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IMPACT OF HYDROELECTRIC PROJECT ON WILDLIFE:

REPORT OF THE FIRST PHASE OF STUDY

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ABSTRACT

This report presents the result of the first phase of the study on the impact of hydroelectric project on wildlife. The study was conducted in Silent Valley area where construction of a hydroelectric dam is contemplated.

General status of wildlife, details of vegetation, importance of the particular vegetation to the survival of certain species of animals, existing sources of disturbance to wildlife and the possible impacts of a dam in Silent Valley area are brought out.

Silent Valley is perhaps the only example of relatively undisturbed rainforest left in the whole of Kerala. Also, this is the only large extent of continuous rainforest in the northern Kerala. The vegetation type of the area is mainly West-Coast tropical evergreen.

Twenty three mammalian species, excluding bats, rats and mice and ninety nine bird species were recorded from the Silent Valley area. Of the twenty three mammalian species, three are endangered - lion tailed macaque, Nilgiri tahr and five are vulnerable - panther, wild dog, Nilgiri langur, gaur, Indian elephant. Hornbill which is a protecttd species is common in the area.

There are about 200 lion tailed macaques, 75 to 100 elephants and 560 to 630 Nilgiri langurs in the Silent Valley -

Attapadi area, Population of all these species is dwindling fast, In the Silent Valley - Attapadi area along with the adjacent areas covered in Nilambur and Nilgiris 20 to 25 tigers and 30 to 40 panthers and 170 to 200 Nilgiri tahr were estimated,

The proposed dam has a power generation capacity of 120 MW and can efford irrigation facilities to 10,000 hectares of paddy fields, It can also offer employment to about 3,000 people for about a period of 5 to 6 years,

The proposed dam is to be constructad across Kundhipuzha, along the course of which lies the best part of the forest of the area. The dam would destray, about 1,000 hectares of forest, The expected labour strength of 3,000 along with their dependents the population may come between 6,000 to 7,000 who will have to stay in Silent Valley for 5 to 6 years, The number of cattle they may bring in cause a severe strain on the fodder of grazers and also may spread diseases to wildlife, They would also go in for cultivation in the area. Their fuel demand would probably affect the forest around, Encroachment to the area, as happened in Idukki should also be expected. All these activities would probably upset the balance of the ecosystem.

Silent Valley forest is very much important in the survival of liontailed macaque which is an endangered, endemic species, It is found only in portions of Western Ghats in

Karnataka, Tamil Nadu and Kerala. Silent Valley area holds one of the just two viable breeding populations of this macaque in the world, For a viable breeding population 130 Km^2 of unbroken evergreen forest is required. Silent Valley along with the adjacent Attapadi forest though may not provide the prescribed extent of forest, is the only area available throughout its range, except Ashambu hills where the other breeding population occurs. In the Silent Valley, they occur mainly in the submergible area of the proposed dam, only where Cullenia excelsa is abundant. The mscaque is an obligate Cullenia-rich rainforest dweller. As evergreen forest of Silent Valley is contiguous only to the forest in the western catchment of Bhavani river in Attapadi, the animal cannot move far and settle somewhere. The submergible area of the proposed dam is essential for the survival of this species. All the other endangered and vulnerable species noted were in in and around the submergible area.

As in a tropical rainforest, the environment is almost stable, those species which live inside such forests are well specialized to live in a particular set of environment and are less adaptable to changes. Drastic chznges in tropical rainforest ecosystem would probably blow the death knell to many of the tropical rainforest species in the area. Previous studies elsewhere have shawn, the concept that the animals would 'move up the hill', is a faldacy.

It is! recommanded that the Silent Valley area along with the western catchment of Bhavani river in Attapadi should be kept undisturbed and declared as a 'Biosphere reserve' and the vested forest around it should be Cept as a buffer zone.

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INTRODUCTION

Hydroelectric dams, the history of which goes back to 2700 B.C., apart from their indubitable contributions to human welfare are considered to be a symbol of progress and technological excellence. As a result, massive structures with huge reservoirs have come up, Owen falls in Uganda, Bratsk in U.S.S.R., Kariba in Rhodesia, Aswan High in Egypt, Akosombo in Ghana are some of the dams with spectacularly large reservoirs.

Augmentation of energy and Irrigation facilities to keep pace with the growing population necessitates development of more hydroelectric dams; the proliferation of which is viewed with concern by Environmental Scientists, Wildlife Experts and Conservationists, In India no studies have so far been undertaken to evaluate the impact of hydro-electric dams on wildlife, But in countries like United States and Canada considerable work ha8 been done, Edwards (1957) noted that the 91 metre high dam across Nechako river in Western Canada has affected the moose, the largest deer species, According to him moose trapped in hills and ridges got drowned, flood range reduced the living space and farm

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Sadd el- Kafara Dam in Egypt built in 2700 B.C. is believed to be the oldest in the world, Its ruins are reported to be visible even today (Mermel, *1974).*

lands and debris about shores formed an effective barrier in migration of the moose. Patterson (1961) indicated that the Rocky Reach Project would result in the loss of 2,000 deer and 33,000 upland game birds. Oliver et el (1966) showed that among other species about 885 deer, 200 elk, 3,300 grouse and 1,500 band tailed pigeon, utilized the impoundment area of Mayfield and Mossyrock dams. Bowhay (1972) after a comprehensive study before and after inundation found 67% nesting loss in Canada goose due to hydroelectric development of the Columbia and Snake Rivers, Oliver (1972) recorded that at Wells Dam in Columbia 243,200 wildlife units got reduced to 32,000 consequent to inundation, The four Snake River Dams are reported to have caused the loss of about 1,800 deer, 120,800 units of upland game and 13,400 furbearers (Anon, 1973). Wynoochee project in Western Washington, according to (Oliver, 1974) would have inundated the range of about 250 elk and 95 black-tailed deer. Simmons. (1974) reported that musk rat population was affected by the W.A.C. Bennett Dan in British Columbia, The Quebec governments James Bay Project would drown one year's producticn of timber from the province and many Indians and Eskimo resources areas (Ibid),

A study in the Mekong basin lists various species of mammals, reptiles and birds found there, Of these 22 species are very important as they occur only in the basin

and if they become extinct in the basin they will likely to be gone for ever., However, the study did not lead to any conclusions, but suggested certain probabilities. If indiscriminate hunting of animals during construction work is prevented, certain species might get adapted to the changes in the area., It is also pointed out that when more lands could be used more productively as a result of irrigation by dams, the pressure on the more marginal lands on the hills will be reduced.*

There are several examples of environmental considerations influencing the decision to undertake construction of hydroelectric dams, In 1971, the Canadian government gave up the proposal for construction of a hydroelectric dam across Nahanni river in Northern Canada and set aside the area for a national park (Krasemann, 1977). In 1967, two dams across Grand canyon of the Colorado river in Arizona, proposed by the U.S. Bureau of Reclamation were not given clearance on account of wildlife and scenic beauty (Fagan, 1974). Proposal of Rampart Dam on the Yukon River of Alaska, perhaps one of the largest hydroelectric projects proposed in recent years was turned down in favour of wildlife and forests of

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* Wildlife And The Mekong Project: Information note by the Secretariat, Economic And Social Commission for Asia and the Pacific,

the area (Ibid), Nearer, home, in Tamil Nadu, the Moyar project with an estimated yield of 150 MW was abandoned considering its adverse effect on wildlife of Mudmalai and Bandipur sanctuaries.

There are also instances where the loss of habitat for wildlife due to construction of hydroelectric dams is appropriately compensated. A well known example is the 'Wells Mitigation Settlement' (Oliver, 1974). The Washington Department of Game negotiated a settlement with the concerned authorities. Accordingly 2,995 hectares of off-project land were given for wildlife management. Apart from this, control of project lands adjoining the reservoir was given to the Department of Game to undertake lasting habitat management programmes. A provision of $1.5 million was also made to accomplish the task, Patterson (1961) reported that the same Department received 7,204 hectares of wildlife land as mitigation to the loss caused by Rocky Reach Project.

This points out that human welfare programmes and conservation requirements need not always run a collision course. There is scope for compromise. If an abdurate approach was taken for developing hydroelectric dams, most of our beautiful wildlife areas would have disappeared from the face of earth. Similarly if the conservationists remained unbending, many of our dams would not have come up and there would have been more scarcity of power and irrigation facilities.

Objects of the present study:

Objects of the present investigations are (1) to study the impact of hydroelectric dams on wildlife and (2) to identify management options which result in minimal disturbance to wildlife if such projects are inevitable for the country.

Such studies have not so far been undertaken in the country due to several factors, mainly perhaps the time factor, as it requires a fairly long time with broken periods in between to complete the study. Though it is possible to study tho status of wildlife around an existing dam, it is impossible to evaluate the impact of the dam on wildlife without hawing the data concerning the status of wildlife before the construction of the dam.

Thekkady has often been cited as an example where construction of a dam helped the promotion of wildlife, Thouqh Thekkady at present, appears to be rich in wildlife, it is erroneous to make a conclusion that construction of a dam in that area has promoted the wildlife. There is no data regarding the status of wildlife before the present dam came up in that area. There was, perhaps, more wildlife in Thekkady before the construction of dam. Therefore investigation before and after the construction of dam is essential to evaluate the impact of the dam on wildlife of the area,,

Method of Study:

This study is proposed to be undertaken in three stages.

Stage 1 : Before construction of the dam
Stage II : After completion of the construction
Stage III : Five years after the commissioning of the dam.

The present report envisages the findings of the first stage of the study. To assess the status of wildlife, Linear-transect method was employed. The observer walked either through a forest path or animal track and the following points were recorded. (1) Time of observetion (2) species of animal seen (3) total number in a herd, troop or pack (4) activity at the time of observation (5) the habitat where the species was seen (6) indirect evidences like droppings, hoof marks, pug marks,, diggings, burrows and scratchings (7) vegetation changes and (8) time spent in each vegetation type. This method would be followed in the succeeding stages of the study also,

Study area:

As information on the status of wildlife before and after the construction of a dam is required to evaluate the impact of hydroelectric dams on wildlife, Silent Valley reserve forest was selected where construction of a hydro-electric dam is contemplated, Forests adjacent to and contiguous to Silent Valley - Nilambur, Nilgiris and Attapadi -

were also included in the study area so as to find out the influence of hydroelectric dams on neighbouring areas and also to note whether animals migrate to adjacent areas as a result of such constructions,

CHAPTER II

Physical and Biotic features of the study area

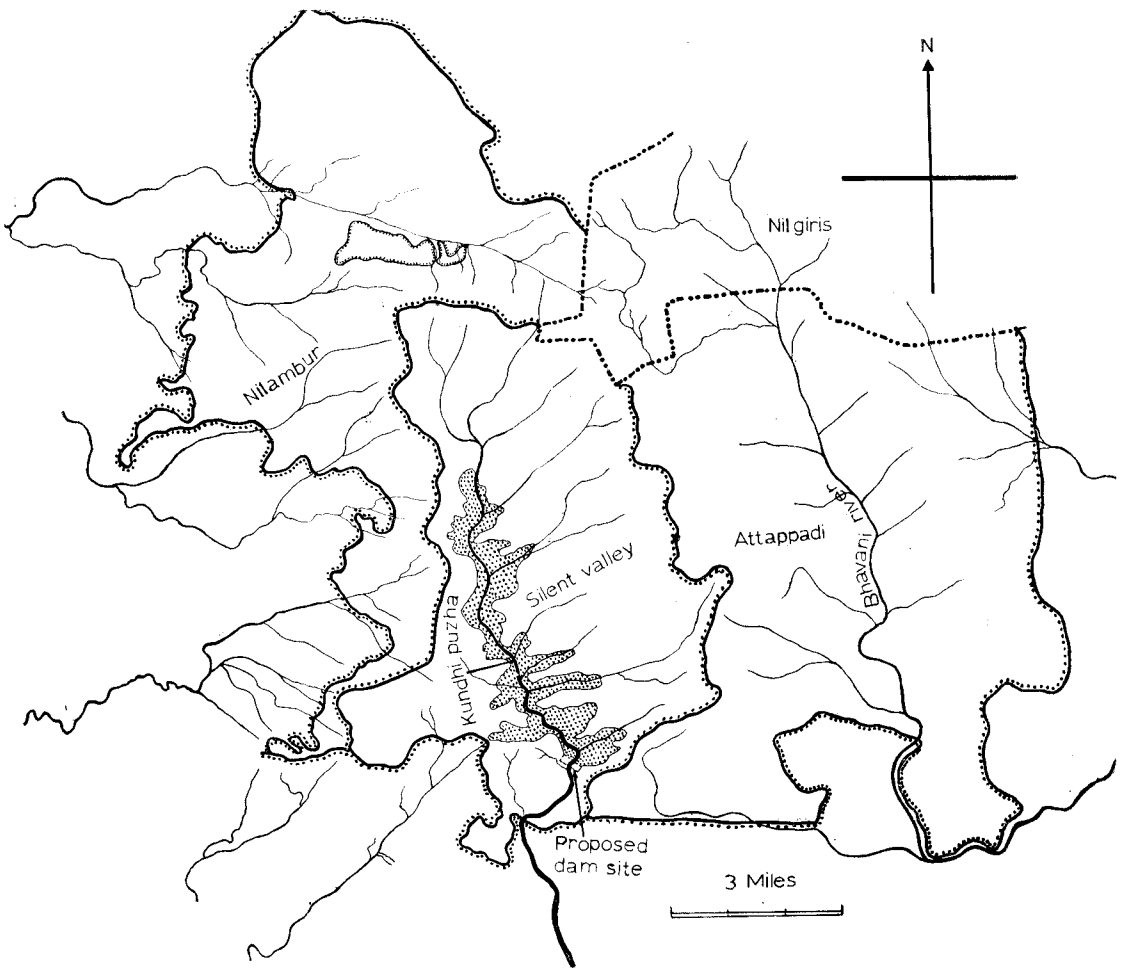
Physical features

Location & Topography:

Silent Valley (11°5'33N, 76°27'15"E) in Palghat District, Kerala, is about 45 Km north of Mannarghat, the nearest town. The entire reserve is on a plateau, On the north, part of the boundary is formed by the vested forests of Nilambur Division and part by the Nilgiris. The highest peaks on the northern boundary are Kozhipara (1904 metres), Sispara (2206 metres) and Anginda (2383 metres), On the south tho reserve is bordered by the vested forests of Falghat Division, On the east, Attapadi reserve lies contiguous to Silent Valley reserve while on the west the reserve is bounded by the vested forests of Nilambur Division (Map 1).

Tho Silent Valley reserve is about 8,952 hectares in extent. There are several hills within the forest, and water from all these hills drains into Kundhipuzha, This river, a tributary of Bharatapuzha, takes its origin from Silent Valley and runs north to south, The lowest point on the plateau is about 685 metres on the southern boundary where Kundhipuzha runs down the ghats in a series of rapids and the highest peak is Anginda 2,383 metros on the northern boundary,

Map. 1. STUDY AREA



Submergible area
of the proposed dam

Attapadi reserve lies east of Silent Valley reserve and is the main catchment area of Bhavani river which takes its origin from Nilgiris. The reserve is bounded on the north by the Nilgiris and on the south and east by private forests, The lowest point in the reserve is 530 metres. The hills rise to over 2,212 metres on the Nilgiri boundary, Malleswara Malai about 1,681 metres, is one of the highest peaks in the lower area and can be seen from Mukkali.

The vested forests of Nilambur Division lying close to Silent Valley area on the west and north were included in the study. The areas lying close are Vadekkekotta malavaram, separating the Silent Valley from Amarambalam reserve of Nilambur Division on the north and Kozhipara malavaram and Kannoth Malavaram on the west,

A portion of Nilgiri plateau, Kundha and Korakundha ranges lying close to Silent Valley and Attapady reserve on the north was also included in the study,

Climate:

Silent Valley area is benefitted by both south-west and north-east Monsoons. However, most of the precipitation occurs during the South-West Monsoon. Average rainfall in the area is 3,180 mm. (Average of 8 years) and the highest rainfall is during the month of July. January, February and March are comparatively drier (Table I), The area experiences the highest temperature during May ($85^{\circ}F$) and the lowest during January ($44.67^{\circ}F$).

TABLE - I

Meteorological Data

Month	[1]Rainfall (Average) 65-73	[2]Temperature (Average) 71-73	
		Max.	Min.
	mm	F.	
January	5.9	72.67	44.67
February	2.4	78.67	48.67
March	12.6	84.3	47.3
April	66.9	85.0	50.67
May	202.0	80.3	57.0
June	530.8	71.3	55.67
July	885.8	68.3	54.3
August	678.9	69.0	56.0
September	319.3	76.0	54.3
October	309.0	75.67	53.0
November	12101	75.67	49.67
December	454	7300	47.67
Total:	3180.1		

[1]Source: Chand Basha (1974) - Revised working plan for Palghat Forest Division.

[2]Source: Kerala State Electricity bard
Investigation Circle
Trichur.

Geology of the area;

Geology of the area was reported by Sri. Srinivasan of Geological Survey of India. According to him "In the dam site area the prevalent rocks are well foliated gneisses to grantioid gneisses, and granites referable to Archaean Complex. More commonly seen are the hofublends-gneisses and hornblend-mica-gneisses" (Cited from Silent Valley Project Report-1965 of Kerala State Electricity Board).

General Biotic Features

Tropical evergreen forests, to which most of the forests in Silent Valley area belong, are amongst the most complex and diverse vegetational communities on earth. It is considered to be a climax formation. Though invertebrates par exceed vertebrates in density and abundance in Tropical Rain forests, the diversity of vertebrate species is more than that of invertebrates, Those animal species dependent on vegetable food resources are the most dominant ones in this type of forest,

Among vertebrates, birds are the most successful forms in these forests, having different kinds of feeding mechanisms and adaptations, Among mammals those having an arboreal life are more abundant than those with a terrestrial mode of life, The food resources at the forest canopy are more than those at the forest floor. Liontailed Macaque, Nilgiri Langur and Giant Squirrel are the three arboreal mammals common in Silent Valley area.

The animal species which live in the evergreen forests are highly specialized forms. Since there is no much variation within a rain forest environment, the species inhabiting the forest are highly specialized to live in that environment. As the rain forest ecosystem is very complex and stable and as the species in the ecosystem are less adaptable, drastic changes in their environment are detrimental to their survival.

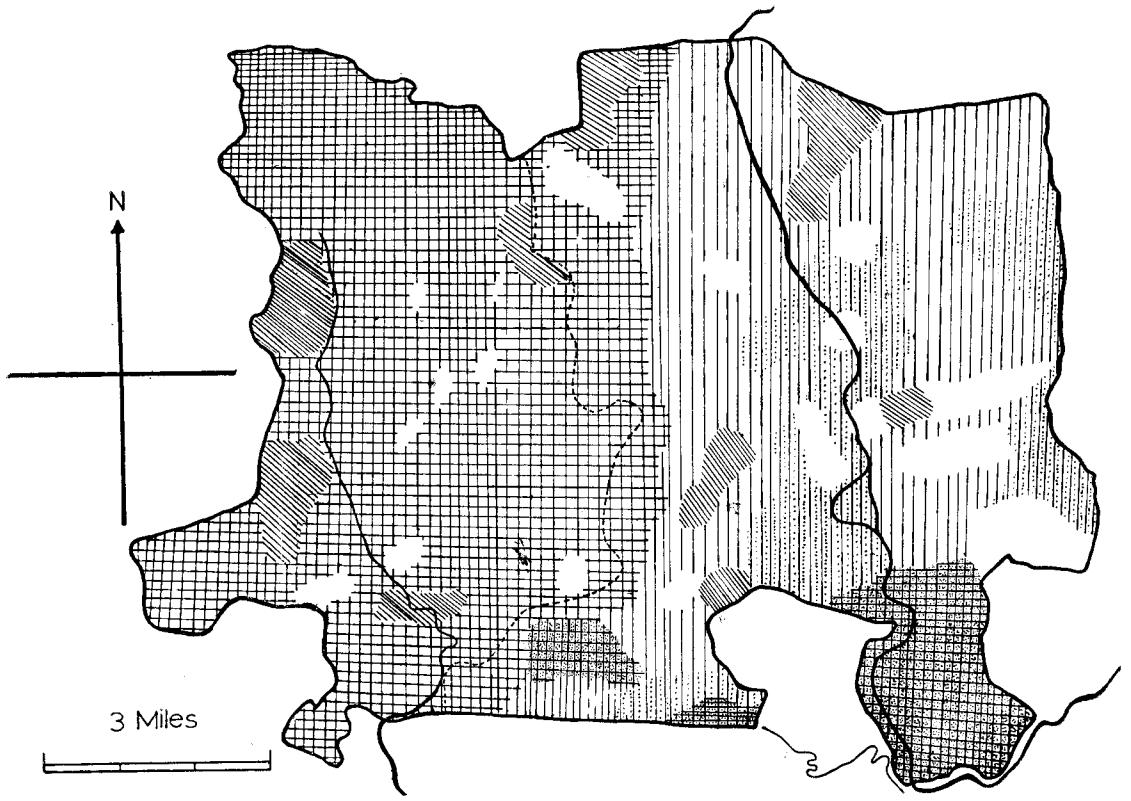
In the semi-evergreen and moist deciducus type of forests terrestrial herbivores are more common than in the evergreen forests. Ths greater availability of food at the floor of these forests account for this.

The grasslands are veritable abode for grazers. Nilgiri Tahr, an endangered goat depends mostly on grassland. Many predator species also favour open grass land area for searching their prey.

Vegetation:

Vegetation of Silent Valley is mostly West-coast tropical evergreen type of Champion & Seth (1968). In the Attapadi reserve three types of forests occur; west-coast tropical evergreen, west-coast semi-evergreen and southern secondary moist mixed deciduous forest (Map 2). West coast tropical evergreen forest occurs in the area lying close to Silent Valley reserve., In the Nilgiris the vegetation is southern montane wet temperate. A transitional zone of

Map. 2. VEGETATION OF SILENT VALLEY-ATTAPPADI



West coast evergreen forest

West coast semi-evergreen forest

Southern secondary moist mixed deciduous forest

Grassland

Plantation

vegetation from west coast tropical evergreen to southern montane wet temperate occurs at the higher reaches of Silent Valley reserve where this merges with the forest of Nilgiris, At Sispara the vegetation is almost similar to Nilgiris - vast expanses of grassland interrupted by small pockets of forests in valley of rolling hills. In the area covered in Nilambur vested forests, the vegetation is mostly southern secondary moist mixed deciduous forests, West coast semi-evergreen type of forest also occur at some places,

West Coast Tropical Evergreen Forest: (Figs.1, 2, 13, 14 & 15)

This is the climax vegetational formation in this area. Here species are numerous and the trees are huge, Dominant species forming the ton canopy arc: Cullenia excelsa, Palaquium ellipticum, Mesua ferrea, Poeciloneuron indicum, Machilus macrantho, Calophyllum elatum, Canarium strictum, Hopea sp. and Syzygium sp. Secondary layer is constituted mainly by Hydnocarpus wightiana, Gercinia spicata, Elaeocarpus serratus, Baccaurea courtallensis, Glochidion malabaricum, Actinodaphnc hookeri, Myristica sp. and Gomphandra polymorpha. Common species in the shrub layer are Agrostistachys indica, Leea indica, Clerodendron infortunatum, Macaranga roxburghii, Olea dioica, Laportea crenulata and Vernonia arboroa. Calamus grows profusely in patches while Ochlandra dominates the bank of streams, Elaeagnus latifolia, Smilax zeylanica, Gnetum scandens and Derris sp. are the common climbers met within this type of forests,

Fig. 1. West Coast Tropical Evergreen Forest Silent Valley

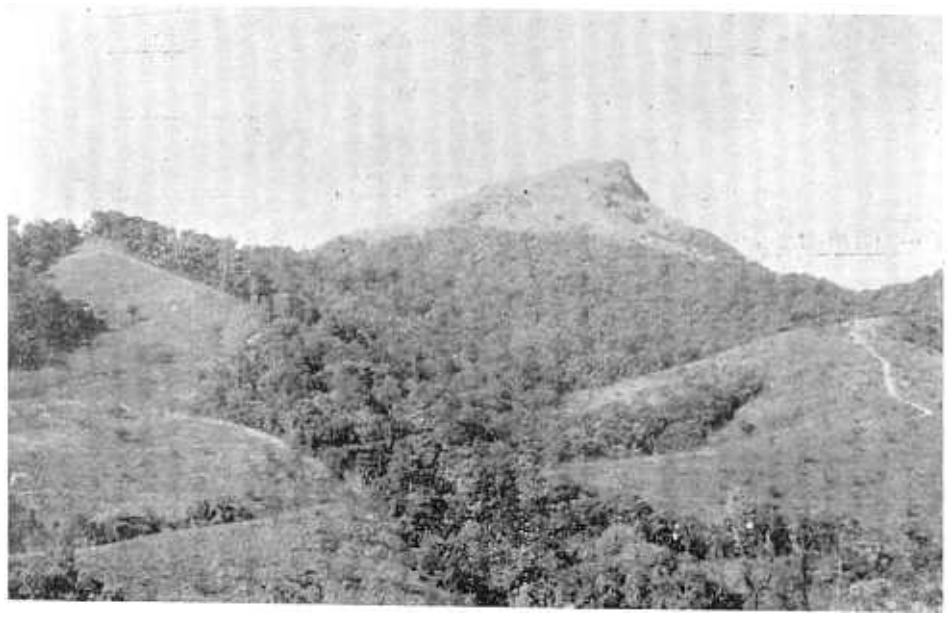


Fig. 2. West Coast Tropical Evergreen Forest Silent Valley

Southern Secondary Moist Mixed Deciduous Forest

This type of vegetation is seen in part of Attapadi,, around Thadikundu, Chindaki, Gottiyarkandi and Anavai and also in part of the vested forests of Nilambur Division under study - Chakkikuzhi, Vadakkekotta Malavaram and Chichipara area. Major species are Xylia xylocarpa, Terminalia paniculata, Grewia tiliaefolia, Lagerstroemia lanceolata, Dalbargia latifolia, Albizzia odoratiesima, Salmalia malabarica, Pterocarpus marsupium and Terminalia tomentosa. Lannea coromandelica, Careya arborea and Randia dumetorum are also seen, in the shrub layer Helicteres isora and Clerodendron infortunatum are common. Bamboos are common in some places.

In the Malleswaram area southern dry mixed deciduous type of forest is seen. The paak of the hill is carpeted with grass, while the slopes on the upper reaches have scattered trees with tall grass outgrowth. Dalbergia latifolia, Terminalia tomentosa, Albizzia odoratissima etc,, are found here.

Southern Montane Wet temperate forest

This type occurs in Nilgiris. At the higher reaches of Silent Valley and Attapadi, the West Coast tropical evergreen forest passes through a transitional stage and merges into the southern montane wet temperate forest. The trees here arc shorter than the West Coast tropical evergreen forest and mostly short boled and branchy. Lichen

and moss cover the branches and trunks of trees profusely. Rhododendron arboreurn is typical of this kind of forest, Cinnamomum wightii, Meliosma wightii, Eugenia sp., Symplocos sp., Ilex wightiana, Gaultheria fragrantissima and Mahonia leschenaultii are common, Several species of Strobilanthus form thickets of undergrowth.

Grass land:

There are mainly two types *of* grasslands in the study area, the grassland which is closer to the West Coast tropical evergreen forest and the grassland which is closer to southern montane wet temperate 'forest, The former is common in the comparatively low lands of Silent Valley - Attapadi area whereas the latter is common in the upper reaches of Silent Valley - Attapadi and also in the Nilgiris. In the grassland closer to evergreen forests certain tree species are common - Phyllanthus, Dalbergia, Wendlandia and Careya (Figs.3 & 4). Phoenix is common in restricted places. On Attumudi hill near Mukkali Phoenix is very common, All these species are fire resistant, Below Kanjikornban peak Dalbergia is common, This is so on the grasslands near Valiaparathodu and in the center of the forest roads (Fig.5). The average height of this economically important species is only 1 to 1½ metres. In the high lands close to montane wet temperate forest the grassland is mostly stunted - giving the appearance of a green carpet on the ground, Though rainfall is very heavy in these area, the run off is also very fast due to the slopy nature of the terrain. This grassland is directly exposed to wind. Fire is very rare and human

Fig. 3. Grassland Near Valiyaparathodu - Silent Valley

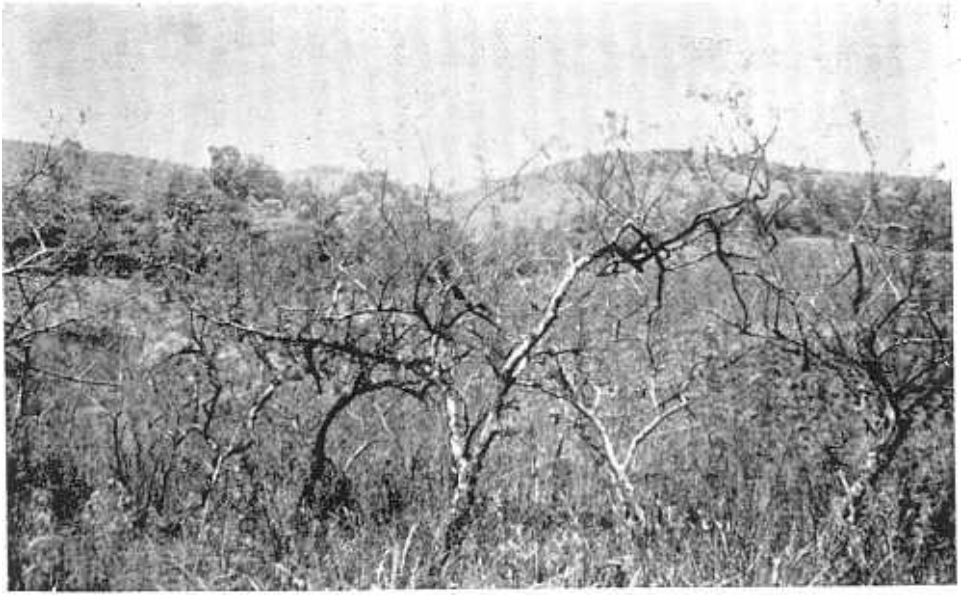


Fig. 4. Grassland with Phyllanthus emblica - Silent Valley

Fig. 5. Dalbergia latifolia - near Kanjikomban area - Silent Valley

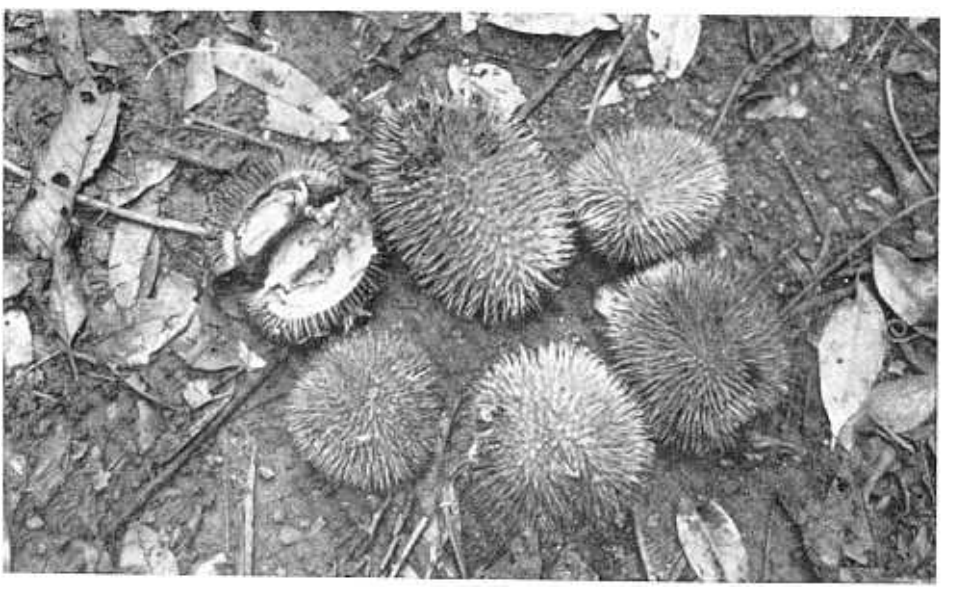


Fig. 6. Cullenia excelsa - The favourite fruit of Liontailed macaque

interference is practically absent. Lower down, these grasslands converge and merge into sholas. The grassland in Walakad area is man-made and is in the process of secondary succession, Coffee plantations were raised in this area after clearfelling natural forest sometime during 1843 and 1873, and abandoned later. Since then frequent fires ravaged the vegetation of the area and led to its present condition. In some areas Wendlandia notoniana can be seen colonizing. In the Nilgiris, Wattle, Pine and Eucalyptus are planted extensively in the grasslands, thereby reducing the area of grassland.

Abundance of tree species in Silent Valley area:

The most abundant tree species in Silent Valley area is Palaquium ellipticum followed by Cullenia excelsa (Table 2). Abundance of each species vary greatly in different locations. Cullenia excelsa, for example, is the most dominant tree species in compartment 1, 13 and 14 (Map 3), whereas there is no Cullenia excelsa in several compartments. Similarly Palaquiurn ellipticum is the dominant species in compartments 2, 3, 4, 5, 6, 8a, 9a and 12, while this is less in abundance in compartments 10a, 10b, and Ilb (Table 3).

Map. 3. TREE ENUMERATION COMPARTMENTS IN SILENT VALLEY AREA

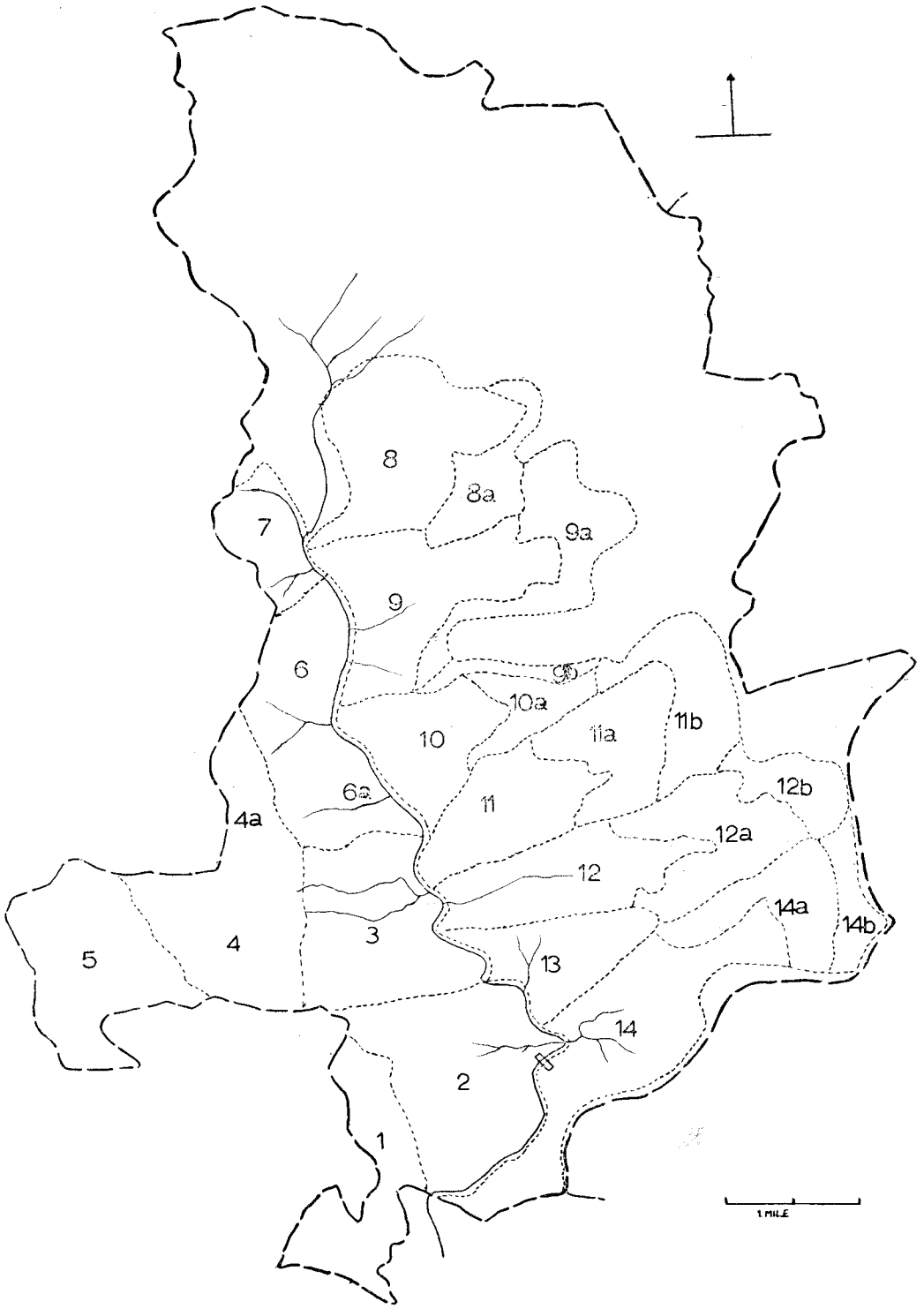


TABLE 2

Number of trees per hectare by species in Silent Valley Reserve

Species		Total
Artocarpus integrifolia	..	2.18
Bridelia retusa	..	1.37
Calophyllum sp.	..	1.70
Canarium strictum	..	5.30
Cinnamomum zeylanicum	..	9.75
Cullenia excelsa	..	37.89
Eugenia Sp.	..	15.77
Evodia lunu ankenda	..	0.93
Macaranga peltata	..	0.47
Machilus macrantha	..	19.96
Mesua ferrea	..	19.22
Myristica attenuata	..	26.37
Palaquiurn ellipticum	..	63.07
Schleichera trijuga	..	16.95
Spondias mangifera	..	0.56
Vateria indica	..	0.60
Others	..	253.34
		475.43

Source: Chandrasekharan, C. 1973, Forest Resources of Kerala - A quantitative Assessment.

TABLE 3

ABSTRACTS OF ENUMERATION OF TREES IN SILENT VALLEY AREA

Compartment No. / SPECIES	1 *5/265	2 5/642	3 5/402	4 5/627	4a 5/146	5 5/661	6 5/618	7 5/315	8 5/779
Adina cordifolia	1	-	-	-	-	-	-	-	-
Artocarpus integrifolia	-	14	5	12	1	8	7	-	1
Bischofia javanica	7	11	5	25	2	33	14	1	-
Calophyllum elatum	4	35	4	48	1	17	19	3	6
Canarium strictum	4	10	2	1	-	-	-	-	-
Cullenia excelsa	28	21	10	6	-	5	6	-	-
Dysoxylum malabaricum	3	12	3	14	-	15	16	-	-
Dysoxylum purpureum	-	2	-	-	-	-	-	-	-
Elaeocarpus sp.	-	-	-	-	-	1	-	-	-
Eugenia sp.	-	20	2	10	-	8	-	-	-
Hopea parviflora	9	11	16	1	-	12	18	6	10
Machilus macrantha	24	50	57	33	2	41	47	24	29
Mesua ferrea	20	88	61	48	-	22	44	15	35
Nephelium longana	-	11	6	10	-	7	10	2	-
Palaquium ellipticum	21	121	79	118	2	43	68	22	57
Poeciloneuron indicum	-	1	-	2	-	-	-	13	164
Other sp.	2	-	6	-	2	17	17	-	-

* $\frac{\text{Area sampled (in acres)}}{\text{Net area (in acres)}}$

TABLE 3 (Contd.)

Compartment No. / SPECIES	8a 5/291	9 5/869	9a 5/519	10 10/560	10a 10/240	10b 10/88	11 19/286	11a 10/454	11b 10/440
Adina cordifolia	-	-	-	-	1	-	4	6	-
Artocarpus integrifolia	-	3	5	3	1	-	2	4	1
Bischofia javanica	3	-	1	4	4	1	10	4	3
Calophyllum elatum	10	13	29	11	14	-	21	31	7
Canarium strictum	1	-	2	1	3	-	-	1	-
Cullenia excelsa	1	1	-	1	-	-	-	-	-
Dysoxylum malabaricum	1	8	8	9	2	-	18	9	8
Dysoxylum purpureum	-	-	-	-	-	1	-	-	-
Elaeocarpus sp.	1	-	-	-	-	-	16	-	1
Eugenia sp.	2	10	6	22	4	4	24	9	11
Hopea parviflora	3	3	3	6	5	1	10	13	9
Machilus macrantha	3	11	37	19	6	4	29	7	12
Mesua ferrea	14	24	47	38	47	12	100	83	-
Nephelium longana	-	-	4	1	-	-	11	1	2
Palaquium ellipticum	44	84	69	25	6	1	49	29	3
Poeciloneuron indicum	34	170	58	108	-	-	52	7	-
Other sp.	-	-	6	2	-	1	15	-	9

TABLE 3 (Contd.)

Compartment No. / SPECIES	12 10/417	12a 10/513	12b 10/274	13 10/285	14 10/806	14a 10/406	14b 10/184
Adina cordifolia	2	2	2	-	-	1	-
Artocarpus integrifolia	6	9	-	10	16	9	1
Bischofia javanica	20	11	7	23	46	8	1
Calophyllum elatum	15	28	41	8	27	52	5
Canarium strictum	-	-	-	6	16	6	-
Cullenia excelsa	66	12	1	218	930	41	-
Dysoxylum malabaricum	16	-	4	7	59	11	-
Dysoxylum purpureum	1	23	-	12	23	16	2
Elaeocarpus sp.	9	3	2	10	29	20	-
Eugenia sp.	27	36	2	10	104	23	-
Hopea parviflora	8	38	4	10	23	23	-
Machilus macrantha	18	55	9	19	47	61	-
Mesua ferrea	61	142	2	76	279	216	1
Nephelium longana	10	6	-	7	15	7	1
Palaquium ellipticum	91	41	2	137	487	68	-
Poeciloneuron indicum	-	-	-	-	1	-	-
Other sp.	17	2	2	5	25	16	-

Source: Mohammad, E (1967). Revised Working Plan for Palghat Forest Division, 1959-'60 to 1973-'74.

The local variation in the abundance of different tree species affects the local distribution of animals in this area. This aspect will be discussed in the next section.

Fauna

A thorough faunistic study was not attempted. Only mammals and birds in the area were studied. The Silent Valley area has almost all the representative Peninsular Indian mammals of which three are endangered - Tiger, Lion-tailed Macaque and Nilgiri tahr. Other common species are Nilgiri langur, Elephant, Wild Hoar, Toddy Cat, Sambar, Sloth Bear, Jungle Cat, Giant Squirrel, Gaur and Wild Dog, Among the larger predators, panther too occurs here apart from tiger, Black panther, a melanic form of Panthera pardus are found in the area,

As regards Avifauna, Silent Valley is very rich. 99 species were observed during the field studies (Appendix 1). The Great Indian Hornbill Buceros bicornis occur in the area in good numbers, Black-and-Orange Flycatcher, Muscicapa nigrorufa was noted near Cheriya Walakad area. There was a preponderance of Black Bulbul, Hypsipetes madagascariensis during November 1976, when the Cullenia excelsa was in flower, But during March 1977, their number seemed to have reduced considerably,

CHAPTER III

Status of Wildlife

The study was conducted mainly between January and May 1977, During November 1975, the principal investigator made a preliminary survey in the area. On the whole the team mads 438 hrs of observation, spread over 73 days.

Twenty three species of mammals excluding bats, rats and mice were observed in Silent Valley area (Table 4). Many of these species were recorded in the adjacent forest *too* (Tables 5, 6 and 7). The status of these species are different; some are endangered and some are vulnerable while some are rare and some are indeterminate.

Liontailed macaque, Macaca silenus

Eight troops of this endemic andangered primate were observed in the Silent Valley - Attapadi area; of this three were from Attapadi area and five were from Silent Valley

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Endangered : "Taxa in danger of extinction and whose survival is unlikely if the casual factors continue operating".

Vulnerable : "Taxa believed likely to move into the endangered category in the near future if the casual factors continuo operating".

Rare : "Taxa with small world populations that are not at present endangered or vulnerable, but are at risk",

Indeterminate: "Taxa that are suspected of belonging to one of the above three categories; but for which insufficient information is currently available".

area. Contact call of o R individual was heard from Havlock area in Thodikki, This can be considered as a separate troop as the former troops were located in distant places. One liontailed macaque was sighted in the compartment *14* from where the Electricity Board has been laying a diversion road, Of the five troops located in Silent Valley, three were in the submergible area an3 two were near the submergible area.

The outer cower of the nut of Poeciloneuron indica, a species which is very common here, was eaten by these macaques and the portions they left out were seen scattered on the ground. They fed heavily on Cullenia excelsa fruits also (Fig.6). During the month of November they were found feeding on the flower of this tree. In the month of August the forest floor in several places was covered mostly with the pericarps of this fruit and also the portions loft out by the monkeys.

Three troops were observed in Attapadi side on the western catchment of the Bhavani river which is contiguous *to* Silent Valley reserve on its eastern ridge, From enquiries it was found that there were many more troops in the Attapadi side as well as in the Silent Valley reserve. It *is* estimated that in the Silent Valley - Attapadi area there should be approximately 20 troops, making a population of around 200.

TABLE 4

SIGHTINGS OF ANIMALS, DROPPINGS AND SPOORS IN SILENT VALLEY AREA

Name of species	Seen	heard	Frequency of droppings			Frequency of foot prints		
			fresh	old	very old	fresh	old	very old
1	2	3	4	5	6	7	8	9
1. Bonnet Macaque, *Macaca radiata*	(1)	-	-	-	-	-	-	-
2. Liontailed Macaque, *Macaca silenus*	(5) 43	-	-	-	-	-	-	-
3. Nilgiri Langur, *Presbytis johni*	(30)	-	-	-	-	-	-	-
4. Tiger, *Panthera tigris*	-	-	-	6	5	5	3	-
5. Panther, *Panthera pardus*	-	-	-	7	4	-	3	-
Black Panther	(3)	-	-	(3)	-	-	-	-
6. Jungle Cat, *Felis chaus*	-	-	4	6	32	-	2	-
7. Small Indian Civet, *Viverricula indica*	-	-	2	3	(1) 11	1	1	-
8. Toddy Cat, *Paradoxurus hermaphroditus*	-	-	8	28	27	1	-	-
9. Jackal, *Canis aureus*	-	-	-	-	2	-	3	-

TABLE 4 (Contd.)

1	2	3	4	5	6	7	8	9
10. Wild Dog, Cuon alpinus	-	-	-	(9) 9	10	-	2	-
11. Sloth Bear, Melursus ursinus	-	-	2	1	10	-	32	-
12. Otter, Lutra sp.	-	-	-	1	-	2	-	-
13. Nilgiri Marten, Martes gwatkinsi (?)	-	-	-	1	-	-	-	-
14. Giant Squirrel, Ratufa indica	25	11	3	-	-	-	-	-
15. Porcupine, Hystrix indica	-	-	3	6	45	1	(1) 30	-
16. Indian Elephant, Elephas maximus	(2) 8+	5	(1) 9	(1) 70	(2) 208	(4)	6	23
17. Gaur, Bos gaurus	-	-	-	(10) 9	-	-	(2) 5	-
18. Nilgiri Tahr, Hemitragus hylocrius	-	-	(1)	-	-	-	(1)	-
19. Sambar, Cervus unicolor	2	-	-	-	(1) 4	6	1	32
20. Barking Deer, Muntiacus muntjak	3	1	-	-	-	2	(2) 9	-
21. Mouse Deer, Tragulus meminna	-	-	-	-	-	-	15	-
22. Wild Boar, Sus scrofa	-	-	-	-	-	(1) 1	(1) 1	(5) 42
23. Indian Pangolin, Manis crassicaudata	-	-	-	2	-	6 Burrows	-	-

TABLE 5

SIGHTINGS OF ANIMALS, DROPPINGS AND SPOORS IN ATTAPADI AREA

Name of species	Seen	Heard	Droppings			Foot prints		
			fresh	old	very old	fresh	old	very old
1	2	3	4	5	6	7	8	9
1. Bonnet Macaque, *Macaca radiata*	(6)	-	-	-	-	-	-	-
2. Liontailed Macaque, *Macaca silenus*	(3)	(1)	-	-	-	-	-	-
3. Nilgiri Langur, *Presbytis johni*	(22) 1	(12)	-	-	-	-	-	-
4. Tiger, *Panthera tigris*	-	-	-	-	1	1	-	-
5. Panther, *Panthera pardus*	-	-	-	1	7	-	-	-
6. Jungle Cat, *Felis chaus*	-	-	-	6	10	-	-	-
7. Small Indian Civet, *Viverricula indica*	-	-	-	11	-	2	2	-
8. Toddy Cat, *Paradoxurus hermaphroditus*	-	-	1	1	13	-	-	-
9. Common Mongoose, *Herpestes edwardsi*	-	-	-	-	-	5	-	-

TABLE 5 (Contd.)

1	2	3	4	5	6	7	8	9
10. Wild Dog, Cuon alpinus	-	-	-	(3)4	(4)3	-	(1)	-
11. Sloth Bear, Melursus ursinus	-	-	2	7	17	1	51	-
12. Nilgiri Marten, Martes gwatkinsi (?)	-	-	-	-	1	-	-	-
13. Giant Squirrel, Ratufa indica	22	-	-	-	-	-	-	-
14. Porcupine, Hystrix indica	-	-	1	10	32	105 diggings	-	-
15. Indian Elephant, Elephas maximus	(1)8+	-	2	11	(3)8	3 tracks	4 (16 tracks)	(1)3
16. Gaur, Bos gaurus	-	-	-	-	1	-	5	17
17. Sambar, Cervus unicolor	5	-	1	(1)10	27	4	7	123
18. Barking deer, Muntiacus muntjak	2	3	-	7	--	1	22	-
19. Mouse deer, Tragulus meminna	-	-	1	1	4	5	8	-
20. Wild Boar, Sus scrofa	-	-	2	1	-	-	-	50
21. Indian Pangolin, Manis crassicaudata	-	-	-	1	-	17 Burrows	-	-

TABLE 6

SIGHTINGS OF ANIMALS, DROPPINGS AND SPOORS IN NILAMBUR AREA

Name of species	Seen	Heard	Droppings			Foot prints		
			Fresh	old	very old	fresh	old	very old
1	2	3	4	5	6	7	8	9
1. Bonnet Macaque, *Macaca radiata*	(3)	(2)	-	-	-	-	-	-
2. Nilgiri Langur, *Presbytis johni*	(5)	(2)	-	-	-	-	-	-
3. Tiger, *Panthera tigris*	-	-	-	3	1	1	-	-
4. Panther, *Panthera pardus*	-	-	-	4	2	-	-	-
5. Jungle Cat, *Felis chaus*	-	-	-	22	-	-	-	-
6. Small Indian Civet, *Viverricula indica*	-	-	-	65	75	2	-	-
7. Toddy Cat, *Paradoxurus hermaphroditus*	-	-	-	1	-	-	-	-
8. Common Mongoose, *Herpestes edwardsi*	-	-	-	-	-	-	1	-
9. Wild Dog, *Cuon alpinus*	(1)8+	-	-	9	19	-	-	-

TABLE 6 (Contd.)

1	2	3	4	5	6	7	8	9
10. Sloth Bear, *Melursus ursinus*	-	-	-	29	23	1	1	-
11. Porcupine, *Hystrix indica*	-	-	-	3	1	7 2 diggings	2	-
12. Indian Elephant, *Elephas maximus*	-	-	2	-	277	2	-	-
13. Gaur, *Bos gaurus*	-	-	-	-	-	(1)	(1)	(1)
14. Sambar, *Cervus unicolor*	-	-	3	3	12	15	1	2
15. Barking Deer, *Muntiacus muntjak*	2	-	2	1	-	-	-	-
16. Mouse Deer, *Tragulus meminna*	-	-	-	-	-	1	-	-
17. Wild Boar, *Sus scrofa*	-	-	-	-	-	(1) 1 5 diggings	(3) 1	3

TABLE 7

SIGHTINGS OF ANIMALS, DROPPINGS AND SPOORS IN NILGIRI AREA

Name of species	Seen	Heard	Droppings			Foot prints		
			fresh	old	very old	fresh	old	very old
1	2	3	4	5	6	7	8	9
1. Bonnet Macaque, Macaca radiata	(1)5+	-	-	-	-	-	-	-
2. Nilgiri Langur, Presbytis johni	13	(10)	-	-	-	-	-	-
3. Tiger, Panthera tigris	-	-	1	2	10	2 2 scratches	-	-
4. Panther, Panthera pardus	1	-	-	6	3	-	-	-
5. Jungle Cat, Felis chaus	1	-	5	29	11	-	1	-
6. Small Indian Civet, Viverricula indica	-	-	-	1	-	-	-	-
7. Toddy Cat, Paradoxurus hermaphroditus	-	-	-	2	-	-	-	-
8. Common Mongoose, Herpestes edwardsi	-	-	1	3	-	-	-	-
9. Ruddy mongoose, Herpestes smithi	1	-	-	-	-	-	-	-

TABLE 7 (Contd.)

1	2	3	4	5	6	7	8	9
10. Jackal, Canis aureus	3	-	4	34	7	1	1	-
11. Wild Dog, Cuon alpinus	(1) 10+	-	-	-	3+	-	-	-
12. Giant Squirrel, Ratufa indica	-	1	-	-	-	-	-	-
13. Porcupine, Hystrix indica	-	-	3	49	9	(1) 3+	1	4
14. Indian Hare, Lepus nigricollis	4	-	-	15	(1)	-	-	-
15. Indian Elephant, Elephas maximus	-	-	-	15	79	-	3	7
16. Nilgiri Tahr, Hemitragus hylocrius	140	-	2	(3) 68	(2)	-	-	-
17. Sambar, Cervus unicolor	17	-	28	(22)	57	134	21	(1)
18. Barking Deer, Muntiacus muntjak	2	-	-	5	6	14	3	-
19. Mouse Deer, Tragulus meminna	-	-	-	-	-	2	-	-
20. Wild Boar, Sus scrofa	-	-	-	1	-	(3)	(6) 2	(3) 7 diggings
21. Pangolin, Manis crassicaudata	-	-	-	2	1	-	-	-

Of the right troops seen, the largest number was noted in the troop located in Thondakulam area - 18 individuals. However in many cases the total number in a troop could not be counted due to the inaccessibility of the terrain.

Nilgiri Langur, Presbytis johni

The status of this species is noted as 'Vulnerable' in the Red Data Book of the IUCN; however, this has been referred to as an endangered species quite often, In Silent Valley this is the most abundant species, 30 troops were recorded in Silent Valley area, 22 troops in Attapadi area, 5 troops in Nilambur area and 13 troops in Nilgiris. Number of individuals in a troop varies from 4 to 12 to 15. In many cases the exact number could not be counted due to inaccessibility and the quick movement of the animals through the cover as soon as it detects the observer. They were seen in West Coast tropical evergreen forests, southern secondary moist mixed deciduous forests, West Coast semi-evergreen forests and also in the Montane Wet temperate forest,

It is estimated that there should be around 80 to 90 troops in Silent Valley-Attapadi area of which 5.2 troops were actually seen, If an average of 7 individuals for a troop is considered their population in this area should be around 560 to 630. This is a very conservative estimation.

Bonnet macaque, Macaca radiata

This is a very rare species in Silent Valley area. Only one troop was located in Silent Valley, 6 in Attapadi area, 3 in Nilambur area and ▮ in Nilgiri side. This macaque is common in secondary forests, and around villages, However the troops observed in Silent Valley was in West Coast tropical evergreen forest inside the submergible area. Their population will not be more than 100 in Silent Valley - Attapadi area.

Tiger, Panthera tigris

Though tho team could not see this endangered species, indirect evidences of their presence were recorded from various places inside Silent Valley reserve and tho adjacent forests, In the Silent Valley area alone five fresh pug marks - one or two days old - and three old - a week's old - pug marks were seen. Of the five fresh pug marks, one was of a cub and another was of a tigress, both from the same place. In November 1976, pug marks of five tigers were seen within a week in the Silent Valley area. As the terrain was very hard compared to November pug marks were not clearly seen, In the Nilgiris two fresh pug marks and in the Attapadi one fresh pug mark were seen. One fresh and 12 old droppings were found in the Nilgiris. Old droppings were collected from four places in Nilambur area adjacent to Silent Valley reserve (Table 8). It is possible that there are 20 to 25 tigers in Silent Valley - Attapadi - Nilgiris (only Kundha

TABLE 8

LOCALITIES WHERE TIGER SPGOH SIGHTED

Date of observation	Locality of sightings	Frequency of sightings of Droppings	Frequency of sightings of pugmarks
7-1-'77	Varayattumudi - Attapadi	1	-
29-1-'77	Puruganayam Shola- Thodikki	-	1
27-2-'77	Elathottam, near E.B.Camp-shed, Silent Valley,	-	1
1-3-'77	Silent Valley hill, behind camp shed, near Silent Valley Dam site,	2	-
3-3-'77	Boundary of Vested Forest at Elathottam, Silent Valley, near Dam site,	2	-
4-3-'77	Near Pulipara - Silent Valley, near submergible area,	1	2
5-3-'77	Cheriawalakad - Silent Valley, submergible area.	3	-
7-3-'77	Madinam Thodu. S. Valley	-	1 Ad (1 cub)
12-3-'77	Cheriawalakad, Silent Valley, near submergible area,,	3	2
16-3-'77	Waliawalakadau, S. Valley	-	1
24-4-'77	Muttiala, Nilambur	-	1
25-4-'77	Pullata, Sispara	2	-
27-4-'77	Chichipara, Nilambur	1	-
1-5-'77	Manalipadam, Nilambur	1	-
23-5-'77	Kinnakkora, Nilgiris	2	-
25-5-'77	West Varagapallam - Peyi Bungalow, Nilgiris	5	-

TABLE 8 (Contd,)

Date of observation	Locality of sightings	Frequency of sightings of Droppings	Pugmarks
31-5-'77	Emerald - old Avalanch Road, Nilgiris.	5	-
2-6-'77	Western Catchment No.1, Nilgiris.	-	1
3-6-'77	Bengihalla F.R.H.Hill, Nilgiris.	-	1 scratching
4-6-'77	Bison swamp, Nilgiris	1	1
5-6-'77	Sispara	-	1 scratching
	Total:	29	14 (11 / 12 scratches / 1 cub)

and Korakundha) - Nilambur (vested forests lying close to Silent Valley reserve) area, In the Silent Valley alone there should be about 8-12 tigers,

Panther, Panthera pardus

This 'Vulnerable' species occurs in Silent Valley and the adjacent areas. Pug marks of three panthers were seen in Silent Valley area, Droppings were collected from 11 places in Silent Valley, 8 places in Attapadi, 9 places in the Nilgiris and 6 places in the Nilambur area. Black Panthers, a melanic form of panther, Panthera pardus were seen in Cheriyawalakadu area and in the Panthanthodu area. The two black panthers seen in Cheriyawalakadu were near a stream in the fringes of evergreen forests, facing grassland. The one seen in Panthanthodu area was on the Mukkali - Silent Valiey road side. The animal was about to cross the road and the observer could see it about 3 metres close. It appears to be very peculiar that when the animal saw the observer it looked at the observer for a few seconds and then retreated into the forest.

Population of panther, Panthera pardus in the area covered should be about 30 to *40*. In the Silent Valley area alone it should be around 10 to 15,

Jungle Cat, Felis chaus

This crepuscular creature could be seen only once in the Nilgiris. In the Silent Valley area pug marks could be seen at two places and the droppings at 42 places. In

the Attapadi area droppings could be sighted only at 16 places and in the Nilambur area at 22 places, In the Nilgiris droppings were sighted at 45 places, Pug mark of jungle cat was also noted in the Nilgiris. From the frequency of tho sightings of droppings it can be noted that Silent Valley area has a good population of Jungle Cat; their population in the area should be around 60-75,

Small Indian Civet, Viverricula indica and
Toddy Cat, Paradoxurus hermaphroditus:

The team could not see either of these species in the area covered. From the droppings at times it was very difficult to distinguish the sptcies. Altogether, droppings were located at 79 localities in the Silent Valley area; out of which 16 were supposed to be of small Indian civets and the rest was supposed to be of toddy cat, One species, presumably toddy cat showed a particular preference to dead logs, small dead twigs, roots lying across forest paths and small stone pieces as sites for excretion. From the occurrence of the droppings it was found that in some places like Cheriyawalakad their number is quite high. Their population is apparently negligible in tho Nilgiri area studied; droppings were located only in 3 localities. In the Nilambur area their number appeared to be very high, droppings were located from 141 places, In the Attapadi area they did not appear to be very common. Their population in the Silent Valley area should be approximately 70-100 (This estimation is very conservative).

Jackal, Canis aureus

Jackals were seen only in the Nilgiris and indirect evidences of their presence were available from Silent Valley area, Their population in this area seems to he very small (Table 4). From the data available it is very difficult to make an estimation. Three jackals and 45 droppings of jackal were sighted in the Nilgiris,,

Wild dog, Cuon alpinus

One pack contain!-rig 8 individuals was located in the Nilambur area. In the Silent Valley - Attapadi area, the team could not see any wild dog. Droppings were sighted at 19 places in Silent Valley area. They were seen in clusters of 5 to 10 which perhaps, indicated the numbers in a pack, Around the dam site droppings in such clusters were seen at 5 places, Five such clustsrs of droppings were found in the Cheriyawalakadu and five in Valiyawalakadu area, In the Attapadi area only seven such clusters of droppings were seen, Population of this species should be 15-20 packs in Silent Valley - Attapadi area. Silent Valley alone may have about 10 packs.

Sloth Bear, Melursus ursinus

From the frequency of occurrence of droppings it was found that Sloth bear is more common in the Nilambur area than in Attapadi and Silent Valley area. In the Nilgiris no sign of Sloth bear was seen. Droppings were sighted at 13 places in Silent Valley area, 52 places in Nilambur and

26 places in Attapadi area. In the Silent Valley area, they appeared to be common in the Cheriyawalakadu and Valiyaparathodu area. Out of the 32 foot prints of this species seen, 17 were from these areas. In the Attapadi area they seemed to be more common in the Thodikki area. Out of the 52 foot prints observed in the Attapadi area 24 were from Thodikki area. About 50 Sloth bears should be present in Silent Valley - Attapadi area. In the Silent Valley area alone the population should be around 20-25,

Giant Squirrel, Ratufa indica

Twenty five giant squirrels were recorded in Silent Valley area and 22 in Attapadi area, In the Nilambur area covered none of them were seen and in the Nilgiris only one was heard, The fleshy portions of the fruit of Calophyllum tomentosum and Poeciloneuron indicum were seen eaten by these squirrels. In most of the cases they were seen singly. There should be about 50-75 giant squirrels in Silent Valley area and there should be almost the same number in Attapadi area.

Porcupine, Hystrix indica

This Hystricidac species is common in all the areas studied except the Nilambur area, In the Silent Valley area 54 droppings of this species were located, Most of them were from the dam site area and from the Cheriyawalakadu area. In the Attapadi area 43 droppings were seen, In the Thodikki area especially in the upper

Thodikki their population was appeared to be very high, GI droppings were located in tho Nilgiri area covered, of which *46* were from Thaishola in Korakundha range. Their population should be approximately 40-60 in Silent Valley area and 60-80 in Attapadi area.

Indian Elephant, Elephas maximus

A herd of eight and another two solitary elephants were seen in the Silent Valley area. Five wore heard, Dung was seen in 287 places in Silent Valley area. Out of this 208 were very old, From the distribution of the feces it is found that elophants utilize and/or present in almost all the areas covered in Silent Valley reserve. However certain areas were found to be frequently used by elephants, like the dam site, Elathottam side, Poonnamalai area, Nellickal plot,, Thondakulam area and Cheriyawalakadu area.

In the Attapadi area too a herd of only eight were seen. Dung was sighted at 21 places. In the Attapadi reserve they were found to be more common in the upper Thodikki area. In the Silent Valley - Attapadi area their population should be around 75-100, In the Nilambur area covered they were found to be as common as in the Silent Valley area. Dung was located at 279 places, out of which 277 were very old. In the Nilgiri area covertd dung was sighted at 94 places, which suggested that they were less common here.

Gaur, Bos gaurus

Population of gaur does not appear to be high in the Silent Valley area. Dung of herds was located at 10 places and of solitary individuals at 9 places; hoof marks of solitary individuals were seen at 5 places and of herds at 2 places. In the Attapadi area dung was seen at one place and hoof marks at 22 places. In the Nilambur area hoof marks of 3 herds were sighted. No sign of gaur was found in the Nilgiris covered. In the Silent Valley area signs of their presence were obtained from Elthottam side near dam site, around Poonnamalai, Cheriyawalakadu, Valiyaparathodu, Thondakulam and Valiyawalakadu. They appeared to be more common in the Cheriyawalakadu - Valiyawalakadu area. Their population in Silent Valley - Attapadi area should be around 40 to 60, and in the Silent Valley area alone approximately 40.

Nilgiri Tahr, Hemitragus [redacted]

Many of the hills in Silent Valley area are known as 'Tahr hills', though tahr is no longer present there. The present investigators could see the sign of their prtsence only on the grassland facing Kundhipuzha beyond the Nellickal preservation plot. According to our local guide Sri. Hamsa, who is reliable and familiar with the area for the last 45 years, this area has at present a population of at least 20 to 30 tahrs. The number of droppings seen lends support to this. There was no sign of tahr in tht Attapadi area though we covered many of the so called

'Tahr hills' in this area. In the Nilambur area covered also the team could not see any tahr. In the Sispara area once a herd of not less than 15 and another time about 42 of them were seen. And in the other adjacent area of Silent Valley in the Nilgiris 83 tahrs were found. There is a good concentration of them in the Bangithapal and Sispara area.

It was difficult to estimate tho population of tahr in the Silent Valley area. Huwever there will be about 30-40 tahrs in the area,

Sambar, Cervus unicolor

This is the largest deer species found in India, In the Silent Valley area they were not as common as in the Attapadi area, Only two of them were seen in the Silent Valley area. Thirty nine hoof prints also were seen, In tho Attapadi area 5 sambars were seen; 134 hoof prints of this species were also seen here, They were common around the Chindaki area but more common in the upper Thodikki area. Their population seems to be very low in the Nilambur area covered but quite high in the Nilgiri area. 17 sambars were seen in the Nilgiri area, droppings of solitary individuals were obtained from 85 sites; and droppings of herds from 22 sites and hoof marks of solitary individuals were sighted at 155 places and of herd in one place. Wattle plantations appeared to be a favourite habitat of this species,

Fresh skeleton? of sambar were sighted at +LIE places. One in the Walakad area and the other near Sispara. Pellets were also seen near the skeletons in the Walakad area. More evidences of human activities were obtained from here. Therefore it was rot sure whether the sambas was killed by poachers or by predators. However some predators, probably wild dogs, must ave attended on this, because most of the larger bones were pulled apart and scattered around,

The population of sambar in Silent Valley - Attapadi area would be roughly 150 to 175. In the Silent Valley area alone about 5) to 70 should be present.

Barking deer, Muntiacus muntjak

Barking deer was nottd in all the areas covered, though their population was appeared to be very small. 5 of them were seen in Silent Valley - Attapady area and 4 were heard. Hoof marks were seen at about 34 places. In the Silent Valley - Attapadi area their population would be around 50-80, In the Silent Valley area alone around 40.

Mouse Deer, Tragulus meminna

Population of this smallest deer appeared to be very small in the area studied. Thtir horf mark is quite unmistakable that it appears as a mark left out by a walking stick, 15 hi; f arks were seen in the Silent Valley area and 13 in Attapadi area. Their population would not be more than 60 in the Silent Valley - Attapadi area. In tht Silent Valley reserve alone the population

should be around 30.

Indian Wild Boar, Sus scrofa

In tho Silent Valley reserve they were common in the Cheriyawalakadu area. In Thondakulam, Poonnamalai and Nellickal preservation plot areas also they were common, In the Attapndi area their concentration was found in the Thodikki area. They were very common in the forests closer to cultivated lands. In the Kunjali colony in Nilambur area various snares were used to frighten these animals,

Their population in the Silent Valley area would be around 80-100 and in the Attapadi area around 100-150.

Indian Pangolin, ~~Pan is~~ crassicaudata

No Pangolin was seen in the area cowered, but their burrows were seen in the Silent Valley and Attapadi area. In the Silent Valley reserve the burrcws of this protected species were seen in the Poonnarnalai area, around the darn site and in Nellickal preservation plot, It was difficult to estimate their population, and their number may not be more than 15 in the Silent Valley Attapadi area.

CtiAPTEK I V

EXISTING SOURCES OF DISTURBANCE TO WILDLIFE IN THE AREA

The area is already subjected to disturbances by various anthropogenic activities like plantation, agriculture, minor forest produce collection, tribal settlement, poaching and fire. However, in Silent Valley proper such disturbances are comparatively less, The nature and extent of such disturbances is discussed below,

Plantation

Various plantatiuns have been raised in the areas lying close to Silent Valley reserve although there is no plantation inside the Silent Valley reserve proper (Table 9), At Panthanthodu in Attapadi reserve on the way to Silent Valley teak, softwood and Eucalyptus are planted, Eucalyptus was planted in 1967 and the first rotation crop is almost over and the stumps are coppicing. This plantation is raised only on one side of the road leading to Silent Valley and the other side is natural forest, Therefore a striking contrast between the planted area and the natural forest can be seen here. Teak in this area shows a retarded growth, Teak is also planted in Thadikundu and Pottikal areas of Attapadi reserve, The distance from Silent Valley reserve to these two teak plantations is $3\frac{1}{2}$ and $6\frac{1}{2}$ Km respectively as crow flies. Very close to the proposed dam site about 162 hectares of land have been converted into coffee estates (Fig.7).

TABLE 9

PLANTATION IN ATTAPADI AREA

Total area in hectares

	Teak	Soft wood	Eucalyptus	Rose wood	Misc.	Total	Distance from Silent Valley Reserve
Panthanthodu	8.90	114.22	50.00	1.00	--	174.12	
Thadikundu	154.41	--	--	2.00	--	156.41	
Pottickal	184.82	7.65	--	--	--	192.47	
Chindaki	--	--	--	--	12.15	12.15	
Total area	348.13	121.87	50.00	3.00	12.15	535.15	

Source: Chand Basha (1977). Revised Working Plan for the Palghat Forest Division.

Fig. 7 Forest Clearfelled for Plantation - very near the Dam Site - Silent Valley

Fig. 8 Great Indian Hornbill - Squab
Tribals persecute it along with other birds.

In the western boundary of Silent Valley reserve adjacent to vested forests rubber and tea have been raised. In the grass land in Nilgiris Wattle, Pine and Eucalyptus have been tried thereby shrinking the habitat of Nilgiri Tahr.

Clearfelling of natural forest and converting it to plantation has significant effects on wild life, particularly in a Tropical Rain forest as i results in habitat transformation.

As the habitat is changed, a change takes place in the animal community of the area. Occurrence of the bulbul Pycnonotus cafer in Thadikundu area is a very conspicuous example for this, This species is usually seen in scrub jungles or similar forests and its nearest 'more or less natural' habitat here is Mukkali. Clearfelling natural forests and raising of plantations must have created conditions conducive to its establishment here. Similarly in the Nilgiris when grasslands were replaced by wattle plantation considerable changes occurred In the faunistic composition, One of the very conspicuous examples is the occurrence and abundance of Sambar in this area. Such invasion of species would lead to structural changes in the animal community of the area. The effect of this structurally changed community of the disturbed area on the natural community in the adjacent forest might, perhaps be adverse,

When forests are clearfelled and plantation raised continuity of the forest is lost thereby those species which are obligate forest dwellers would lose part of their habitat.

Tropical rain forest species are very specialized forms to live in a particular set of habitat, Since the environment is more or less stable in tropical rein forest, they are well specialized to live in that set of environmental factors and they are less adaptable to drastic habitat changes. Therefore creation of new habitat in the forest by plantation etc., would only amount to reducing their living space, Only those forms which are partially dependent on the rain forest make use of this habitat, also those forms which live in the similar type of habitat elsewhere would migrate to this area and colonize. Therefore the ecosystem as such of the area would be affected,

II. Collection of Minor Forest Produce

Under this apparently unimportant category falls cane, reed, cardamom[s] honey and wax. Sizable quantities of MFP are being collected from the area, Unregulated collection of minor forest produce has its impact on the wildlife of the area.

During 1975-'76, from Silent Valley area 133,100 bundles of reed, were extracted, each bundle contains 30 reeds ie., in all 3,993,000 reeds were removed. 12,800 canes were removed from Silent Valley, Attapadi. and Panakad area during 1973-'74. Cardamom was removed in good quantity from Silent Valley area. (Source: Divisional Forest Office, Palghat)

Collection of reed and cane perhaps speeds up the shrinkage of Wildlife habitats. Reeds which usually grow along water courses-in Silent Valley the good reed area is the river margin of Kundhipuzha - offer nesting sites for various species of birds, Many shy species ust this habitat as cover while they come down for water, Tigers arc knowmto use this habitat as cover to stalk their prey when the latter come fcr water.

Apart from this, thos species which feed on it are deprived of its food, Elephant activities at these sites were noticed many times. Indiscriminate removal of reeds from river banks may lead to soil erosion. More over, tho right of collection of the produce is sold by auction to private parties for a specific period of time. A number of peoplt art employed to collect the produce. These people live in temporary sheds inside tho forest, Material for sheds are collected from the forest around. Fuel for cooking is also gathered from the same source, They also keep fire on throughout the night to scare away wild animals, All these activities cause not only disturbance to the wildlife but also degradation *of* the forest and reduction of tha habitats of wildlife. These workers might probably go for poaching wild animals. As they are put up in the interior of the forest the chances of bringing them into book are also negligible, As a result this illicit poaching goes unchecked.

III. Tribal Colony and Tribal Welfare Schemes

There are no tribal settlements inside the Silent Valley area. In the adjacent Attapadi area there are 11 settlements belonging to thr e classes of tribals - Kurumbas, Mudugas and Irulas. In all, their population was about 843 during 1976. It is found that the population is on the increase as detailed below:

TABLE 10

	1943		1959		1976	
	No.of families	Total population	No.of families	Total population	No. of families.	Total population
Thodikki	23	114	22	100	18	88
Kadumanna	11	41	22	78	23	119
Anavai	5	29	18	70	25	134
Thadikundu	11	42	12	41	13	59
Murugalai	10	52	10	35	3	15
Pottickal	10	37	19	79	20	96
Gottiyargandi	7	26	11	54	25	114
Kurukathikallu	7	40	10	43	17	82
Galassi	--	--	2	14	4	23
Thodikki (lower)	--	--	--	--	21	93
Kinattinkara	--	--	--	--	5	20
Total:	84	381	126	514	174	843

Source: Chand Basha (1976). Revised orking Plan for the Palghat Forest Division.

If the present trend in the growth of population is maintained, it is estimated using Lagrange's formula that the population by 2000 A.D. would be about 2000. Tribals interfere with the ecosystem in various ways.

Agricultural Practices

In the olden days tribals practised shifting cultivation. They had to abandon this prectica at the insistance of forest department and to live permanently at a place and nractice agriculture around their settlements. Usually forest around the settlements are clearfelled for agricultural practices. It is noticed that the extent *of* land utilized for cultivation is also on the increase (Table 11). From the bare 221 hectares in 1927, it rose to 1820 hectares by 1976. The increase in land use does not appear to be directly relattd to the increase in population, There is an increase in the per head requirement of land. In 1943 per nead land area was 1.33 hectares nnd in 1976 it was 2.41 nectares. Apart from the direct shrinkage of habitat of wildlife their agricultural practices would result in: disrupting the continuity of the forest, changing the configuration of the vegetation of the area and in altering the animal community of the area,

As tho continuity of the forest is disrupted certain animals will lose pert of their range, as they are shy of crossing the opened up area. Those species which arc not shy of such habitats when trying to cross the patch are scared away in order to protect the crop, Elephants at night usually cross these cultivated areas trampling upon the cultivation thereby arousing the enemity of settlers,

TABLE 11

Area in hectares used for agricultural practices by Tribals in Attapadi area

	1927	1933	1943	1959	1976
Thadikundu	42.90	68.13	48.56	66.00	100.00
Anavai	19.43	34.00	48.56	130.31	300.00
Murugalai	36.42	43.71	36.42	80.94	140.00
Gottiyargandi	18.21	24.28	34.00	96.72	160.00
Kurukathykallu	17.00	38.85	98.85	99.14	100.00
Thodikki	51.00	87.41	104.41	189.43	280.00
Kadukumanna	22.25	34.00	63.13	35.40	300.00
Pottikal	14.14	46.14	72.84	72.56	72.56 ?*
Galassi	--	--	--	4.05	140.00
Thodikki (Lower)	--	--	--	--	240.00
Kinattinkara	--	--	--	--	40.00
Palapada	--	--	--	--	20 000
Total :	221.35	376.52	506.77	674.55	1,892.56

Lower Thodikki was formed around 1969-'70.
Kinattinkara was formed around 1973-'74.
Palapada was formed around 1973-74.
*Data for 1976 not available,
Source: Chand Basha (1977). Revised Working Plan for Palghat Division.

As the vegetation of the area has changed - in Attapadi. area they cultivate ragi, maize, chena, mustard and vegetables - the animal community of the area also undergo changes. This change in the animal community is very evident in Thodikki area. In this area large extent of forest were clearfelled for shifting cultivation, As a result, at present the area is covered by thick scrub and

secondary growth. Occurrence of Blackwinged Kite, Elanus elanus in this area is noteworthy and so is the occurrence of Yellowthroated Sparrow, Patronia xanthcollis. Blackwinged Kite is a habitant of cultivated areas in the hills, they occur also in grasslands with sparse true growth, However there is no record of their occurrence in evergreen forest, Their main food is field rats and lizards, The species apparently came to Thodikki area when the forest is opened up and various cultivations are practised. As this species occupies a position at the apex of food web the entire ecosystem gets disturbed. Agricultural crops attract rodents from the adjacent forest. A good proportion of them are preyed upon by the new predators arrived and another portion are caught and killed by the tribals in order to protect the crop. This makes an imbalance in the rodent population in the adjacent forested areas. At Thodikki the population of porcupine is found to be very high,

Yellowthroated Sparrow usually occurs in deciduous forests, "affects light secondary jungle and the neighbourhood of cultivation and homestcads along the backwaters" (Salim Ali, 1969), Spotted Dove Streptopelia chinensis which is also a deciduous forest lover occurs here in good numbers. All these are caused by the change in the wegetation and are examples for invasion of species to a man made habitat, Certain species live in the adjacent forest and visit the cultivated area regularly for food. This would reduce the dependence of such species on the natural ccosystcrn.

The tribals carry out snaring of various species of mammals and birds, They are caught and sold in markets, From a hut in Achanalla near Saivala the following species of birds were seen in cages; caught and kept by tribals.

Roseringed Parakeet, Psittacula krameri
Blossomheaded Parakeet, Psittacula cyanocephala
Small Green Barbet, Megalaima viridis
Blackheaded Munia, Lonchura malacca
Spotted Munia, Lonchura punctulata
Grey Jungle Fowl, Gallus sonneratii
Lorikeet, Loriculus vernalis
Great Indian Hornbill, Buceros bicornis

Groat Indian Hornbill is a protected species. The tribals were having a squab (Fig.8) which is said to be a great delicacy for them. At Thodikki the Principal Investigator found them trapping field rats,

They set fire the grassland intentionally or otherwise during their wanderings through the forest, In Cheriyawalakad area in Silent Valley for example, one day two tribals were seen far away from our camp site and after some time the grassland in that area was found burning,

For the fuel for cooking tribals depend solely on forest woods. They, not only collect the dead - fallen trees, but chop large trees, leave thtm for drying and then collect, This causes considerable damage to the forest around.

Tribals keep dog, poultry and cattle. At times they take their pet dog into the forest when they go in search of honey etc. This practice involves the risk of spreading rabies. Cattle population is also dangerous to wild animals as they spread diseases like rinderpest, foot-and-mouth etc.

For the construction of their huts too the poles have to come from the adjacent forests. As new settlements are started quite often the pressure for poles and forest land also goes high, New settlements are started at their own will and at places selected by them. The Thodikki settlement was split into two during 1969-'70 and a few families moved towards the west of Bhavanipuzha, much lower to the Thodikki settlement. This new settlement is known as Lower Thodikki Settlement. The Palapada settlement was formed in order to accommodate the five wives and children of the Moopen - headman of the settlement - of the Anavai settlement sometime between 1973-'74 (Basha, 1977). Similarly Kadukumanna settlement was bifurcated during the same period and a new settlement called Kinattinkara settlement was formed about 2 Km from Kadukumanna. These new settlements came up without the approval of forest department (Ibid). Therefore there is every danger for the tribals to move towards Silent Valley side and make their colonies there.

At Mukkali a housing colony has come up (Fig. 8 & 9) for the tribals as a part of the Tribal Welfare Scheme of the government and forests around it are being converted to various plantations. A large cardamom nursery has been

established here.

IV, Fire

Firs was common at many places; on the way to Silent Valley from Mukkali a little short of Panthanthodu and above, around tho proposed dam site, near Cheriawalakad, around Valiyaparathodu, near Kanjikomban peak are the few to mention. These fire are man-made. Minor forest produce collectors and tribals are responsible for most of these fire. At Cheriyawalakad we witnessed the tribals setting fire to grass (Fig.10).

Nan-made fire is a disturbance to wildlife and to natural ecosystem. The immediate effect of fire is that it causes a shortage in food supply to herbivores and to those species which depend upon tht burnt. vegetation. These animals are forced to migrate to areas where fire has not reached. The young of ungulates are frequently destroytd in fire while the fully grown escapes death from grassland fires (Phillips, 1965). Rodent populations are affected very badly. In B rkely mouse populations were reduced to practically nil due to fire (Cook, 1959). These mouse moved away from the area and after six months started returning. During tho second post-burning season though the population density was almost normal, the relative population of the different species was not stabilized (Ibid). Ground nesting, and ground feeding birds arc affcttd very badly and are forced to migrate temporarily, Insect population is also affected. A study conducted in Washington

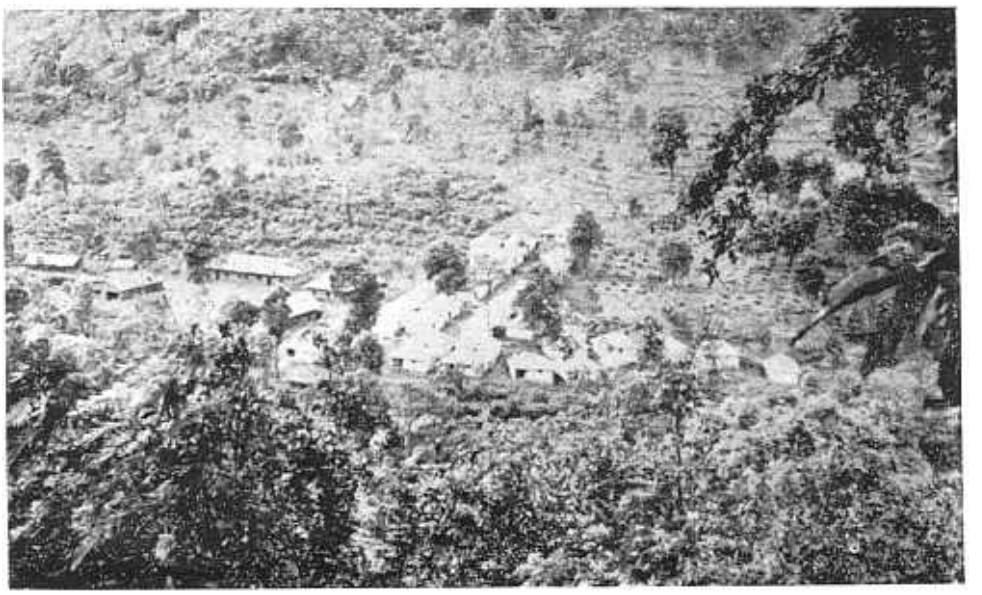

Fig. 9 Tribal Colony at Mukkali

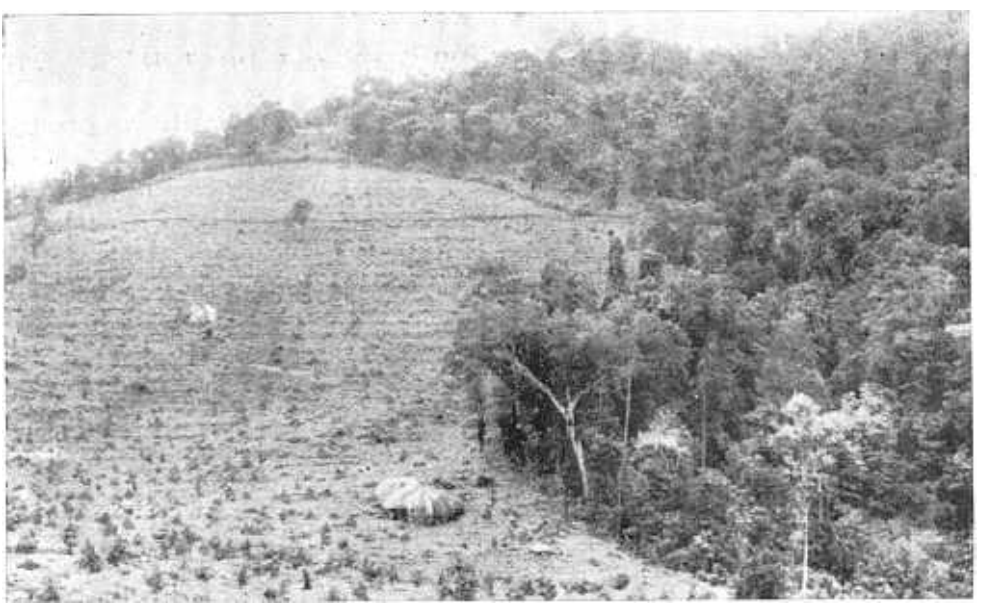

Fig. 10 Grassland near the dam site - after fire - Silent Valley

showed that Lepidopteran larvae were reduced to 50 times in number due to fire. (Crawford and Harwood, 1964). Microfeuna of the area also undergoes rapid changes,

Frequent fire cause considerable damage to the vegetation of tho surrounding area. The fire which spread rapidly in the direction of the wind goes up to the fringes of the evergreen forests, and those plants in the fringrs are burnt or affected. If it is moist deciduaus forest the fire encroach into the forest ond devastate the undergrowth. This affects the regeneration of seedlings. Growing seedlings in the grasslands, whose seeds arc! dispersed by natural agencies are burnt off, only those species which are fire resistant thrive in the area. This was noticed near Kanjikomban area where all the seedlings were appeared to be burnt off due to fire leaving aside only the fire resistant species Dalbergia. Emblica officinalis, a firt resistant species is common in the grasslands of lower elevation, where the grass grow very high. As a result of fire the leaves are wilted and fallen off and the tree remains as dead, till the rain arrives, when there will be a spurt of new leaves and shoots.

However, burning was practised in wildlife management, Selected areas arc burnt sufficiently earlier, so that young shoots come up when the grasses in the adjactnt areas are dried up or burnt by wild fire in summer. This providesprotoin rich fodder to grazers at a time when grass in the area is dried off and become nutritionally

poor. Apart from this, controlled burning is practised mainly to remove inedible grass, to influence the the distribution of animals on the range and also to check fire hazard,

V. Poaching

On the top of the above factors, poaching is yet another factor which speeds up the disappearance of wildlife in the area. Liontailed macaque, Nilgiri langur and sambar are the three major species said to be under consistent persecution. During the study pellets were seen in Walakad area. Poachers approach here through Karivarakundu area. Illicit hunting is heavy in Attapadii area too. We came across a tribal carrying the flesh of sambar at Chindaki. Workers in the estate near tho proposed darn site might also be indulging in poaching,

VI. Wild Dog Kills ~~and Man~~

When a sambar is killed by wild dogs, the local people chase the dogs away and snatch the kill. This activity denies the wild dog of its prey. This has been an usual practice in this area. The wild dug has to look for another sambar for its meal. The practice indirectly amounts to poaching sambar by local people, This would upset the natural balance between the predator and prey.

CHAPTER V

THE PROPOSED SILENT VALLEY HYOROELECTRIC PROJECT

A proposal is under consideration for construction of a hydroelectric dam in Silent Valley across Kundhipuzha. The area was first investigated for its power potential by the then Madras Government in 1920. Technical investigation in the area started in 1958 and preliminary construction work for infrastructural facilities taken up in 1976.

The site selected for the dam (Figs, 11, 12, 13 & 14) is about 45 Km from Mannarghat the nearest town, This is very near the exit of Kundhipuzha from Silent Valley. The site could be reached through Mukkali which lies on the way to Coimbatore from Mannarghat. The power house is preposed to be located at Thathengalam, 8 Km from Mannarghat and approximately 7 Km from the dam site,

The dam is proposed to be a double curvature parabolic arch dam with 131 metre height and 430 metre length at top. Water spread areais estimated to be 830 hectares; full reservoir level 979 m and catchment area 7,700 hectares (For more technical details see appendix 2).

The project envisages an installed power capacity of 120 MW. The expected annual firm power goneration is 522 million units and the secondary power generation is 16 million units, Irrigation facilities arc expectcd to cover an area of 10,000 hectares of paddy fields by using tail

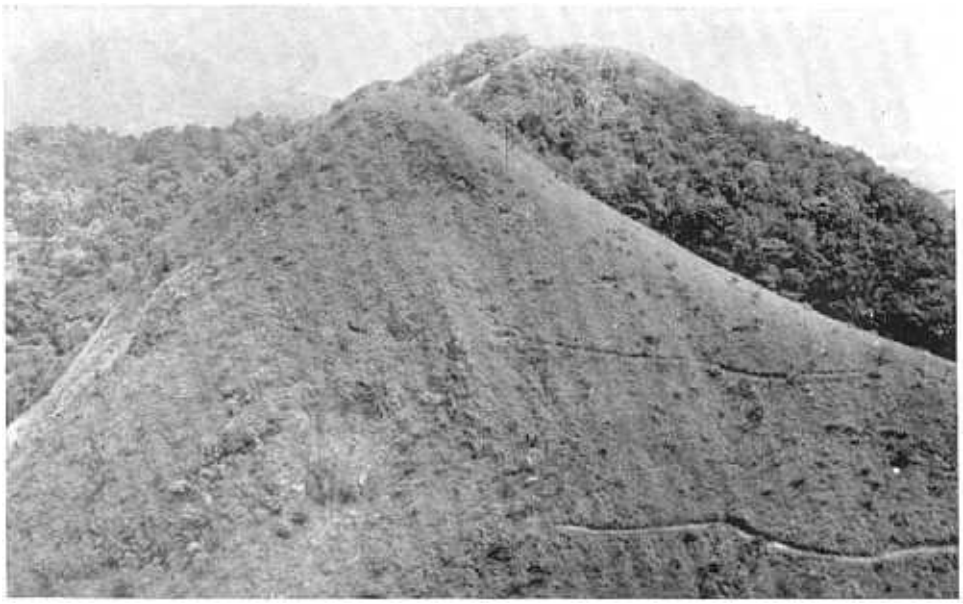

Fig Dam Site One side of the gorge

Fig. Dam Site other side of the gorge

Fig. 13 Kundhipuzha at Dam Site

Fig. 14 Electricity Board Camp Shed at the Dam Site - Part of the forest around this will be submerged

waters of the project. The project is estimated to cost Rs.41/- crores. Forest area required for the project is 1022 hectares of which about 962 hectares are reserve forest and the rest vested forest (Table 12).

TABLE 12

Forest area required for the Silent Valley Hydroelectric Project

	Approximate area in hectares	Status of Forest
Silent Valley Area		
Reservoir area	900	Reserve Forest
Temporary colony at Silent Valley dam site and adjacent area,	25	50% is reserve forest and another 50% vested forest,
Spillway, Tunnel, inlet, quarry etc.	23	Reserve Forest
Tunnel exist, Surge, Low pressure pipe line etc.	2	Vested forest
Power house area		
Colony site	10	Vested Forest
Pipe lines, Power house, Transformer yard, work area etc.	10	Vested Forest
Road from Dan site to power house.	15	Vested Forest
Road from Power house site to Cherumkulam.	2	Vested Forest
Magazine and detonator Store	2	Vested Forest
Mukkali area		
Colony site	5	Vested Forest
Dam site road from Mukkali	28	27 hectares reserve forest, 1 hectare vested forest.
TOTAL:	1,022	

Total Reserve Forest = 962.50 ha; Total vested forest 59.50 ha.

Source: Office of the Divisional Forest Officer, Palghat Forest Division, Palghat.

The project requires a labour strength of about 3000 per day and is expected to be completed by 1984,

Justification for the Project

Though Kerala has an annual rainfall of about 3000 mm, the state experiences both flood and drought. This is mainly due to the disparity in the distribution of rainfall throughout the year. During the period from January to May the state gets only 14.1% of' the total rainfall causing a dry spell and the rest 85.9% of precipitation occurs during the period of seven months from June to December, causing flood at several places, (Bureau of Economics and Statistics, 1976). The state at present has 10 irrigation projects (Table 13), affording facilities to only 18.8% of the net cultivated area of the state (Ibid). Therefore, there is an urgent need to augment state's irrigation facilities. Silent Valley Project would irrigate 10,000 hectares of paddy field.

As regards energy, hydel-power is the major source of energy in the State. Kerala is one of the leading States in India where water is used for power generation. On the whole the State's power grid has an installed capacity of 1011.5 MW (Table 14). It is estimated that for internal consumption alone Kerala requires an installed capacity of

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* In this calculation canal irrigated land of the State does not appear to have been included.

T A B L E 13

Irrigation Projects in Kerala

Name of Project	Year of completion	Ayacut in hectares
Walayar	1964	3,238
Malampuzha	1966	21,045
Cheerakuzhi	1973	1,620
Gayathri	1970	5,465
Mangalam	1966	3,440
Pothundy	1971	5,405
Vazhani	1962	3,565
Peechi	1959	17,555
Chalakudy (Diversion)	1966	19,690
Neyyar	1973	11,740

Source: Government of Kerala (1974). Irrigation Projects in Kerala, Public Works Department, Trivandrum.

T A B L E 14

Hydel Power Projects in Kerala (1976)

	Installed capacity M.W. 31 - 12 - 1976	Units generated M.K. W.H. 31- 3 - 1976
Pallivasal	37.5	21g.o
Sengulam	48.0	159.0
Neriamangalam	45.0	293.0
Panniar	30.0	125.0
Peringalkuthu	32.0	219.0
Sholayar	54.0	22200
Sabarigiri	300.0	1284.0
Kuttiyadi	75.0	263.0
Idukki (1st stage)	390.0	
Total:	1011.5	2784.0

Source: Economic Review 1976.

2181.5 MU by 1983-84. Therefore every attempt *to* augment State's power grid needs to be appreciated and supported. The additional 1170 MU required is cxpocted from the new schemes of Idamalayar, Silent Valley, Kakkad, Lower Puriyar, Karappara-Kuriarkutty, Perinjakutty, Korala Pandiyar-Punnapuzha and Idukki Stage II (Kerala State Electricity Board, 1976).

Apart from this tho project could give employment to about 3000 people per day for a period of 5 to 6 years.

CHAPTER VI

POSSIBLE EFFECTS OF THE PROJECT ON WILDLIFE

As the project requires rnanipulaticn and even destruction of a relatively undisturbed ecosystem for its reservoir and surrounds and as there is every possibility of an influx of human population, the effect of such a project on the general binta and environment may be adverse. As Tropical Rainforest ecosyster is one of the least studied ecosystems and the complexities of the interaction between the many species of animals and plants and the environment are not well established, the nature end extent of the possible impact cannot be stated now in precise terms. It is only after the future stages of tho study are completed that valid conclusions can be drawn, At this stage, when the details of the flora and fauna are known, the particular importance of this relatively virgin area as a repository of a heritage, can only be described and the possible Effects indicated on the basis rf existing knowledge.

Importance of Tropical Rain Forests of Silent Valley

According to Duncan Poore, Senior ecologist of the International Union for the Conservation of Nature and Natural Resources "Tropical Rain Forest is the richest expression cf life that has evolved on this planet". (Gwynne, 1976).

This climax vegetational formation is the product of several million years of evolution, A discussion on the

importance of Tropical Rain Forest is beyond tho scope of this report. However, the most important functions are summarized. Water supplies to tho plains arc regulated by these forests. By absorbing rain water in the soil and letting them slowly down, tho hydrologic balance is maintained and serious flood and drought in the plains are averted. Soil erosion is efficiently controlled by the forest. The recent land slide in Idukki district could be mainly due to the clearfelling of forests frcm the hills, The climatic conditions of the area are largely dependent on the forest cover. As it maintains hydrologic balance it is so of heat balance also. Tropical rain forest is unique in its flora and fauna, The flora is so diverse and complex that its richness is not yet understood and utilized by man. Tropical evergreen forest has been a focus of plant evolution for an extremely long time. Most of the flowering plants seem to have derived from tropical rain forests (Richards 1966). Tho plant breeders could make use of the 'gene pool'(Frankel, 1969) of the rain forest which is very rich, to produce the best timber plantations. This serves as a nature's *zoc* for biologists to unravel the intricacies of various biological phenomena. Finally, this could be utilized as a controlled area for reference and experimentation which are necessary for various wise land management programmes,

One of the most important features of Silent Valley forest is that it is amongst the very few isolated and relatively undisturbed rain forest area with the above

attributes and natural potentialities enumerated,

Direct impact on vegetation

Altogether the project requires 1,022 hectares of land. Out of this 950 hectares are evergreen forests (Figs.15, 16 & 17). The total number of tree loss from the area is not assessed yet, However information on the tree loss from a portion of the submergible area is available, According to the old project proposal *of* the dam the water spread area was to be 770 hectares, Out of which 240 hectares were grassland and the rest 530 hectares Evergreen forest, Trees of this area were enumerated. Accordinq to this Palaquium ellipticum and Cullenia excelsa are the tuo species which would suffer the most (Table 15). A good number of Mesua ferrea also will be lost,

Impact on Wildlife

The impact of construction of such a hydroelectric dam on all wildlife species of this area cannot be predicted with much accuracy because of our inadequate knowledge of the ecology of most of the wildlife species. However it is possible to forsee tho probable impact an certain species.

Liontailed macaque, Macaca silenus

Five troops of this macaque were seen in Silent Valley area and three in Attapadi, One solitary individual was also noted from Silent Valley. Of the five troops,

T A B L E 15

Statement of major tree loss from part of the Submergible area

Species	No. of trees with 125 cm. and above GBA	No. of trees with 75 cms. and above GBA	Total
Canariurn stricturn	121	--	121
Palaquim ellipticum	1,658	66	1,724
Calophyllum elatum	134	--	134
Machilus macrantha	102	14	116
Mesua ferrea	435	35	470
Cullenia excelsa	974	86	1,062
Hopea, Sp.	17	3	20
Nephelium longana	--	20	20
Bischofia javanica	--	13	13
Holigarna arnottiana	--	32	32
Cinnamomum	--	7	7
Dysoxylum purpureum	--	2	2
Miscellanecus wood	1	320	321
Total:	3,442	600	4,042

Source: Forest Range Office, Mannarghat. The Forest Department conducted a survey in the submergible area, enumerating the trees specially sleeper species.

three were sighted in ths submergible area and two were very near to the submergible area (Figs.18 & 19). The solitary individual was also noted near the submergible area (Map 4).

Fig. 15 Submergible area

Fig. 16 Submergible area

Fig. 17 Submergible area

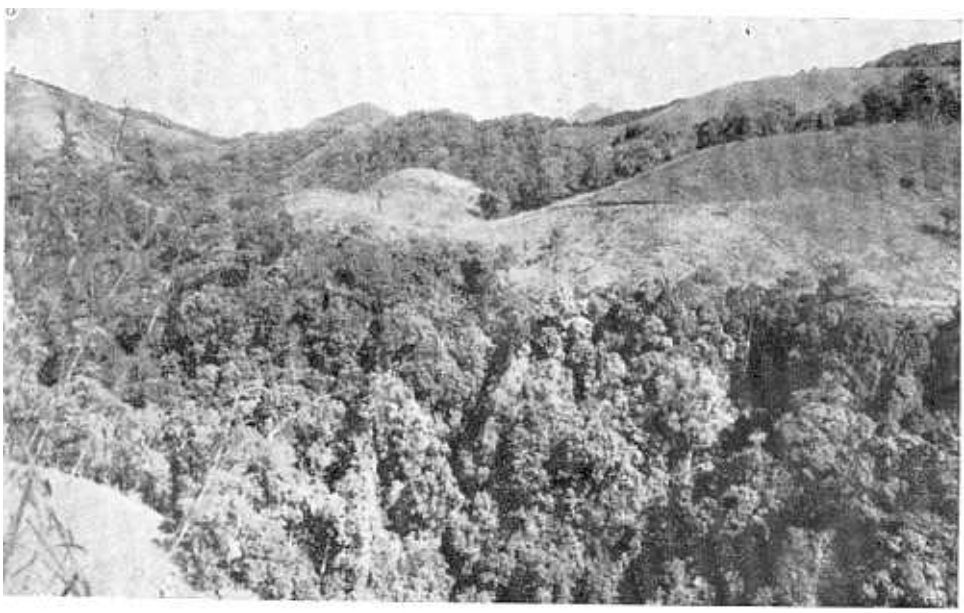


Fig. 18 Submergible area - A troop of Liontailed macaque was observed here

Fig. 19 Road construction in progress - A troop of Liontailed macaque was seen here

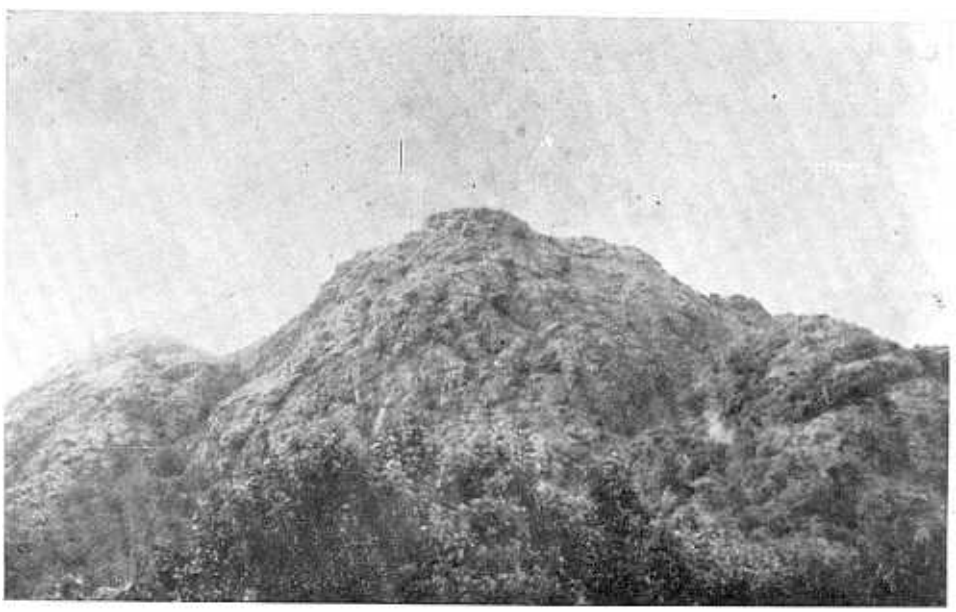
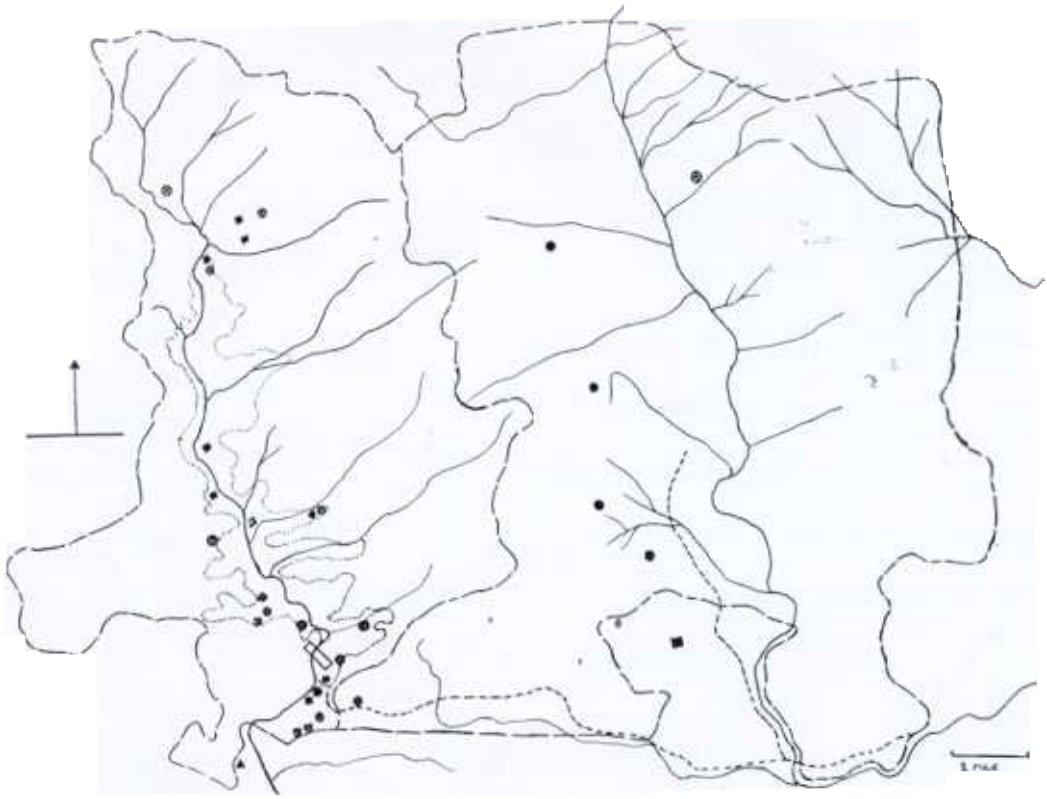


Fig. 20 One of the 'Tahr Hills' in Silent Valley

Map. 4. SIGHTINGS OF RARE ANIMALS-LOCATIONS



- TIGER PUG MARK
- TIGER DROPPINGS
- LIONTAILED MACAQUE
- NILGIRI TAHR

Cullenia excelsa, a favourite tree of the species is abundant in compartments 13 and 14. These compartments will be completely devastated by the project. All the troops in tnis area are met with in places where cullenia is abundant. More than 1,000 trees of this species will be lost due to inundation.

Liontailed macaque, which is an endemic species has a very restricted distribution in the evergreen forests of the Western Ghats in South India. This extremely rare animal is threatened with extinction due to shrinkage of the habitat, shooting and trapping, Its population has been estimated as 1,000 based on a survey conducted during 1961-'63 in its range between $9^{o}30'$ and $10^{o}3'N$ (Sugiyama, 1968). In 1975 its population was estimated to be about 500, after surveying a larger area, from $8^{o}30'N$ to $15^{o}N$ (Green - a private report). This shows that the population size has been dwindled to half during a short span of 12 years.

According to a study conducted by Steven Green of Yale University (Private Communication) each troop requires a minimum of 5 Km^2 of continuous wet evergreen forest. The study emphasises that pockets of such areas of forests will not encourage a viable breeding population since, a breeding population requires a minimum of about 130 Km^2 of unbroken forest with a minimum of 33 troops, After his survey of the status and habitat of this macaque from $8^{o}30'N$ to $15^{o}N$; be reached the conclusion that Ashambu hills and Silent Valley are tho only two areas where the macaques

could have a viable breeding population,

The whole of Silent Valley reserve is only 89.52Km^2. Therefore:, ´40 Km^2 contiguous forest of identical typo should be added to Silent Valley reserve to satisfy the minimum requirement of 130 Km^2 for a viable breeding population. Attapadi reserve, especially the ucstern catchment of Bhavanipuzha is tho only suitable forest contiguous to Silent Valley reserve. In this area too Liontailed macaques occur. Though in Amarambalam reserve macaques were recorded, their population appears to be isolated from the Silent Valley - Attapadi population due to the discontinuity of forest between the two areas. The ridge in the northern boundary of Silent Valley is too high, 1904 metres at Koyipara and 2,205 metres at Sispara. lhe lowest point in this ridge is about 1,768 metres. The peak is mostly grassy with isolated shola forest, Therefore, the connections between the forests of Amarambalam end Silent Valley are lost, On the western boundary of Silent Valley reserve, in the vested forests of Nilambur Division Forests are mainly moist deciduous, with patches of semi-evergreen forests. Various plantations and crops are raised at the foot hills and above upto certain alevation. During the survey no Liontailed macaques were seen in this area. Hence it is concluded here that these forests adjoining Silent Valley reserve on the west are unsuitable for Liontailed macaque habitation, Thus it is clear that the only identical macaque habitat that is contiguous to Silent Valley reserve is in Attapadi reserve, on the western

catchment of Bhavanipuzha. Including even this the total undisturbed area may not be as Large as 130 Km^2 prescribed for a viable breeding population. Therefore, any destruction of their habitat in Silent Valley would be disastrous to these macaques which are obligate rain-forest dwellers and cannot adapt to a new environment. The destruction of Silent Valley forest would amount to the destruction of one of the just two viable breeding populations of the Liontailed macaques in the world. The proposed hydroelectric dam would unintentionally but inevitably destroy the most suitable habitat of this species in Silent Valley area.

Nilgiri Tahr, Hemitragus hylocrius

Nilgiri highlands is the home of this endangered goat whose relatives live in the Himalayas and Arabia. Population of Tahr has been estimated as fewer than 1500. Though many of the grassy hills in Kerala are known as 'Varayattumudi' or 'Tahr Hill' (Fig.20), the tahrs are no more seen in these places due to indiscriminate killing and interference with their hahitat.

In Silent Valley a small population of this goat occurs, near Nellickal preservation plot (Map 4). In the Sispara area, and in the adjacent grasslands of Nilgiris a good population of Nilgiri tahr is present. We have recarded 140 of them in these areas. The distance between the tahr habitat and the proposed dam's reservoir is only 3.5 miles as crow files, As it is, the species is to some extent protected by nature because of the inaccessible

nature of the terrain in which they live. If the dam materializes, the accessibility to the interior of the forest would be easier resulting in severe casuality to the population of Tahr in this area. In the Nilgiris, Wattle, Pine and Eucalyptus plantations have already threatened them.

Tiger, Panthera tigris

Population of this cndangerod species has been estimated as 20 to 25 in *the* Silent Valley - Attapadi - Nilgiris (only Kundha and Korakundha area) - Nilambur (vested forests lying close to Silent Valley reserve) area. In the Silent Valley area, five out of eight pugmarks and six out of 11 droppings were sighted in the submergible area of the proposed dam (Map 4). This suggests that in Silent Valley area submergible areas is important to the tiger population, Therefore, If the dam comes up it may affect the population of tiger very badly.

Nilgiri Langur, Presbytis johni

The population of this species has been dwindling fast due to habitat destruction and poaching, This has been often referred to a5 'an endangered' species. Of the 30 troops seen, 7 troops were located in the submergible area, and 12 troops were seen around the dam site. The construction of a hydroelectric dam in this area would further diminish their already dwindling population, Silent Valley area along with Attapadi forest would form a promising area to preserve this langur.

Elephant, Elephas maxirnus

The decreasing trend in the population of Asiatic elephants has been creating increasing alarm among conservationists. The population *of* this animal has been estimated approximately to *4,500* in the Kerala - Tamil Nadu - Karnataka area. In the Silent Valley - Attapadi area we estimate its population very conservately to be 75 to 100, It was told that elephants of this area migrate to Nilgiris during heavy monsoon and return to Silent Valley during the hot period of the year, Elephant tracks were seen through Thodikki upwards to Korakundha. The various tribal colonies and the land cleared up for their agricultural practices in Attapadi side has already disrupted their habitat and obstruct their free movement, The reservoir of the proposed dam would further cut down their habitat.

Construction of Silent Valley- hydroelectric darn would affect the avian fauna too, Hornbills, Buceros bicornis a protected species is seen here in good numbers. Evergreen forest is the typical habitat of this species, Hornbills require large areas of forests to maintain a breeding stock adcquato to prevent extinction. The Bushy-crested Hornbills in Malaya require 2000 Km^2 of forest area to support a breeding stock of 500 individuals (Mcdway and Wells, 1971). In the Helmeted Hornbills the requirernsnt was found to be 10,000 Km^2 (Ibid). Also, these species require large hollow trees for nesting.

Impact OR Village Crops

There has already been a complaint that the crops in the villages around the forests have been raided by wild animals. Wild boar and porcupine arc! the curse of these villages, Cattle lifting by tiger was reported in Kunjali Colony in the Nilambur area. Further pressure and persecution of wildlife and its habitats in the centre of the forests would force them out into the fringes of forests and ultimately they become a real threat to the crop. There has been an increase in the instances of elephants raiding the crops in Kunjali Colony, and the villagers attribute this to the construction activities in Silent Valley, They are seemingly worried of their agricultural prospects in the area because of the impending large scale disturbance in the adjacent Silent Valley forest.

Indirect Impact

Free flowing river has a natural shore line vegetation which provides habitat for many wildlife species. When the area is submerged, the impoundment shore line could not have the same vegetation as the natural shore line vegetation, since the soil condition in the new area is different.

Frequent fluctuation in the reservoir level reduces tho chances of re-establishment of a natural ecosystem.

Vegetation of the free flowing stream would be altered by inundation. It has been found that free flowing water produces more nutritionally rich algae flora than still water. Inundation has reduced the production of food of a water fowl (Benson, 1972).

The free flowing stream with the numerous boulders on the banks along with the riparian vegetation offers habitat for various species of wildlife. Shore line vegetation offers nesting sites for various species of birds and cover for various smaller mammals. Droppings on the boulders suggrst that various species of birds of prey, civets and smaller cats visit this area regularly. Inundation of this riparian vegetation with boulders would be followed by a chain of reaction on other related species, For example, disappearance of birds of prey from an area would result in a plague of rodents except, perhaps, squirrels. These rodents in a natural forest feed on eggs of birds and also at times on nestlings; they feed on fallen fruits and seeds as well. Thercforc, a sudden outburst of their population might affect the population of at least few bird species and also the natural propagation cf vegetation in the area. When the natural propagation of vegetation is affected, the population of herbivores is affected which would in turn affect the population of carnivores. Inundation of this riparian ecotype may not result in the disappearance of all the species of wildlife attached to it, But those species which are completely dependent cn the riparian habitat and

are very much habitat specific and non-adaptable would disappear. Population of other species also will be affected which will be followed by a series of changes in related species.

Human influx and its consequences

Tht construction work requires large number of people and according to the present plan these workers would be stationed around the dam site (Fig.21). During the peak period of construction about 3000 people will be employed. A conservative estimate would show that this labour force with their dependents would form a population of anything around 6000 to 7000. They will be settled near the dam site for 5 to 6 years. The consequences will be: (1) They will invariably bring cattle with them. These cattle will be left free in the forest for grazing thereby reducing the fodder for wild animals and increasing the chances of spreading diseases to them, The rinderpest which claimtd a high toll of Indian Gaur in Thekkady Wildlife sanctuary was apparently brought in by domestic cattle, (2) Poultry, pet dogs and cats are brought in, These dogs will not be looked after well and at times they will be dangerous to smaller games. In the Parambikulam sanctuary for example, dogs were seen chasing spotted deer. (3) Natural forest around the settlements would have to suffer very greatly to satisfy their demand for cooking fuel and construction material. (4) Illegal cultivation is bound to take place. (5) Poaching and trapping of wild animals would become a usual practice.

Fig. 21 Worker's Camp Shed in Silent Valley

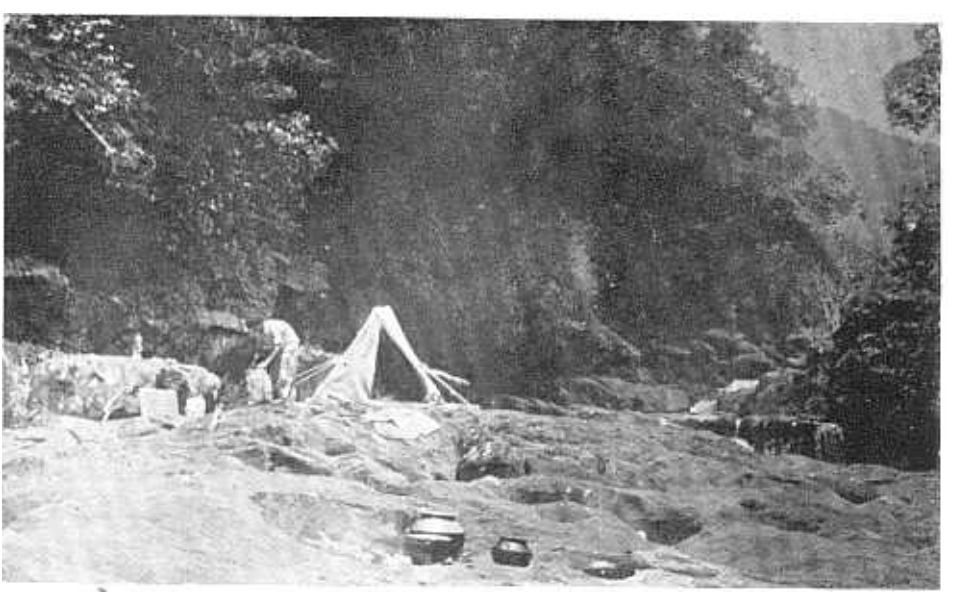


Fig. 22. Study Team's camp in Valiyawalakadu - Silent Valley

Other ecological impacts of the dam arc not considered here in detail. A glaring example can bc cited to elucidate man's ignorance of the various ecological phenomena of naturt, Aswan High Dam in Egypt aimed at modernizing agricultural practices in the Nile delta and boosting up the industrialization of U.A.R. was constructed at a cost of one billion dollars (Collier et al, 1973). The ambition was to add 1.3 million acres of agricultural land and to produce 10 billion kilowatts of power annually. The net results are:

(1) The fertility of. the Nilc delta has been desparately deteriorated. Before the construction of dam, for over thousands of years the agriculture in Nile delta area nas been associated with the annual cycle of the river which was vtry regular. The flood which occurs annually helps to restore soil water supply, to flush awav soil salts and to add the Fertility of the soil by depositing a new layer of rich organic silt, Inspite of the continuous cultivation in Nile dclta for thousands of years, the area has been kept fertile by this natural phenomena, After the construction of dam there was no more silt deposition in the delta as the silt accumulated in the bottom of the reservoir, Therefore, the fertility was tremendously decreased and artificial fertilizer had tc be used which affecttd the quality and quantity of harvest (Collier et el, 1973).

(2) Salinity of soil in the delta has increased considerably due to canal irrigation. During flood concentrated

salts from tht deeper layer of soil tend to be transported up duo to the capillary movement of wattr, This process does not take place in canal irrigated area, It has been noted that unless remedial measures are taken up at a minimum cost of one billion dollars agricultural prospects of tht entire Nile delta would be doomed (Sterling, 1971).

(3) Aswan High Dam has threatened the foundation of many of the edifices that exist between Aswan Dam and the sea. Silt-ridden water below the darn increases erosion of banks. As they flaw faster they tend to reacquire tho silt from banks, This is found to be dangerous for several dams and 550 bridges below, A project known as Nile Cascade, involwiny the construction of 10 new barrier dams at tht cost of about 250 million dollars has been proposed to slow down the river flow (Sterling, 1977).

(4) Incidence of several diseases like bilharzia, malaria and trachoma have increased duo to canal irrigation (Wagner, 1971). The parasites responsible for bilharzia require fresh water snail at certain stage of its life cycle, Though the snail was widely spread during flood, seasonal drying up of ditches and pond habitats destroyed them, Permanent water source by canal irrigation increased their population. Instances of bilharzia were also increased simultaneously. An annual loss of about $.560 million was estimated due

to the increase of this disease (Benarde, 1970).

(5) Population of fish was also affected by the closure of Aswan Dam. In 1964, the fish harvest was 1,35,000 tons, By 1967, this had dropped to 85,000 tons (Anon, 1570). Sardine population was particularly affected. It is reported that prior to 1965 annual catch of sardine alone was 15,000 tons (Ibid). This had declined to 500 tons by 1968 and sardine fishery is reported to have completely disappeared by 1971 (Mayhew, in Collier et el, 1973).

On the top of this "ecocatastrophy" it is noted that the reservoir could not be filled even after seven years of the target date and the latest estimates suggest that it may require anywhere from 12 to 20G years to complete. the filling (Starling, 1971).

CHAPTER VII

DISCUSSION AND RECOMMENDATIONS

Augmentation of power and irrigation facilities are inevitable for any country pledged to grow. Therefore, it would be rather unwise for any environmental scientist, wild-life expert or conservationist to blindly oppose such developmental activities. The country should have enough facilities to irrigate its drought affected areas and to convert drier area into production farm lands; the country should have enough power for its factories and also for the daily requirement of the people. Along with this the country should also have a healthy environment and ensure the same healthy environment for generations to come. Moreover, it is the responsibility of man to conserve and preserve the priceless gift of nature. A compromise is therefore the only solution and it is possible when there is appreciation of conflicting interests of the Naturalists and the Planners.

Construction of hydroelectric dams destroys large extent of forest and alters the ecology of the area. Those species which cannot adapt themselves to disturbed environment will be very badly affected and those which adapt to the new environment would survive in the area.

Therefore, any proposal for construction of hydro-electric dam could be supported only after studying the area well, finding out the faunistic and floristic features and the importance of the area to the fauna and flora. Also,

the potentialities of the proposed hydroelectric project should be considered to see whether such a loss could be justified.

In the present case, Silent Valley reserve forest is unique in many ways and is very important for the survival of certain species. The area holds one of the just two viable breeding populations of liontailed macaques in the world. This species is an endemic, endangered one, with a world population of only around 500. The reserve has to its credit two more endangered species, tiger and Nilgiri tahr. Indian elephant, Nilgiri langur and panther whose population is fast dwindling occur in this area in good numbers. Silent Valley is the only large chunk of shola forest in the northern Kerala.

The proposed Silent Valley Hydroelectric project envisages production of 120 MW of power and offers irrigation facilities to about 10,000 acres of land. By 1983-'84, the state would require an additional 1170 MW of power to the present production of 1011.5 MW. Silent Valley project could meet 10% of the additional requirement.

The above advantage should be considered against the destruction of an ecosystem bestowed with certain unique distinctions.

The proposed dam would devour the Cullenia - rich forest, most of which are in the submergible area and around the dam site. Liontailed macaque is an obligate

Cullenia - rich forest dweller. Disappearance of these Cullenia - rich forest would mean, perhaps the disappearance of the Liontailed macaque from the area. Their population is too small to take any chance.

Idukki area supported an equally valuable forest before the construction of the dam. Construction of the dam and the subsequent human influx destroyed most of the virgin forest from the area. Such an "ecocatastrophy" is not worthy of repetition. As there is a great pressure for forest land due to various reasons, it was thought at one time that catchment areas of dams were, perhaps, the only hope for natural forest, as they would be preserved for the proper functioning of the dam. But the Idukki example proved otherwise.

In the light of the above facts, it is strongly felt that Silent Valley should not be regarded just as a chunk of forest, like any other forest. As its destruction may blow the death knell to one of the few vestiges of the magnificent rain forests in the state and threaten the very existence of the liontailed macaque; any so-called developmental programmes should take note of the naturalists' legitimate concern. The example shown by Tamil Nadu very recently is worth mentioning. The State, inspite of its accute shortage in power and water, abandoned a project - Moyar Project - which had a potential of 150 MW of power in order to save the wildlife of Mudumalai and Bandipur sanctuaries.

Recommendations

1. The proposal to construct a hydroelectric dam in Silent Valley should take into consideration the unique features of the area brought out in this study.

2. Silent Valley - Attapadi area should be kept undisturbed and declared and preserved as a Liontailed Macaque - Preserve or as a Biosphere Reserve. The vested forests around Silent Valley should be kept as buffer zone to the preserve. This preserve would be ideal for Nilgiri langur, giant squirrel, Indian elephant, tiger, panther and also black panther, leave alone the smaller mammals.

APPENDIX - I

LIST OF BIRDS OBSERVED IN SILENT VALLEY AREA

Indian Pond Heron, Ardeola grayii
Blackwinged Kite, Elanus caeruleus
Shikra, Accipiter badius
Black Eagle, Ictinaetus malayensis
Greyheaded Fishing Eagle, Icthyophaga ichthyaetus
Short-toed Eagle, Circaetus gallicus
Crested Serpent Eagle, Spilornis cheela
Falcon, Sp.
Painted Bush Quail, Perdicula erythrorhyncha
Grey Junglefowl, Gallus sonneratii
Common Bustard Quail, Turnix suscitator
Green Pigeon, Treron Sp.
Jerdon's Imperial Pigeon, Ducula badia
Nilgiri Wood Pigeon, Columba elphinstonii
Indian Spotted Dove, Streptopelia chinensis
Indian Emerald Dove, Chalcophaps indica
Blossomheaded Parakeet, Psittacula cyanocephala
Bluewinged Parakeet, Psittacula columboides
Malabar Lorikeet, Loriculus vernalis
Common Hawk-Cuckoo, Cuculus varius
Crow-Pheasant, Centropus sinensis
Collared Scops Owl, Otus bakkamoena
Forest Eagle-Owl, Bubo nipalensis
Brown Fish Owl, Bubo zeylonensis
Malabar Jungle Owlet, Glaucidiun radiatum
South Indian Hawk-Owl, Ninox scutulata
Spotted Owlet, Athene brama
Brown Wood Owl, Strix leptogrammica
Indian Jungle Nightjar - Caprimulgus indicus
Brownthroated Spinetail Swift, Chaetura gigantea
Whiterumped Spinetail Swift, Chaetura sylvatica

APPENDIX - I (Contd.)

Malabar Trogon, Harpactes fasciatus
Whitebreasted Kingfisher, Halcyon smyrnensis
Chestnut-headed Bee-eater, Merops leschenaulti
Small Green Bee-eater, Merops orientalis
Malabar Grey Hornbill, Tockus griseus
Great Indian Hornbill, Buceros bicornis
Small Green Barbet, Megalaima viridis
Little Scalybellied Green Woodpecker, Picus xanthopygaeus
Yellownaped Woodpecker, Picus chlorolophus
Goldenbacked Threetoed Woodpecker, Dinopium javanense
Great Black Woodpecker, Dryocopus javensis
Heartspotted Woodpecker, Hemicircus canente
Malherbes' Goldenbacked Woodpecker, Chrysocolaptes lucidus
Dusky Crag Martin, Hirundo concolor
Nilgiri House Swallow, Hirundo tahitica
Redrumped Swallow, Hirundo daurica
Greybacked shrike, Lanius schach
Indian Oriole, Oriolus oriolus
Black Drongo, Dicrurus adsimilis
Bronzed Drongo, Dicrurus aeneus
Racket-tailed Drongo, Dicrurus paradiseus
Grey-headed Myna, Sturnus malabaricus
Common Myna, Acridotheres tristis
Southern Grackle, Gracula religiosa
Southern Tree-Pie, Dendrocitta leucogastra
Jungle Crow, Corvus macrorhynchos
Blackbacked Pied Flycatcher-Shrike, Hemipus picatus
Malabar Wood Shrike, Tephrodornis virgatus
Orange Minivet, Pericrocotus flammeus
Common Iora, Aegithina tiphia
Fairy Bluebird, Irena puella
Redwhiskered Bulbul, Pycnonotus jocosus
Redvented Bulbul, Pycnonotus cafer
Yellowbrowed Bulbul, Hypsipetes indicus
Black Bulbul, Hypsipetes madagascariensis

APPENDIX - I (Contd.)

Spotted Babbler, Pellorneum ruficeps
Scimitar Babbler, Pomatorhinus schisticeps
Blackheaded Babbler, Rhopocichla atriceps
Rufous Babbler, Turdoides subrufus
Wynaad Laughing Thrush, Garrulax delesserti
Quaker Babbler, Alcippe poioicephala
Brownbreasted Flycatcher, Muscicapa muttui
Black-and-Orange Flycatcher, Muscicapa nigrorufa
Whitebellied Blue Flycatcher, Muscicapa pallipes
Tickell's Blue Flycatcher, Muscicapa tickelliae
Nilgiri Verditer Flycatcher, Muscicapa albicaudata
Greyheaded Flycatcher, Culicicapa ceylonensis
Paradise Flycatcher, Terpsiphone paradisi
Blacknaped Blue Flycatcher, Monarcha azurea
Coorg Longtailed or Wren-Warbler, Prinia hodgsonii
Greenish Leaf Warbler, Phylloscopus trochiloides
Large Crowned Leaf Warbler, Phylloscopus occipitalis?
Leaf Warbler, Phylloscopus sp.
Malabar Whistling Thrush, Myiophoneus horsfieldii
Whitethroated Ground Thrush, Zoothera citrina cyanotus
Blackbird, Turdus merula
Yellowcheeked Tit, Parus xanthogenys
Velvetfronted Nuthatch, Sitta frontalis
Richard's Pipit, Anthus novaeseelandiae
Yellow Wagtail, Motacilla flava
Grey Wagtail, Motacilla caspica
Thickbilled Flowerpecker, Dicaeum erythrorhynchos
Small Sunbird, Nectarinia minima
Little Spider-hunter, Arachnothera longirostris
White-eye, Zosterops palpebrosa
Yellow throated Sparrow, Petronia xanthocollis
Rufousbellied Munia, Lonchura kelaarti
Hodgson's Rosefinch, Carpodacus erythrinus

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APPENDIX II

Silent Valley Hydroelectric Project

Salient features

LOCATION:

State	Kerala			
District	Palghat			
River	Kunthipuzha, Tributary of Bharathapuzha			
Site of dam	Lat. 11^{o}	05'	35"	N
	Long. 76^{o}	26'	40"	E
Site of power house	Lat. 11^{o}	02'	30"	N
	Long. 76^{o}	27'	10"	E

HYDROLOGY:

Catchment above dam site	77 Sq. Km.
Av: annual rainfall	460 CM
Av: run off at dam site	293 $M.m^3$
Design flood	970 m^3/sec

RESERVOIR:

Full reservoir level	979.00 m.(3212 ft.)
Gross storage at FRL	317.00 $M.m^3$
Minimum draw down level	894.00 m
Dead storage below MDDL	3.96 $M.m^3$
Live storage	313.04 $M.m^3$
Water spread area at FRL	8.30 Sq. Km.(2050 acres)

DAM

Type of dam	Double curvature Parabolic arch
Nominal bed level	+854.00 m.
Deepest foundation level	+850.00 m.(2788.00 ft)
Road level at top of dam	+981.00 m.(3218.00 ft)
Height of dam above deepest foundation level	131.00 m.(430 ft)

APPENDIX II (Contd.)

Length of dam at top	430.00 m.(1410 ft)
Top width	6.00 m.
Volume of concrete	3.56 lakhs m^3(125.70 Lakhs cft)
SPILLWAY:	
Location	At right side saddle
Crest level	+ 973.00 m.
Length	39.00 m.
Type of gates	Radial
No. and size of gates	3 Nos. 11 m x 6 m
INTAKE:	
Location	On the left flank upstream of the dam
Sill level	+ 887.27 m.
POWER TUNNEL:	
Shape	Circular
Size	Finished dia 2.90 m.
Lining thickness	30 cm. (av:)
Length	4525.00 m. (14840 ft)
Maximum discharge	18.70 cumsecs (660 cusecs)
SURGE SHAFT:	
Type	Circular
Size	Inside dia 6.00 m.
Top level of shaft	+ 1005.00 m.
Lining	Concrete lined, 45 cm. thick
Horizontal expansion chamber	16.5 m^2 x 80 m.
LOW PRESSURE PIPE LINE:	
No. of tunnels	One
Size	2.30 m. dia. (7.55 ft)
Length	260.00 m. (850 ft)

APPENDIX II (Contd.)

PENSTOCKS:

No. of Penstocks	One, bifurcating at power house end
Dia. of main pipe	2000 mm. (6.56 ft)
No. and dia. of feeder pipes	2 Nos. 1450 mm.
Length of penstock	2335 m. (7660 ft)

POWER HOUSE:

Type of turbines	Pelton wheel
Generator floor level	+ 98.00 m.
Centre line of pelton runner	+ 93.50 m.
Maximum gross head	885.50 m. (2905.75 ft)
Average gross head	857.00 m.
Minimum gross head	800.50 m.
Firm power draft	8.7 cumsecs.(307 cusecs)
Installed capacity	120 MW
No. of generating units	2 Nos.(60 MW each)
Size of machine hall	50 m x 20 m

Source: Kerala State Electricity Board, 1977.
Silent Valley Hydroelectric Project.

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