
Chasing	Wild boar

3.4.5.2. Modern methods

Trenches, cracker lines and live wire fencing are the modern methods applied by the tribals and local people for controlling the crop damage. In addition to this, electric fence with energiser were also erected by the Kerala Forest Department to control the crop damage, in some tribal settlements.

Trenches

Tribals of Paranthode settlement employed trenches for protecting the crop. But later they have abandoned it due to the difficulty in maintaining. Maintenance of trenches

was laborious due to the loose soil structure and intermittent rain fall in all the months.

Cracker lines

This is a common method in which a bit of gun powder is packed in a paper and kept under a stone. When an animal touched the lead line from the cracker assembly, it triggered a mechanism by which the stone placed above the gun powder falls on it creating a loud sound. This noise functioned as a warning to the watchers and also as a threat to the marauding animals. Local people widely applied this method and tribals also employed it, when intensive cultivation was going on. One disadvantage of this method was that, as these lines provide only warning, people have to go to the field to drive away the animals. Deviarkunnu and Pannikuzhi were some of the locations, where this method was prominently used (Plate 2).

Live wire fences

Connecting AC current directly to barbed wire fencing or to the iron wires is known as live wire fencing. The connection may be either from domestic wiring or directly from 220 KV lines. In many areas, local people have adopted this method which is highly lethal to humans and also to the wild animals. This method was not employed permanently but whenever threat of wild animals was anticipated, live wire fencing was made active. This was mainly practiced to save the coconut palms against the attacking elephants. No human or animal casualties were detected due to this method, during the period of study.

Electric fences

Electric fence with energiser has been very efficient in controlling the crop damage all over the world including India. Eventhough electric fences have been erected in many of the wildlife sanctuaries in Kerala by the Kerala Forest Department, no effort has been made to study the effectiveness. A solar electric fence with energiser was constructed at Chemmankala settlement as described in methods.

Electric fence considerably reduced the attack of elephants on crops at Chemmankala (Table 27). An instance of breakdown of electric fence was observed during March. This was due to an elephant running amok, and entering the settlement destroying the

fence. In the case of small animals, the fence was not effective. As the terrain was undulating with small creeks and ditches, wild boar entered the settlement through the fence.

Table 27. Number of indirect evidences recorded inside the fence and outside the fence.

Months	No. of signs inside the fence					No. of signs outside the fence					
	El	WB	BD	OD	P	El	WB	BD	OD	P	GA
January	0	3	0	1	0	1	3	0	1	0	0
February	0	2	0	1	0	1	2	0	0	0	0
March	2	0	0	0	0	2	0	0	0	0	1
April	0	1	0	0	0	0	1	0	0	0	1
May	0	1	0	0	0	0	3	0	0	0	0
June	0	4	1	0	1	0	4	1	0	1	0
July	0	4	1	0	2	0	4	0	0	1	0
August	0	3	0	0	1	0	0	4	0	0	1
September	2	4	0	0	1	3	3	0	0	1	1
October	0	3	0	0	1	0	3	0	0	1	0
November	0	2	0	0	1	2	3	0	0	1	0
December	0	0	1	0	0	3	3	2	0	0	0
Total	4	27	3	2	7	12	29	7	1	5	4

El - Elephant, WB- Wild boar, BD-Barking deer, OD- Other deer(Sambar, Mouse deer)

P - Porcupine, GA- Gaur.

Problems encountered in managing the electric fence

Though the electric fence was effective in controlling the elephants and other large herbivores many problems were encountered in its maintenance. The electric fence was built with the co-operation of Kani tribals. A portion of the labour was provided by the

tribals for which a refreshment was given. Poles for the fence were collected from the settlement. *Lania coromandalicum* was used for poles. Some of the poles sprouted, where as others dried up. Maintenance of the fence was carried out by the project staff, during the period of study.

Head person of the Kani settlement was assigned with the responsibility of battery room and energiser. It was observed that, when intensive cultivation was not practiced by a family, they were not interested in maintaining the fence. Due to this it is not advisable to leave the responsibility of fences to individual families. Filling of distilled water in the batteries and recharging the batteries needed outside support. Another difficulty was in the repair of instruments. Since the instruments were not widely used, finding an expert for repairing the energiser was not easy. As the rainfall in this area was heavy and occurs in all the months, the growth of vegetation was heavy. Due to this one labour was required to remove the vegetation at least on alternate days.

With the fast growth of vegetation, lower line of the electric fence used to touch the vegetation, which caused a drop of voltage from the fence. Due to the insufficient sunlight, battery was not fully charged during the months of monsoon. This has caused depletion of voltage in the fence and a fence with low voltage was not a barrier to wildboar.

3.5. Wildlife attacks

Many instances of attacks by wild animals on people were recorded during the period of study. Among them the prominent was man-slaughter by elephants. In addition to this, assaults by sloth bear were also happened in the sanctuary.

3.5.1. Man- slaughter by elephants

Four human deaths were recorded in five encounters (Table 28). In the first incident a lady was killed by a tusker, while she was collecting fire wood along with her husband and friends. It happened adjacent to the sanctuary boundary in the Agasthiavanam Biological Park. Vegetation type where this happened was moist deciduous forest with *Helicteres isora* bushes. While the victim was going for collecting fire wood, two sub adult tuskers suddenly appeared after a curve. One tusker charged the group and when the women fell down, while running for life, the tusker lashed the women with trunk, killing her instantly. After some time the elephant left the area leaving the body of the victim. Due to the incident, laborers abandoned the area for a month. The cause of attack was identified as close encounter with the tuskers.

The second man-slaughter by an elephant occurred in an eucalyptus plantation. A man was killed by a female elephant from a herd. Initially the group of people comprising the victim threw stones at the elephant herd, to chase them away from the forest path. After some time when they moved through the way thinking that the elephants have left the area, elephants suddenly attacked them and the victim was beaten up with the trunk. No visible injury was seen on the body and he died in the hospital after three days.

In the third event a lady was slayed by a lone tusker. The encounter happened again in the Agasthiavanam Biological Park. A group of five women were going for fire wood collection. While they were moving through the forest, talking loudly a tusker turned up and chased the women. While running most of them fell down. The victim was attacked with the trunk and died of excessive bleeding. In the fourth case, a male belonging to Aryanad was put to death while he was collecting fiber from *Helicteres isora.* The encounter happened in the Kuttappara swamp of Paruthippally Range.

3.5.2. Cattle lifting

Three incidence of cattle lifting were recorded during the study. In the first incident at Kunnatheri settlement a goat was disposed of by a leopard in September 1994. On 26 th May 1995 a leopard killed a calf of 2 years from the Mankode Kani settlement in Agasthiavanam Biological Park. The remains were later recovered from Anjunazikathodu. The third attack occurred on June 25 th 1995 in Valippara settlement of Agasthiavanam Biological Park. A goat (2 years) and a domestic dog was attacked and the carcass was found near a stream, 300 m away.

Table 28. Man-slaughter by elephants in Peppara Wildlife Sanctuary (March 1993 to March 1996).

Group composition of elephants	Victims		Time	Date	Vegetation type	Location of incident
	Age	Sex				
Two tuskers (Sub adults)	52	Female	10.30 A.M.	9.8.93	Reed brakes	Third block of Agasthiavanam Biological Park
Herd	56	Male	4.30 P.M.	17.7.94	Eucalyptus plantation	Chembuthangi
Lone tusker	35	Female	11.00 A.M.	8.12.94	Moist deciduous forest	Agasthiavanam Biological Park
Lone tusker	53	Male	11.00 A.M.	April 1995	Swamp and eucalyptus plantation	Kollotupara

4. DISCUSSION AND CONCLUSIONS

4.1. Larger Mammals

All major Peninsular Indian mammals were recorded from the Peppara Wildlife Sanctuary (30 species). The occurrence of endangered and rare species like lion-tailed macaque, Nilgiri langur and spiny dormouse shows the importance of the area for conservation. Elephants were mainly sighted in moist deciduous forest and eucalyptus plantations. Male to female ratio of 1: 58 shows the good representation of males in the population. Low density of larger mammals was mainly due to the illegal hunting practiced by the tribals and local people. In many of the settlements different types of traps were operated throughout the year, to catch the smaller mammals like, wildboar, porcupine, mouse deer and others. In addition to this, guns were also used extensively by the tribals to hunt the large herbivores. Karunakaran (1995) also reported similar observations based on his studies.

4. 2. Socio- economic status of tribals

An average of 4.3 people live in each house. The settlement Pattinipara has the maximum illiterates and Pothode and Kuravampara has high literacy rates. The peripheral settlements have more educated people and they were practicing modern agriculture with cash crops and the incidence of crop damage was also more. They become less interested in employing the traditional methods of crop protection such as keeping watch and ward. As cultivation was their main occupation , any incidence of crop damage will seriously affect them.

Crop damage incidences can be correlated to their economic condition also. When the families are in debt trap or with low income, they initiate commercial cultivation of cash crops at the instigation of outsiders. This leads to increased crop damage and more frustration. Another social custom which promoted the incidence of crop damage was the custom of marriage with people other than the Kanikkar. Outsiders begin to stay in the settlements when they marry a tribal girl. With their educational background they initiate cultivation of crops like plantains and coconut. This will lead to more crop damage. Amode, Kunnatheri and Cherumangal are examples. With the adoption of modern way

of lifestyle, there is amncreased chance for human-animal conflict. Kotoor tribal market is the main outlet for tribals to sell their NWFP. Eight items were commonly brought to the unique auction market controlled by the Forest Department.

4.3. Dependence of people on the sanctuary

Local people heavily depended on the forests for many of the NWFP, found near their settlements. About 28 species of trees and shrubs were used as firewood. Kotoor tribal market protect the tribals from the vicious circle of traders.

4.4. Crop Damage

Since the cash crops are more nutritive , elephants prefer them (Sukumar, 1991). This may be the reason, why the wild boar also attack the cash crops extensively. One difference noticed in the crop damage between wild boar and elephant was that damage from elephant was seasonal, where as in the case of wild boar it occurred in all months. Seven species of wild animals were involved in crop damage at Peppara. Among them, elephant and wild boar inflict maximum damage. Main produce destroyed were tapioca and plantains. Crop damage by wildboar can be considered as severe where as from elephants it was only moderate. Thirteen indigenous preventive measures were used by the Kanis. Since all the settlements were situated inside the sanctuary, animals attacked the crops regularly. But where the settlements were in cluster and the agriculture not much advanced the crop damage was low.

Since the Kanis have evolved various “Chattu pattu” (Magical songs) to prevent the crop damage from time immemorial, It is believed that crop damage was experienced by them from ancient times and they have accepted it as a natural calamity. Careful selection of crops and planting strategy is a must to reduce the crop damage. Cultivation of crops like medicinal plants and rubber will reduce the problem and increase the income of people where as crops like, plantains and coconut in monoculture will increase the crop damage. When they were practicing shifting cultivation, coconut or plantains were not cultivated. Cassava and cereals were cultivated for sustenance. But with the change in cultivation pattern they initiated the cash crops which are highly vulnerable.

It was found that indigenous methods used for crop protection is effective to control

the animals up to certain extent. Electric fence with energiser was useful in controlling the elephants and sambar. But maintenance of electric fence was a problem. Tribals did not have the organisational initiative or enthusiasm to maintain an electric fence. If day to day instruction was not given, they lose interest in maintaining the fence. Solar electric fence was effective with proper maintenance and it completely stopped animals like elephant. sambar and gaur. Electric fence is not a permanent solution, since the sanctuary is having intermittent rainfall in all the months and the growth of vegetation is fast. In order to keep the high voltage in the line, day to day removal of tree branches and other vegetation is must. Due to the crop damage tribals were not able to increase their income from agriculture. Only by increasing the crop area with the monoculture of cash crops, they will be able to increase the income but this is not possible under the present conditions. When Kanis attempt more cultivation of cash crops to increase their income more crop damage is experienced.

There are different hypothesis on the reasons for crop damage. Kushalappa (1990) described that, summer is the critical period for wild elephants, when they attempt to raid nearby agricultural crops. In such period, most of the trees in the forests are with out leaves, the grasses are dead and burnt with little or no water in streams and tanks makes the animal to move,on to cultivation. The destruction is particularly severe in areas adjoining to the forests with animals such as elephant, tiger, deer, primates and wild pigs. Another hypothesis is the "high risk high gain" strategy of elephants in which males are supposed to make high risk on their life for the reciprocal gain of access to the highly nutritious food which will further increase their chances of having more progenies and thus better transfer of their genes (Sukumar and Gadgil, 1988).

4.5. Wildlife attacks

Main conflict of wild animals was with the local people. Regarding man-wildlife conflict, tribals are experiencing only less of it, where as local people are severely affected. Of the four human deaths, in none of the cases a tribal was involved. All the victims were local people, who went to the forest in search of livelihood. Local people rarely cared for the elephants and took least precautionary measures. While considering the preventive measures, Sale and Berkmuller (1988) suggests that most of these conflicts can be alleviated, if wild animals can be confined to areas set aside for them and conversely

domestic stock can be prevented from entering National Parks and sanctuaries, where they have no legitimate place. More educational programmes should be introduced for the local people to reduce human casualties.

Providing compensation is not a permanent solution to the problem. Andhra Pradesh, Arunachal Pradesh, Manipur and Rajasthan do not pay any payment. Among the States which pay compensation, it varied from Rs.2,000/- to Rs. l0,000/- (Kothari, *et al.,* 1989). Even in Kerala adequate compensation was not given for the crop damage. Human - wildlife conflicts can be reduced, if more tribals are engaged in forest works than the non tribals, who came from far away places.

Management suggestions

1. The road leading to the Bonacord estate is not under the control of sanctuary management. Due to this many forest products are transported to outside through this road from the sanctuary. Poachers have easy access to the sanctuary through this way. Considering this a check post may be started at Adivarambu.

2. Police training camps held in the sanctuary is adversely affecting the wild animals. At a time about 500 to 1500 cadets are getting jungle practice in the sanctuary. Either this may be disallowed or the number of cadets in a camp reduced.

3. At present sanctuary has no buffer area. The areas lying east, starting from Vithura to Kaliakka settlement to Pattankulichippara then up to dam along the left side of the road and the regions staring from Kuttappara to Kuthippara and Chemmungi should be declared (Eucalyptus plantation) as the buffer zone of the sanctuary.

4. Awareness campaign to avoid cultivation of species such as plantains, coconut and tuber crops as far as possible should be initiated which will reduce the crop damage.

5. Steps should be initiated to control the population of wildboar which is causing extensive damage to tuber crops.

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