Possible Impacts of the Proposed Hydroelectric and HPCL Pipeline Projects, on Asian Elephant Populations

Impact Assessments of Proposed Pandiar - Punnampuzha Hydroelectric Project and HPCL Pipeline Project on Asian Elephant Populations

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Preface

The Gudalur and Nilgiri North and south Forest Divisions and Mudumalai Wildlife Sanctuary of Tamil Nadu, southern India are connected to each other, and are a part of the Elephant Reserve number 7. Elephant Reserve Number 7 is one of the elephant reserves designated for elephant conservation by Government of India and it is reported to be support the largest elephant population in southern India. Indeed this is the largest population of elephants in India. This population may be larger than the entire elephant population of any other Asian country. Elephants from these sanctuary and forest divisions migrate south to Nilambur Forest Division of Kerala and Mukuruthi National Park, of Tamil Nadu, both of which form a part of Elephant Reserve number 8. Elephants from the Mudumalai Wildlife Sanctuary (Tamil Nadu), Bandipur National Park (Karnataka) and Wynad Wildlife Sanctuary (Kerala), forest complex moves freely across the divisions. The proposed Pandiyar - Punnampuzha Hydroelectric Project would take place in Gudalur, Nilgiri North and Nilgiri South Forest Divisions and Mudumalai Wildlife Sanctuary of Nilgiri District, Tamil Nadu and it envisages the construction of 4 dams, 2 diversion weirs, interconnecting arrangements and powerhouses. It's expected that the various activities of the project may submerge forested area of Mudumalai Wildlife Sanctuary, Gudalur and the Nilgiris North Forest Divisions. The 27 km diversion tunnel connecting the 2 stages of the project would lie underneath the Reserved Forest areas of Nilgiris North Division.

The impact assessment done for The Pandiyar-Punnampuzha Hydroelectric Project gave experience for developing concept note on the impact of another project on elephant population in Western Ghats. The area from Banjar to Gundiya in Western Ghats is very crucial for elephants. There are a number of private estates, with reasonably good forest cover located between these two regions. Along with reserved forests, these private forests are connected to each other and form a contiguous habitat for elephants. The forest type within this belt includes tropical wet evergreen, semi-evergreen, mixed deciduous and grasslands. Mumbai based Hindustan Petroleum Corporation Limited (HCPL) has proposed a 364 km Mangalore-Bangalore Pipeline Project to transport petroleum products. Eighteen km of the pipeline will cut across these forest regions and it is likely that, the pipeline will fragment the habitat, and the movement of elephant will be stopped if the pipeline goes through this region. It's possible that, even the initial activities of the project would disturb the elephants a lot, and this disturbance may permanently stop the elephant movement. Currently the human - elephant conflict is not a rigorous crisis in these regions. It's possible that the HPCL pipeline project may fragment the elephant habitat and due to habitat fragmentation, loss of habitat and migratory route, in future, a severe human - elephant conflict in this region can be expected.

The document is developed based on the experience of conducting impact assessment and has two sections, the section one describe about the impact of the Pandiyar-Punnampuzha Hydroelectric Project on elephant population, and it discusses about the overall elephant population status in the proposed project area, more specifically on the Elephant Reserve Number 7 and Elephant Reserve Number 8. The insights from various stages of the project, particularly implications on Stage 1 & 2 of the proposed project are discussed, in addition the loss of critical elephant corridors, loss of biodiversity, disposal of soil mass and biotic pressure

The section two discuss about the impact of the HPCL Pipeline project, and a specific insights of the problem, need of the investigation, methodology, status of habitat and elephants in some of the important forested regions such as Banjar and Gundiya and in private forests, habitat fragmentation and resultant conservation issues and the overall effect on the Pipeline project on elephants

Both the project areas support a number of birds, mammals, fishes, amphibians, reptiles and a variety of other invertebrates. Apart from the loss of forest ecosystems, these projects are expected to have an effect on the various species mentioned above. It's assumed that the document developed to review the impacts on elephant populations and habitat may provide some direction and policy makers and it may motivate them to understand the impact of these projects on elephants and biodiversity rich regions.

Acknowledgments

The assessment of the impact of the proposed Pandiar- Punampuzha hydroelectric project on Asian Elephant project was commissioned by the Asian Elephant Research and Conservation Centre (AERCC) at the Indian Institute of Science (IISc). Prof. R. Sukumar and Dr. Arun Venketaraman provided initial support and motivation.

R. Arumugham, at the IISC, Field Station, Masinagudi, Nilgiris with his vast knowledge and dedicated field work provided critical helping hand, traveled with us to the site to investigate the impact. It was very enjoyable, walking with him, jointly exploring the landscape and the problems associated with even in the heavy rain during the investigation. Forest Department Staff provided field support and also place to stay during the assignment. At the Nilgiri Wildlife and Environment Association, Mr. Sounderrajan and Mr. Mohanraj gave all the support to carry out and complete the task.

Mr. Ranjan Rao Yerdoor and Mahalakshmi Parthasarathy of Nagarika Seva Trust, (NST), Bangalore, Karnataka, had initial dialogue with Prof. Sukumar for the impact assessment proposed HPCL Pipeline Project on Elephant Population. Mahalakshimi (NST) A. Madhusudan from AERCC accompanied us, traveled with us and provided the supports needed. At NST field office, Guruvanyankere, Dakshina Kannada district of Karnataka, Mr. Somnath Nayak, and his dedicated team showed us the landscape of Gundiga and Neriya and Banjara. The villagers from about 40 villages were very curious about us and the survey, yet shared their opinions and beverages and food. Dr. D. Kumaran Raju, with his admirable GIS skills, created concepts, brought them to the GIS environment and made the problems more visible. Joshua David, read through the data sheets and reports developed based on the data processing and provided critical, but much needed editorial support.

Section 1:
Possible Impact on the Proposed Pandiar - Punnampuzha Hydroelectric Project on Elephant Populations

Abstract

The Gudalur and Nilgiri North Forest Division and Mudumalai Wildlife Sanctuary are located at the southern end of Elephant Reserve number 7 and elephants from these forest reserves can migrate south to Nilambur Forest Division and Mukuruthi National Park, both of which form a part of Elephant Reserve number 8. Thus the population of Elephant Reserve number 7 is connected to Elephant Reserve number 8 and the Nadukani-Vazhikadavu corridor connects the populations of reserve number 7 and 8. The Pandiyar-Punnampuzha Hydroelectric Project visualizes the construction of 4 dams, 2 diversion weirs, interconnecting planning and powerhouses. The Kerala and Tamil Nadu States likely have equal shares of total yield of 14 TMC out of this project. The project engages the creation of dams in Pandiar, Yelamalai, and Marapalam of Tamil Nadu and Punnampuzha of Kerala. The Tamil Nadu Electricity Board is planned to implement this project in two stages. The project activities will take place in Gudalur, Nilgiri North and Nilgiri South Forest Divisions and Mudumalai Wildlife Sanctuary of Nilgiri District.

The various activities of the project may flood forested area of Mudumalai Wildlife Sanctuary, Gudalur and the Nilgiris North Forest Divisions. The 27.2 km diversion tunnel connecting the 2 stages of the project would lie underneath the Reserved Forest areas of Nilgiris North Division. Stage 1 of the project activity would take place entirely in the Gudalur Forest Division and Stage 2 in the Mudumalai Wildlife sanctuary and Nilgiris North Division. Stage 1 of the proposed project would submerge five forest blocks in Gudalur forest Division**.** The second stage of proposed project would affect at least seven forest types in Muduamali Wildlife Sanctuary Nigiri South and Nilgiri North Forest divisions, which are crucial elephant habitats being used in different seasons.

The project and its activities are expected to cut off elephant migratory paths such as Mudumalai - Upper Gudalur - O'Valley - Mukurthy National Park, Mudumalai - Karianshola - Devala – Nilambur, Nilambur - Elias kadai - Ayankolli - Mullanvayal - Pattavayal - Mudumalai and Mudumalai - Srimadurai - Kuchimuchi - 4th mile - Marapalam - Nilambur. The anticipated impacts on the surrounding ecosystem are loss of critical elephant corridors, loss of biodiversity, disposal of soil mass of 4.5 lakh M^3 accumulated in the process of construction of the tunnels and biotic pressure through a large-scale influx of labour force for the project

Background

Gudalur taluk is situated in Nilgiri district of Tamil Nadu. Devala and Devagiri villages situated in Gudalur taluk receive an annual rainfall of 2500 mm of rainfall through 230 rainfall days. The Devala-Punnapauzha river systems geographically fall in these village areas. These river systems eventually reach the Arabian Sea through Kerala state. The states of Tamil Nadu and Kerala propose to utilize the waters of these rivers through the Pandiar - Punnapuzha Hydroelectric Project. The Pandiyar - Punnampuzha Hydroelectric Project envisages the construction of 4 dams, 2 diversion weirs, interconnecting arrangements and powerhouses. The Kerala and Tamil Nadu States have agreed to have equal shares of total yield of 14 TMC out of this project.

It is proposed that 3 X 50 (150) MW power will be generated using Tamil Nadu's share of water. The project would involve the construction of dams in Pandiar, Yelamalai, and Marapalam of Gudualur region of Nilgiris, Tamil Nadu and Punnampuzha of Kerala. Around 7 TMC of water would be released from Yelamalai to Tamil Nadu through a tunnel. Kerala's share of 7 TMC of water will be sent from Marapalam dam through a 7 km tunnel starting from Nadugani and ending at Keelnadugani. Based on this agreement the Tamil Nadu Electricity Board has agreed to implement this project in two stages. This project received the approval of the Planning Commission in 1968. Later a modified proposal was submitted to increase the installed capacity from 3 X 50 MW into 4 X 50 MW. The work was taken up in 1969, but was subsequently stopped for exploring the feasibility of diverting Punnampuzha waters to irrigate the arid areas of Coimbatore district as the second stage of the project.

The second stage of the project involves diversion of 7 TMC water towards the east into Tamil Nadu. For this purpose a 27 km long diversion canal would be constructed between Pandiar basin and Sigur River. After power generation in Sigur Power house (located on the banks of Moyar River) the water will be released from the forebay into Moyar River, with necessary conductor system for further utilisation at the Lower Bhavani dam. So the second stage would involve: 1) Construction of Sigur power house, 2) Construction of a diversion tunnel and water conducting tunnel to a length of 28.8 km, 3) Construction of forebay dam across Sigur river and its power house with water conductor system and 4) Tail race. The project activities are expected to take place in Gudalur, Nilgiri North and Nilgiri South Forest Divisions and Mudumalai Wildlife Sanctuary of Nilgiri District. The 27.2 km diversion tunnel connecting the 2 stages of the project would lie underneath the Reserved Forest areas of Nilgiris North Division.

Stage 1 of the project activity would take place entirely in the Gudalur Forest Division and Stage 2 in the Mudumalai Wildlife sanctuary and Nilgiris North Division.

Status of elephant population in the proposed project area

The Gudalur, Nilgiri North and Nilgiri South forest divisions and Mudumalai Wildlife Sanctuary (see Joseph, 1970 for additional information of the regions) form a part of Govt. of India's Project Elephant Reserve number 7. This reserve has a number of sub populations, which are referred to as Bramagiri-Pushpagiri sub-population, Nilgiri Ghats sub-population and the Eastern Ghats sub-population. These sub populations can be considered as a single large population in southern

India as they are inter-connected through a number of narrow corridors. The Gudalur and Nilgiri North Forest Division and Mudumalai Wildlife Sanctuary are located at the southern end of Elephant Reserve number 7 and elephants from these forest reserves can migrate south to Nilambur Forest Division and Mukuruthi National Park, both of which form a part of Elephant Reserve number 8. Thus the population of Elephant Reserve number 7 is connected to Elephant Reserve number 8.

Elephant Reserve Number 7: The Nilgiri-Eastern ghats population

In order to understand the uniqueness and future of this population, it is important to consider its distribution and movement pattern. Elephant Reserve Number 7 (Figure 1) supports the largest elephant population (6300+) in southern India (Sukumar, 1986). Indeed this is the largest population

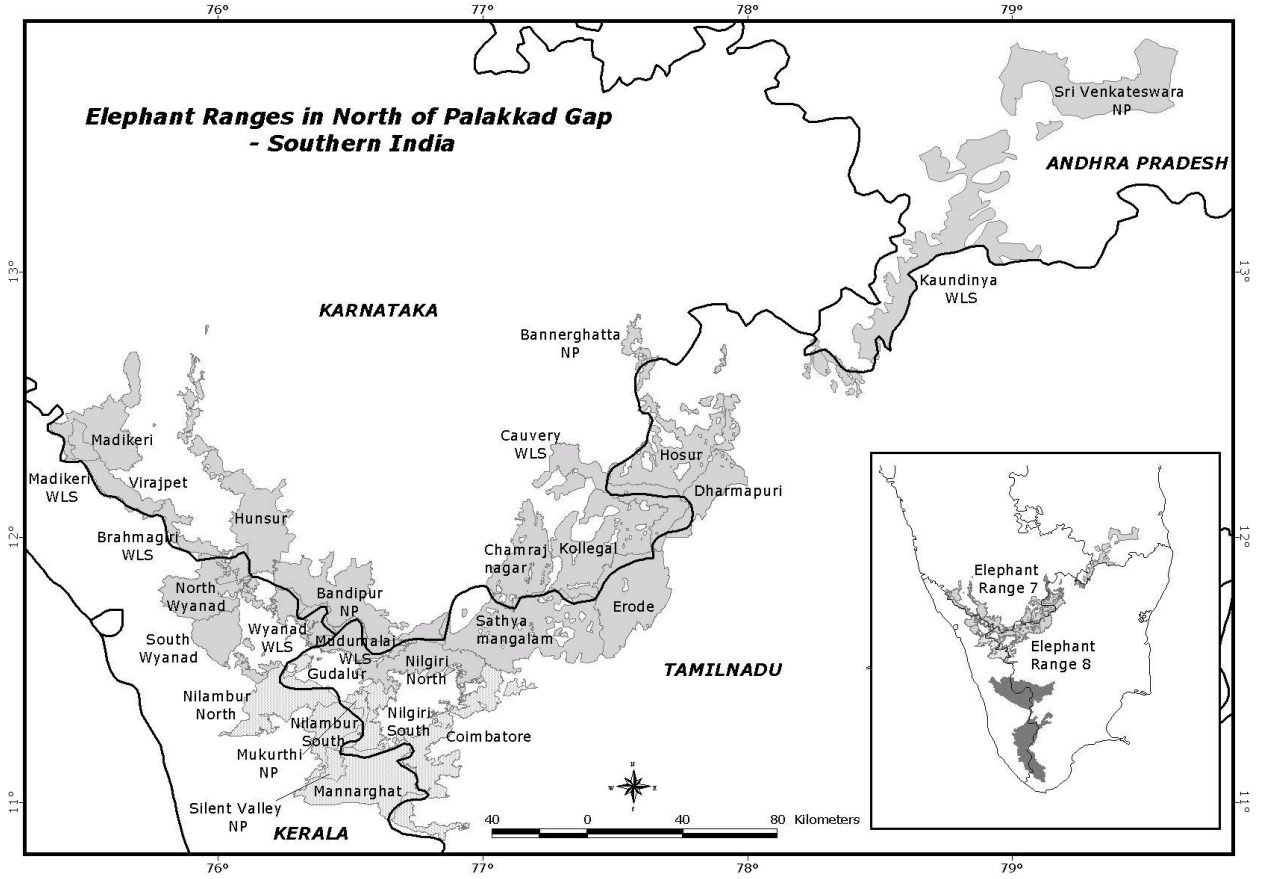


Figure 1: Elephant distribution and location of Mudumalai Wildlife Sanctuary, Gududalur, Nilgiri north and adjoining forest divisions of Elephant Reserves 7 and 8

of elephants in India. This population may be larger than the entire elephant population of any other Asian country. The density of elephants (Figure 2) varies across divisions with the highest densities reported in Wynad Wildlife Sanctuary (WLS), Bandipur National Park (NP), Nagarahole National Park (Hunsur), Mudumalai Wildlife Sanctuary (density of 2.2 to 2.8 elephants/ km ^{2}) and adjoining forest complex (Varman, et al., 1995). Elephants are reported to move across the divisions which influence the density of elephants in given area and time in the following pattern.

Elephants from the Bandipur, Wynad, Mudumalai complex moves freely across the divisions. (Nair, et al., 1980)Elephants from Brahmagiri division can move south across their entire range, the Pushpagiri elephants move north as far as Subramanya lying north-west of the Pushpagiris.

Figure 2: A group of elephants in one of protected areas of the Elephant Reserve No.7

This is probably the northernmost limit of the major elephant habitat of the Western Ghats. From Hosur Division (part of the Eastern Ghat complex) elephants can move into the Madheshwar Malai forests (Kollegal Division) which constitute a very large tract of viable elephant habitat and they enter the Cauvery Wildlife Sanctuary (Kanakapura Division), which offers contiguity with the rest of the Eastern Ghats (Sukumar, 1984) and the Nilgiri ghat sub-population. Elephants within Reserve number 7 move south into the Nilambur sub-population. The migration of elephants from Reserve number 7 to Nilambur population is possible by 4 routes; most of the areas under this route fall under private holdings which adjoins the forest areas.

Elephant Reserve Number 8 - The Silent Valley-Nilambur-Coimbatore Population

Despite the hilly nature of Elephant Reserve Number 8 (Figure 1), elephant movement is rather unrestricted and most of the traditional migration paths are reasonably intact. The elephant population within this reserve can be considered to be distributed in three distinct areas (Nair, et al., 1980).

They are 1) Nilambur and Manjeri Koviligams (Nilambur North division) 2) New Amarambalam Reserve Forests (Nilambur South division), Silent Valley National Park and the Attapadi Reserve Forests Blocks (Mannarghat division). 3) The southern slopes of the Nilgiris (Coimbatore division). Forest contiguity exists between these 3 areas and a migratory path exists to the Mukurthi National Park and the Nilgiri South Division. Forest types (Figure 3 and 4) range from scrub forest to mixed deciduous mountain grasslands and patches of evergreen forests.

Figure 3: Mixed deciduous, dry thorn and foot hill riverian forests of Elephant Reserve Number 7

Figure 4: Mountain grassland and shoal forest of Elephant Reserve Number 8

The Nadukani-Vazhikadavu corridor, which connects the populations of reserve number 7 and 8 (Sukumar, 1984), is situated on the Gudalur-Nilambur road and has both wet evergreen and semi-evergreen vegetation. A stretch of forest (26 km long) exists on both sides of the road. However the slopes are too steep for easy crossing. Most of the crossing occurs 5 km away from the village of Vazhikadavu, where the terrain is fairly leveled. This corridor effectively connects habitats within the Nilambur and Manjeri Koviligams with those in New Amarambalam.

The impact of the proposed project on the elephant population

Implications of Stage 1 of the proposed project:

The various activities of the project would submerge forested area of Mudumalai Wildlife Sanctuary, Gudalur and the Nilgiris North Forest Divisions. Stage 1 of the proposed project is expected to submerge the following forest blocks in Gudalur Forest Division.

1. Marapallam forest block
2. Pullimparai, additional forest block
3. Goldmine forest block
4. Ambalakadu forest block
5. Punnampuzha forest block

The above mentioned forest blocks come under submergible limits of power house, penstock, road and the dam site. The 13 km long linear shaped Punnapuzha reservoir, with an average width of about 0.8 km falls under the migratory path of elephants of Mudumalai Wildlife Sanctuary, Mukurthy National Park, Gudalur and Nilambur Forest divisions. The forest and the tea plantations (Figure 5) to an extent of 5000 acres will be submerged by the project.

Figure 5: Mixed deciduous forests and tea plantations of the Gudalur and adjoining regions

In addition to this around 1000 acres of land coming under section 17 of Gudalur Jamam Act also would be affected by the construction of two small weirs and a tunnel in O'Valley and Padanthyrai areas. Most of the areas in O'Valley range of Gudalur Forest Division are under dispute and occupied by private owners. Some of these areas still under forest cover and elephants are known to use these areas very frequently. This undeveloped area has about 20,000 acres land and reported to be providing forage, water and shade for the elephants.

The existence of elephants permanently in these areas has also been reported. Elephants also migrate through these areas to Mukurthi National Park and Nilambur Forest Division. Mudumalai and Wynad elephants migrate through human settlements (Bidharkad, Rock wood estate, Karian Shola, Devala, Ponnur, Marapalam, Nadugani and Nilambur). Some of these areas have severe human-elephant conflict.

The area under dispute, but still under forest cover has bamboo, grasslands, moist deciduous and semi- evergreen forests, which forms the migratory path of elephants, may be cut off due to project activities.

It is also observed that migration of elephant population from southern edge of the Mudumalai and Wynad Wildlife Sanctuaries to Mukuruthi National Park and Nilambur Forest division would be affected.

It is observed that more than 15 people have been killed by elephants in Devala, Karian Shola and adjoining villages over a period of 10 years. Apart from these human deaths, severe damage to cultivated crops has also been reported from these areas. If the movement of elephants were blocked by the proposed reservoirs of the project (Figure 6), the duration of elephant stay in these human habitations would be prolonged which in turn would increase the incidence of crop damage and human death.

The project may cut off the following migratory paths of elephants (Figure 6).

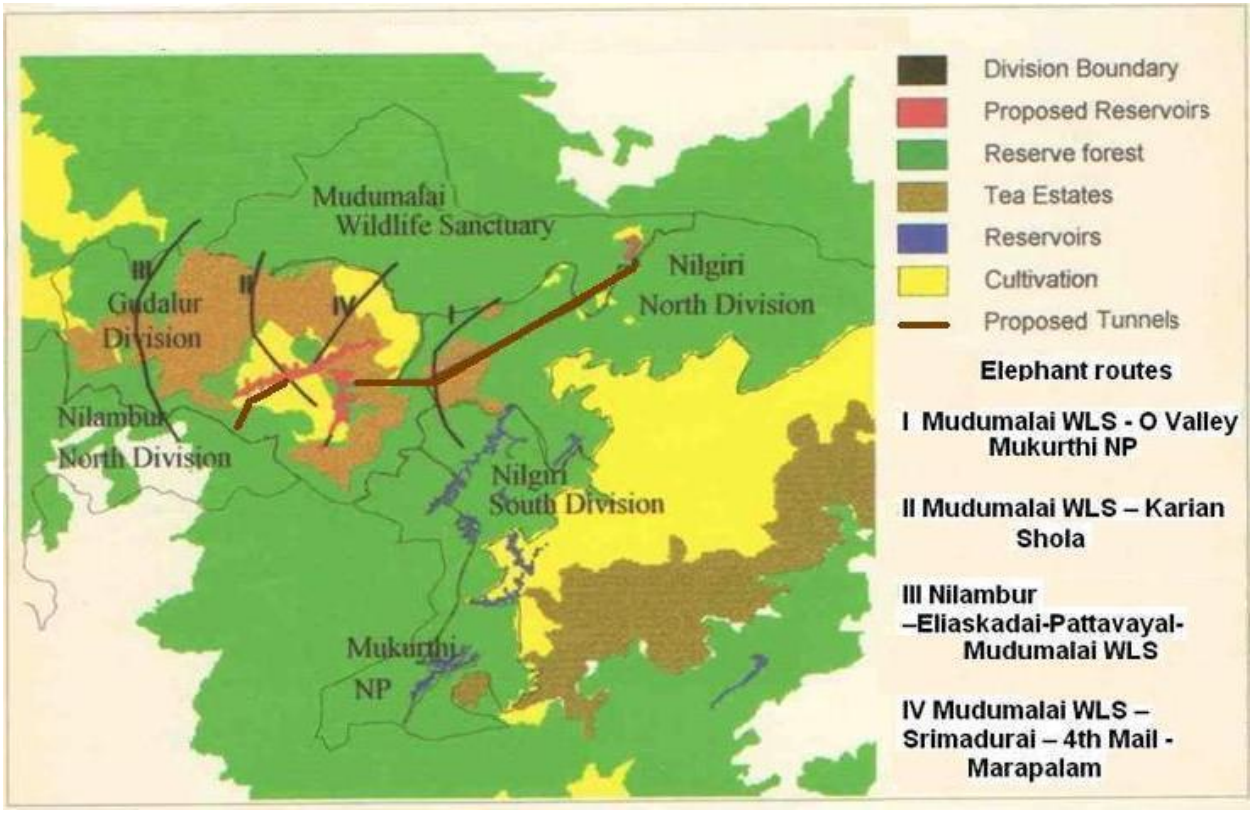


Figure 6: Map showing different forest divisions, wildlife Sanctuary and National Park (NP) and elephant routes in proposed Pandiyar-Punnapuzha Hydro-electric Project location

I. Mudumalai - Upper Gudalur - O'Valley - Mukurthy National Park.
This route is being used regularly by elephants during different seasons. Elephants of Mudumalai move to Mel- Gudalur (through Thorapalli), to O'Valley and to Mukuruthi National Park.

II. Mudumalai - Karianshola - Devala - Nilambur.
Elephants are reported to use this route during dry season when there is incidence of forest fire in Mudumalai and Wynad Wildlife Sanctuaries. Elephants move from Bidharkadu to Mukkati, Choladi, Nillakottai, Rockwood estate, Karian Shola, Devala, Atti, Ponnur, Marapalam and Gene pole, They are also reported to move from Nadugani to Nilambur.

III. Nilambur - Elias kadai - Ayankolli - Mullanvayal - Pattavayal - Mudumalai.
During the dry season elephants from Patavayal migrate to Vellari, Mullanvayal, Ammalamulla, Valat Ayankolli junction, Maravan Cherambadi, Anaipallam Elias kadai and Gleen rock and then to Nilambur Forest Division.

IV. Mudumalai - Srimadurai - Kuchimuchi - 4th mile - Marapalam - Nilambur
Elephants are reported to have last used this route 30 years ago but now only stray elephants are said

to use this route. Elephant movement has stopped due to large scale encroachment, loss of habitat and migratory path. The other route Nilambur - Elias kadai - Ayankolli - Mullanvayal - Pattavayal - Mudumalai would also be lost due to another proposed hydro electric project (Cholatipuzha Hydroelectric Project), which is expected to submerge 1472 acres of forest land in Gudalur Forest Division. This in turn will prevent elephant movement from Nilambur to Mudumalai and Wynad Wildlife Sanctuaries.

Implication of the Stage 2 of the proposed project

The second stage of proposed project would affect the following forest types in Muduamali Wildlife Sanctuary Nigiri South and Nilgiri North Forest divisions, which are crucial elephant habitats being used in different seasons.

(1) West coast tropical evergreen forests
(2) West coast tropical semi-evergreen forests
(3) Tropical moist deciduous forests
(4) Tropical dry deciduous forests
(5) Southern tropical thorn forest and
(7) Riverine forests.

It's expected that around 320 - 350 ha of forest area in Avarhalla Reserved Forest of Mudumalai Wildlife Sanctuary and Nilgiri North Forest Division would be submerged by the reservoir of the Sigur forebay dam. The Avarhalla reserved forest of both these forest divisions is known to support a very good elephant density during dry season (January - April) and second wet season (September - December). Project activity may affect elephant population density and movement of elephants here.

It is anticipated that the project will have the following overall impacts on the surrounding ecosystem.

1) Loss of critical elephant corridors, as mentioned above
2) Loss of biodiversity:

The project area supports around 220 species of birds, 36 species of mammals, 27 species of fishes, 9 species of amphibians, 38 species of reptiles and a variety of other invertebrates. Apart from the loss of forest ecosystems, the project is expected to have an effect on the various species mentioned above.

3) Disposal of soil mass:

It is expected that soil mass of 4.5 lakh M^3 accumulated in the process of construction of the tunnels will be deposited on the surface. Their disposal would pose a problem causing a severe impact on the ecosystem. The debris generated by excavating subterranean tunnel would have to be disposed off in a manner without affecting the environment which otherwise could be major environmental problem.

4) Biotic pressure:

Large-scale influx of labour force for the project would increase the biotic pressure on the forest ecosystem. The project would involve a massive influx of labour force for the actual construction of the dam and other activities. The presence of the labour force would be a major strain on the environment in the project area and its surrounding forested areas.

References

Joseph, S.J. (1970). Tamilnadu Forest Department Management Plan for Mudumalai Wildlife Sanctuary, Forest Department, Tamilnadu

Nair, P.V., Sukumar, R., and Gadgil, M. (1980). The elephant in South India, A review. The Asian Elephant in the sub-continent-IUCN/SSC report 1980

Sukumar, R. (1984). Ecology and Conservation of the Asian Elephant in south India. Brief report of work done under project No.3032 of the WWF-IUCN Asian Elephant Specialist Group.

Sukumar, R. 1986. The elephant populations of India-Strategies for conservation. Proc. Indian Acad. Sci. (Anim.Sci./Plant Sci.) Suppl.: 59-77.

Varman, K. S., Ramakrishnan, U. & Sukumar, R., Direct method of counting elephants; A comparison of results from Mudumalai Sanctuary: A Week with elephants (eds J.C. Daniel & H. Datye), Bombay Natural History Society, 1995, Bombay and Oxford University Press, New Delhi. 331-339.

Section 2:
Possible Impact of the Proposed HPCL Pipeline on Elephants in Part of Western Ghats

Abstract

Mumbai based Hindustan Petroleum Corporation Limited (HCPL) has proposed a 364 km Pipeline Project to transport petroleum products and 18 km of the pipeline is expected to go across the Western Ghats, and its river systems, reserved forests and the private forests part of the landscape. These reserved and private forest areas act as habitat mosaic and connect elephant habitats of Bhadra and Pushpagiri Wildlife Sanctuaries. Some of these forests are seasonal forests, to meet the seasonally changing, food, water, shade and other resources; elephants are known to migrate through the habitat and habitations. All these reserved, State and private forests are located between human habitations. The human habitation with their cultivated crops and the forests intercepted with the human habitations act as asylum for the elephants. As this is the situation, the Asian Elephant Research and Conservation Centre, based at Indian Institute of Science, Bangalore conducted a survey on the possible impact of the proposed project on Asian elephant movement across these habitats.

Impact of the project on elephant population was carried out visiting villages located close to forest or elephant habitat), habitat assessment and habitat utilization pattern of elephants in this region, observation was made to collect information on forest cover, its status and disturbance and other features, indirect signs of elephants were recorded and the GPS locations were obtained for all these features. The information collected through the survey and GPS locations were transferred to digital thematic map to present a geographical representation of the problem. A total of 37 villages located close to reserved and private forests and the HPCL pipeline project were visited during the survey, out of which, 27 villages reported elephant visits. The status of forests, elephant signs and their visits to the villages indicates that the HPCL pipeline project goes through an elephant area.

The survey results give an indication that, the area from Banjar to Gundiya may be crucial for elephants as the private forests are connected to each other and also to reserve forests and form a contiguous habitat for elephants. It was found that, the pipeline may cut through the elephant area and its expected that the pipeline may fragment the habitat, and the movement of elephant may be stopped if the pipeline goes through this region, Felling of trees in the right of corridor, the movement of labor and machinery for creating the trench, welding any laying the pipes in the trench, using transport vehicles, welding machinery, cranes and back filling after placement of the pipe, likely to disturb elephants and their habitat. Currently the human - elephant conflict is not a severe problem in south of Banjar. It's possible that the HPCL pipeline project may fragment the elephant habitat and due to habitat fragmentation, loss of habitat and migratory route, in future, a severe human - elephant conflict in this region can be anticipated

The problem

Mumbai based Hindustan Petroleum Corporation Limited (HCPL) has proposed a 364 km Mangalore-Bangalore Pipeline Project to transport petroleum products. It's expected that, 18 km of the pipeline may go through the Western Ghats, south of Charmadi Ghats, the region known to have 12 river systems, Balur and Dharmasthala Reserved Forests and the location of pipe line is about 20 km from Kudremukh Reserved Forest (KRF). The dimension of the proposed pipeline will be 20/24 "and a strip of 18 meter width will be retained as the right of corridor along the pipeline. It is expected that 25.12 hectares of reserved forest area is expected to be cleared for the pipeline. The project also proposes to have one booster station in Aniyur (which is few kilometers from Dharmastala Reserved Forests and Neriya (estate) private forest area). The may regions hold some important Asian elephant habitats in southern India (Sukumar, 1986, Nair et al., 1980) and the habitat and elephant status have not been not well documented (Sukumar, 1984).

The need of the assessment

Under the overall coordination of Engineers India Limited (EIL), New Delhi, the impact assessment of the pipeline on biodiversity was done by Salim Ali Center for Ornithology and Natural History (SACON), Coimbatore. However, it's imperative that a specific assessment of the project on possible impact on Asian elephant population be done, as the pipeline passes through the Charmadi Ghats. The Ghats has Kudremukh (Figure 1) National Park (Naravi Reserved Forest) in its north-west, Saragudu State Forest, Muthodi State Forest and Bhadra Wildlife Sanctuary in its north and the Balur, Kabbinale, Konajer and Kilar Male Reserved Forests and a number of privately owned forests (as estate) on its south-east and southern directions. These state, reserved and private forest areas connect well-known elephant habitats of Bhadra and Pushpagiri Wildlife Sanctuaries. Some of these forests are seasonal forests, to meet the seasonally changing, food, water, shade and other resources; elephants move across the habitat. All these reserved, State and private forests are located between human habitations. Elephant move across the habitats and these forests act as shelter for them during day time and

Figure 1: Kudremukh National Park, not very far from the proposed HPCL Pipeline Project

elephants are known to visit crop grown in the human habitation during night hours. There was a need of knowing the status of forest, human elephant conflict, impact of the proposed pipe line project on elephant number and the conflict status. As this is the situation, the Asian Elephant Research and Conservation Centre, based at Indian Institute of Science, Bangalore conducted a survey on the possible impact of the proposed project on Asian elephant movement across these habitats.

Methodology

As the direct observation of elephants and study of their movement pattern are difficult tasks in a short time period, the assessment was carried out through village survey (visiting villages located close to forest or elephant habitat), habitat assessment and habitat utilization pattern of elephants in this region. The villages (Figure 2) located south, north, east and west of the proposed pipeline area and those situated close to the state, reserved and private forests were visited. The village survey data was also used to understand the extent of human-elephant conflict reported here. The habitat assessment was carried out by visiting some parts of the reserved and private forests (Figure 3). A given time interval observation was made to collect information on forest cover, its status and disturbance and other features. The habitat utilization pattern aspect of it was studied along with the habitat assessment survey. Indirect signs of elephants, such as, elephant dung, elephant feeding and other signs were recorded. The Geographical Positioning System (GPS) instrument was used to collect the locations of the villages, forests type and elephant feeding and other signs. The information collected through the survey and GPS locations were transferred to digital thematic map to present a geographical representation of the problem.

Figure 2: One of the survey villages

Figure 4: Waling along a trail for habitat and elephant presence absence assessment

Results

A total of 37 villages (Table 1) located close to reserved and private forests and the HPCL pipeline project were visited during the survey, out of which, 27 villages reported elephant visits.

Table 1: Number and name of the villages visited, their distance from the forest, and elephant visits to the cultivated lands of the villages are given in the table.

Sl. No.	Village Name	Elephants Reported	Distance from the Forest
1	Kalmanja	No	1
2	Dharmasthala	No	1
3	Paade	No	1.5
4	Kokkada	No	2
5	Herike	Yes	1
6	Uppinangady	No	2
7	Addahole	yes	0.5
8	Gundiya Nisarga Dhama	Yes	0.5
9	Gundiya Thota	Yes	0.5
10	Manibaanda	Yes	0
11	Banjar	Yes	0
12	Malnadu Estate	Yes	0
13	Ambatemale	Yes	0.5
14	Calicut Estate	Yes	0
15	Puttethuvaduve	No	0.5
16	Gandibagilu	Yes	2
17	Kulenadi	No	1
18	Mavur Sthala	Yes	2.5
19	Neriya House	Yes	0
20	Kolna	Yes	0
21	Kolodi	Yes	0
22	74 badi	Yes	3
23	Neriya coffee estate	Yes	0
24	Periadka	Yes	1
25	Shantigudde	Yes	0
26	Pilikula	Yes	2
27	Matabailu	Yes	2.5
28	Mallamiyar/Kuntiyana	Yes	0.5
29	Oombaja	Yes	2
30	Ballal Estate	Yes	4
31	Decchar	Yes	1
32	Bolmanar	Yes	1
33	Alakki	No	1.5
34	Muddige	No	2.5
35	Mundrial	No	1
36	Arassinamakki	No	1
37	Bandihole	Yes	0.15

The average distance from the villages, where elephants are reported, to the forest is 1.5 km and to water source 0.77 km. The villages are located within an interval of 1.05 km. Elephants are reported in these villages since long. The time of visit varied from 18 to 56 years, with an average of 37 years. Every year, at least twice, the elephants are reported; a maximum of 12 animals and a minimum of one animal visit the villages, with an average of 4.69 animals. As the villages (Figure 5) are located close to each other, there is a chance that the same animal would be visiting many villages, and it would be difficult to estimate the total number of animals using this area. However, the elephant visits to these villages (though many reasons could be attributed for such visits) indicates that the HPCL pipeline project goes through an elephant area.

Figure 5: Being close to forest and cultivating elephant preferred crops, village have elephant problem

Habitat Status

The forest type within this belt includes tropical wet evergreen, semi-evergreen, mixed deciduous and grasslands. The terrain is undulating with elevation varying from 200 m to 800 m. There are a number of private estates (mostly with good forest cover) located between these two regions. These private forests are connected to each other and form a contiguous habitat for elephants. Some of these cultivated crops, and the forest cover with bamboo, Baine (*Caryota urens*), reeds (species not known) and grasslands, may act as ideal habitat for elephants. The area from Banjar to

Figure 6: Status of private and reserved forest within and close to proposed project site

(Banjar's southeast) Gundiya appears be used more by elephants and may be very crucial for them. Elephant signs have been recorded in the forest region and also in elevation varying from 200 m to 800 m. Some part of these forests and grasslands are converted into cardamom (*Elettaria cardamomum*), rubber (*Hevea sp.*), coffee (*Coffea sp.*), arecanut (*Areca catechu*) and banana (*Musa sp.*) cultivation. Paddy (Harvested grains of *Oryza sativa*) is also cultivated in some of these areas.

Status of elephants

Elephants are reported in the private (estate) forest areas such as Banjara Ambatamane, Calicut, Malanad, Balal, Aniyur (where booster station of HPCL pipeline project is proposed to be located), Neriya, Amedikal area, Shisla and Gundia. North of Banjara area, elephants are reported in Bankal, Saragudu SF, Magundi, Balehonnur, Megaramakki Cheikka Agrahara Kusukal SF, Hebbe and Lakavalli State Forest of Bhadra Wildlife Sanctuary. South of Gundia, elephants are reported in Mani Bandapa, Bisale RF and Pushpagiri Wildlife Sanctuary. Elephants use some of the reserved and private forests very extensively. It's also understood that, some of these areas act as prime elephant migratory paths. Within the private forests, Neriya (estate) private forest region appears to be very crucial elephant habitat, where concentration of elephants (number of elephant dung seen- 12° 59′ 36.6″ N, 75° 31′ 11.1″ E) was noticed to be very high.

Figure 7: Contiguous habitat with preferred habitat type within private and reserved forests

The movement of elephants from Banjar to Gundia through Neriya private (estate) forest is possible as there is a contiguous habitat available for them. Banjar to Neriya, the elephant habitat comes under private forests. The area to the south of Neriya, Balur, Miyar, Shiradi Shisla, Karinale and Kemphole Reserved Forests (Figure 8) - provides a contiguous habitat for elephants. At Gundia, (Figure 8) near Barchinahalla bridge (12° 49′ 40″ N, 75° 35′ 14.6″ E) elephants cross the Mangalore - Bangalore highway (elephant dung piles were seen on both sides of the highway and the habitat is bamboo dominated with deciduous tree cover). If elephants cross the highway and the Kemphole River (which runs along the highway), the other impediment to their movement is a railway line (Figure 8), which cuts through Kombar and Kagneri Reserved Forests. The railway line is not in a

straight-line; if elephants move from Bisle Reserved Forest (RF) to Gundiya (Kemphole and the highway) or from Gundiya to Bisle RF, the elephants have to cross the railway line at two or three places. However, local reports suggest that, elephants cross the railway line and there are two elephant crossing points reported (12° 49′ 14″ N, 75° 35′ 43.3″ E and 12° 46′ 23.6″ N, 75° 35′ 47.3″ E). According to the reports, the elephants cross the railway line as no train operates in this line. At present, the railway line is under process of conversion from meter to broad gauge. The conversion process and the frequency of train service after the conversion process are going to stop the movement of elephants, and future activities within the line is going to determine the future elephant movements here.

Figure 8; Map showing different reserved forests, private (estate) forests, proposed HPCL pile line, railway line and human habitations

Impact of the project

The pipeline may cut through this prime elephant area. There is a possibility that, the pipeline may fragment the habitat, and the movement of elephant would be stopped if the pipeline goes through this region. It's expected that, even the initial activities of the project would disturb the elephants a lot, and this disturbance may permanently stop the elephant movement. The project is going to disturb the habitat and elephant

heavily. A long list of disturbance going to be created by the project can be made. Felling of trees in the right of corridor, the movement of labor and machinery for creating the trench, welding any laying the pipes in the trench. Using transport vehicles, welding machinery, cranes and back filling after placement of the pipe, these are some of the expected disturbance to the elephants and their habitat. Apart from this creation of right of corridor may lead to invasion of exotic plants, loss of habitat, habitat fragmentation and open up less accessible forest area to human activities. It's expected that, during the operation phase, route inspection of the pipeline would be done twice a week, if such a pattern is followed, there is no clear indication how this operation would be done. Incase of leakage the impact will be server, part of the forest are dry and known to report forest fire problem during dry season, the leakage along with the forest fire would be disastrous.

Effect on habitat fragmentation on elephant movement

As far as elephants and their movements are concerned, habitat fragmentation is a very important issue to be considered (Sukumar, 1986; Nath and Sukumar, 1998). The habitat fragmentation result in loss of habitat and stops migration across the habitats. It was observed that, though all the villages visited were close to forest and water sources (the average distance between the village where elephants are not reported to the forest was 1.5 km and the water source 1 km), and cultivate same crops (which attract elephants to the villages), the elephants do not visit some villages. Elephants are not reported in the villages located south of Aniyur (up to Kokada) and Kokada to Bandihole. From Banjar to Gundiya, it can be expected that, their movement would be only through the southeast of Banjar. Aniyur - Kokada road (via Nidle) separates the Miyar Reserved Forest (north of Miyar RF, Neriya private (estate) forest is located) and Dharmastala Reserved Forests. Kokada to Bandihole road separates the Miyar and Shibaje Reserved Forests. All along these two roads, human settlements and cultivation have fragmented the habitat (though both sides of the road have good forest cover) and the elephants are seen only in the villages where habitat fragmentation is not noticed. So, any activities that fragment the habitat would stop the elephant movement from one habitat to another. It can be very strongly expected that, the pipeline that goes through reserved Forests and Neriya private (estate) forest would stop the movement of elephants between Bhadra and Pushpagiri Wildlife Sanctuaries.

Most of the elephant habitat in this region is under private forest and reasonably good forest cover is maintained here. Though many cultivated crops (which attract elephant) are cultivated in some of the villages at present, human-elephant conflict is not a severe problem. It was noticed from the evidence that, most of the villages use very primitive methods to prevent the elephant problem. This less human – elephant conflict problem could be due to the contiguous forest cover present from Banjar (south of Banjar) to Bisle Reserved Forests and it's connected to Pushpagiri Wildlife Sanctuary. If the habitat is fragmented (by various reasons) and small patches of forests connected to a large elephant habitat, a severe human elephant can be expected (Balasubramanian, et al., 1995). For example, north of Banjar, from Banjar to Bhadra Wildlife Sanctuary, the habitat is connected through a narrow forest cover and the human-elephant conflict is very severe (areas such as Devermane, Mundagudu, Kodaballu, Taruve, Binnadi, Hosahalli, Sargadu, Darshan, Kundur, Balehonnur, Megaramakki and Cheikka Agrahara). As of now, south Banjar the habitat contiguous

and if the pipeline fragment the habitat in the south of Banjar region and the migratory routes. This may lead to severe human-elephant conflict in this region in the future.

Conclusion

From this survey, the following conclusions can be made:

1. There is strong evidence to support that; the area under the HPCL pipeline is a prime elephant habitat. Elephants use some of these areas (particularly Neriya and adjoining places) extensively. If the pipeline project is permitted in this region (even for a short period of time), it would fragment the elephant habitat, and the habitat contiguity between Bhadra and Pushpagiri Wildlife Sanctuaries would be lost.

2. This prime elephant habitat is owned by private people. As long as the forest is maintained, the elephants have a good habitat for them. However, it was noticed in some of the estates, particularly, Banjar, Neriya and Calicut, the conversion of forest into rubber, coffee and arecanut cultivation. Along with the pipeline project, these activities also may fragment the habitat.

3. Currently the human - elephant conflict is not a severe problem in south of Banjar. It's possible that the HPCL pipeline project may fragment the elephant habitat and due to habitat fragmentation, loss of habitat and migratory route, in future, a severe human - elephant conflict in this region can be expected.

References

Balasubramanian, M., Bhaskaran, N., Swaminathan, S., Desai, A.A. (1995). Crop raiding by Asian elephants (*Elephas maximus)* in the Nilgiri Biosphere Reserve, South India, PP. 350-367 in A Week with Elephants (eds. J.C. Daniel and H.Datye). Bombay Natural History Society, Oxford University Press, Bombay.

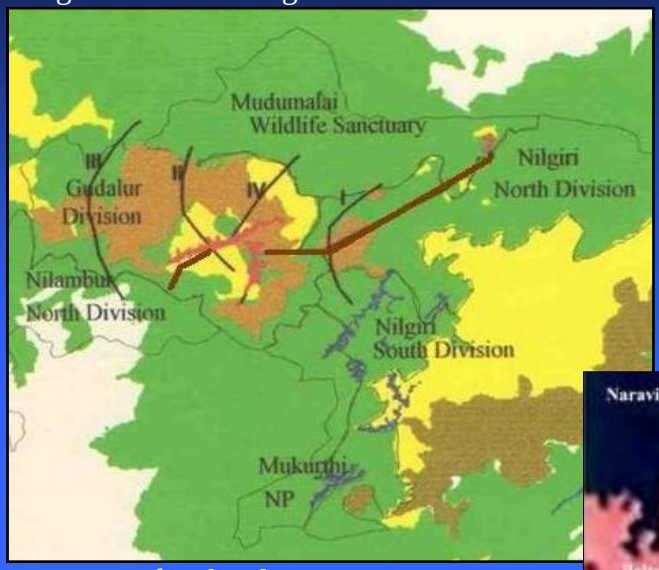
Nair, P.V., Sukumar, R., and Gadgil, M. (1980). The elephant in South India, A review. The Asian Elephant in the sub-continent-IUCN/SSC report 1980

Nath, C. and R. Sukumar. (1998). Elephant-human conflict in Kodagu, southern India: distribution patterns, people's perceptions and mitigation methods. Asian Elephant Conservation Centre, Bangalore.

Sukumar, R. (1984). Ecology and Conservation of the Asian Elephant in south India. Brief report of work done under project No.3032 of the WWF-IUCN Asian Elephant Specialist Group.

Sukumar, R. (1986). The elephant populations of India-Strategies for conservation. Proc. Indian Acad. Sci. (Anim.Sci./Plant Sci.) Suppl.: 59-77.

The proposed Pandiyar –Punnampuzha Hydroelectric Project activities expected to take place in Gudalur, Nilgiri North and Nilgiri South Forest Divisions and Mudumalai Wildlife Sanctuary of Nilgiri District.



The various activities of the project would submerge forested area of Mudumalai Wildlife Sanctuary, Gudalur and the Nilgiris North Forest Divisions. The 27 km diversion tunnel connecting the 2 stages of the project would lie underneath the Reserved Forest areas of Nilgiris North Division.

The impact assessment done for The Pandiyar - Punnampuzha Hydroelectric Project gave experience for developing concept note on the impact of another project on elephant population in Western Ghats. Mumbai based Hindustan Petroleum Corporation Limited (HCPL) has proposed a Pipeline Project to transport petroleum products and a part of it its expected that will cut across the prime elephant habitat, the pipeline would fragment the habitat, and the movement of elephant would be stopped if the pipeline goes through this region. This document assesses the impact of these two projects on Asian Elephant in two different regions of the Western Ghats.