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# JUMBO EXPRESS

## A Scientific Approach to Understanding and Mitigating Elephant Mortality due to Train Accidents in Rajaji National Park

Anil Kumar Singh, Ashok Kumar,
Aniruddha Mookerjee and Vivek Menon

Wildlife Trust of India

IFAW.org
A Better World for Animals and People

The Wildlife Trust of India (WTI) is a non-profit conservation organization committed to initiate and catalyse actions that prevent destruction of India's wildlife and its habitat. In the long run, it aims to achieve, through proactive reforms in policy and management, an atmosphere conducive to conservation. WTI works through building partnerships and alliances and its strengths lie in its willingness to work with innovative conservation techniques like acquiring land for wildlife and rescue and rehabilitation.

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## A Scientific Approach to Understanding and Mitigating Elephant Mortality Due to Train Accidents in Rajaji National Park

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An Occasional Report by Wildlife Trust of India and
the International Fund for Animal Welfare of a Rapid Action Project on
Understanding and Mitigating the Problem of Elephant Mortality due to Train Hits

Wildlife Trust of India
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# PREFACE

When two behemoths meet head to head, one or both might suffer. The Indian Railways and elephants have had a love-hate relationship. The elephant is the mascot of northern railways. Yet the railways continue to fragment elephant habitat and kill them by running over them on tracks. The Rajaji National Park has 14 kilometres of railway track running right through it bisecting the park into two parts. Trains have started running at faster speeds along these tracks and during times of the night when they did not run in the past. Elephants that need to cross the track to use the habitat, for water or food, on the other side of the park became fair game for the trains and an average of one elephant got killed every year on the tracks.

Wildlife Trust of India's Rapid Action Project initiated one of its most successful sets of rapid actions when a series of short-pro-active reforms were undertaken by the Trust in collaboration with the northern railways and the Uttaranchal forest department. This included studying the problem and breaking down the solutions into bit sized chunks that could be done by everyone- patrolling the track at night, clearing bushes and overhangs from strategic points so that train drivers have better visibility, desilting waterholes that elephants used to lessen the need for crossing the track ad public awareness among passengers, train drivers and forest guards.

This report is the result of the first rapid action project that went into the problem and came up with the suit of actions that would solve the problem. With hindsight, these sets of recommendations have proven to be excellent as they have been implemented and the mortality has been completely stopped for five years running to this date.

Vivek Menon
Executive Director, WTI

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We also appreciate the help of Mr P. V. Vaidialingam of the Railway Board in assisting the display of public awareness signages at Haridwar and Dehradoon railway stations. Mr. Bhardwaj, The Divisional Railway Manager, Moradabad, Mr. S. Badola, Station Superintendent, Dehradun and Station Master, Kansrao. We are deeply grateful to the field staff for providing help and support. We also extend our thanks to the villagers for their information and valuable time, without which the report would have been incomplete. Mr. Ramsaran Singh's support was invaluable.

This Rapid Action Project was supported by the International Fund for Animal Welfare (IFAW).

# EXECUTIVE SUMMARY

In Rajaji National Park, Uttaranchal, 18 elephants have been killed in train accidents since 1987. The presence of railways in protected areas around the country not only cause direct mortality of wildlife through accidents but has the effect of causing habitat fragmentation, degradation, population fragmentation and reducing wildlife access to vital habitats. In view of the growing demand for the doubling of existing rail tracks through protected areas, conversion from meter-gauge to broad-gauge and the construction of new tracks, these impacts of the railways pose a serious conservation threat and must be addressed immediately. Rajaji National Park exemplifies this problem of the death of so many elephants, and this prompted the Wildlife Trust of India (WTI), to undertake a Rapid Action Project RAP).

The main objectives of the RAP were; (i) To understand the problems, circumstances and possible biotic and abiotic factors influencing the train/elephant collisions. (ii) To establish a scientific approach, (iii) To collate administrative and legal steps undertaken by various agencies in the past and their role in reducing the problem. (iv) To suggest possible mitigation measures, and (v) To assist the Central and State governments in solving the problem.

The two most vulnerable stretches of track were found to lie between the Motichur railway station and Motichur railway crossing near the forest range office; and the Raiwala and Kansrao railway stations. Field surveys both along the track and on transects laid out at right angles to the track, questionnaire survey of the villagers, forest staff and railway staff and collection of secondary data were the methods used during the study.

Mortality due to train accidents accounted for 45% of total elephant mortality in the three ranges where accidents have occurred (Haridwar, Motichur and Kansrao) from 1987 to 2001. More adult females were killed in the accidents than those of other age and sex classes. Mortality patterns were found to be directly related to temperature and inversely related to rainfall, such that maximum mortality occurred during the summer months of high temperature and low rainfall, with a peak in May. While a greater density of tree species commonly consumed by elephants was found south of the track, the availability of perennial water bodies on the north was significantly greater and in close proximity to the track. The questionnaire survey of the villages revealed that the peak crop depredation period is between March and May, thus coinciding with the peak elephant mortality period in the area. There was no difference in human disturbance as shown by indicators, while indicators of elephant presence were higher on the south. Thus, high temperatures and water appeared to be the deciding factors forcing elephants to cross the tracks during the late dry season when water sources on the southern side had dried up. Furthermore, the presence of crops on the edge of the forest close to the water sources was an added attraction for the animals.

While this answered the question of why elephants were crossing the track, the RAP established further reasons for accidents taking place. Several dangerous turnings where visibility beyond the turnings was restricted due to dense vegetation cover on either side of the track were identified. Certain mounds along the track were also found to be hazardous as they effectively trap animals on the track if they are too steep. Trains were found to travel at speeds of up to 72 km/hr, with the effect that the braking distance is increased and the chances of stopping the train in time to prevent an accident are quite low. These speeds are considerably greater than the 45-50km/hr speed limits claimed to be

maintained by the railway department. Between 27 to 30 passenger trains run through this crucial stretch of forest daily. However, the most significant finding in this respect was that for accidents for which the time is known, all occurred a between 6pm to 6am, making time a prime factor to be considered in the investigation. Additional influencing factors included considerable waste disposal on the tracks and the lack of familiarity with the track stretch by train drivers from outside the Dehradun area. The critical zones of elephant movement along the track, the most important mounds and turnings that need to be addressed, and the trains responsible for the accidents in the past were identified by the investigator.

During previous meetings held in conjunction with the park and railway authorities and scientists from the Wildlife Institute of India, several measures were identified. Among these were the reduction of train speed to 20km/hr through the 18km caution zone through the forest, the removal of mounds and the clearing of bushes at the turnings. Since that time, while the RNP authority has cleared certain mounds between Motichur and Kansrao, trains continue to travel at speeds much greater than that suggested. The railway department has previously argued that such a reduction in speed is not possible due to differences in altitudes from one station to the next. However, the RAP study has established that the actual altitude differences in the critical zone is 18 km only and this may allow some reduction in speed. The cost to the railway department when accidents occur has been found to be quite significant considering the time wasted in detention of the train, possible damage to the track and train components, possible derailments and harm to passengers.

The investigator has identified several measures that may help in reducing elephant mortality due to train accidents to be taken up by the different parties involved.

1. **The forest department is recommended to organize a meeting of all relevant parties and to work towards restoring the Chilla-Motichur corridor.** Restoration of the Chilla-Motichur corridor will enable the elephants to move in a greater range and therefore reduce the movement across the railway track towards the north.

2. **The railway department should implement the suggested reduction in train speeds through the caution zone, alter the timings of certain trains running in the evening and night, stop the running of goods trains at night and ensure that the trains which have caused accidents in the past travel care fully through the section.** Also, they are recommended to level the identified mounds and clear bushes at the critical turnings, ensure that adequate garbage disposal facilities are available and utilized by caterers and passengers and to use experienced drivers from the Dehradun area who are familiar with this section of the track. The use of radio communication between patrolling forest staff and railway staff has been helpful in averting train accidents in the past. Therefore, increasing the wireless network systems at railway stations, on trains and if possible between forest and railway staff could be very effective.

3. **Project Elephant is urged to maintain a database on elephant mortality due to train accidents for the entire country, help restore the Chilla-Motichur corridor and organise meetings amongst the concerned parties.**

4. **WTI offers to assist in the restoration of the Chilla-Motichur corridor, organise training workshops at the regional level**

**for forest and railway staff on the situation and it's solutions.** Siltation has occurred in two natural waterholes south of the track, which can be desilted through another RAP. Finally, WTI can erect signs along the caution zone to alert passengers and drivers, and put up posters in running rooms and railway offices at Dehradun, Haridwar and Moradabad stations.

Several years ago, the option of diverting the rail track out of the forest considered by the Ministry of Railway was rejected on financial grounds. WTI proposes a fresh look at this option as it may prove to be the most viable one in the long term for both the railway department and the animals. Any solution however, will require a coordinated and dedicated effort by all parties.

# 1. WILDLIFE MORTALITY DUE TO TRAINS IN RAJAJI NATIONAL PARK: THE APPROACH

## 1.1 Introduction

Railways and highways are major sources of wildlife mortality (Clevenger, 1997; Buckingham, 1997; Jackson, 1999), threatening wildlife populations throughout the world. Railways also cause direct loss of habitat, degradation of habitat quality, habitat fragmentation, population fragmentation and reduce access to vital habitats (Jackson, 1999). Direct impacts like animal mortality receive instant attention but other forms of indirect impacts have not been studied properly. In the present scenario, when the population of various endangered species is at risk, mortality of wild animals caused by the railways is alarming.

In the Bow River Valley, Canada, both the Trans-Canada Highway and the Canadian Pacific Railway are responsible for mortality of wild animals (Paquet et al., 1995). Paquet (1999) recorded 32 wolf deaths in the Bow Valley, Canada since 1987, including the deaths of five breeding females. Highways and railways combined were found responsible for 81% of the total wolf deaths. Between 1993 and 1997, a minimum of 30 black bears had been killed on the railway between Field and Revelstoke in British Columbia (http://www.whyte.org/bears /roadsandrailway.html.). Around 102 black bears have been killed on the Trans-Canada Highway (TCH) in the same area between 1964 and 1997(http://www.whyte.org/bears /roadsandrailway.html). Munro (1997) recorded the mortality of 17 bears in the last three years in Beaver Valley, British Columbia.

In India, a large number of wild species are being killed annually due to railways (Kumar, 1995; Johnsingh and Williams, 1999) and highways, but

data maintained are very meagre. Data are available only for large animals like elephants and rhinos and that too for recent periods. Mortality of other species have not been recorded properly or in most cases left unnoticed. Since 1992, at least 13 elephants and one rhinoceros have been killed by railways in North Bengal alone (Ghosh, 2001). According to Wildlife Trust of India's (WTI) elephant mortality database, 11 elephants have been killed due to train accidents in the Sonitpur, Lumding, and Karbi Anglong areas of Assam between 1995 and 1998, and nine elephants in the North Chaibasa and Kolhan Divisions in Bihar between 1998 and 2000. In Rajaji National Park, Uttaranchal, 18 elephants have been killed in train accidents since 1987. These few cases available are sufficient to show the gravity of the problem.

Owing to this countrywide problem and after repeated mortalities of elephants in Rajaji National Park (RNP), the Wildlife Trust of India decided to conduct a study under Rapid Action Project (RAP), on train accidents in RNP. This RAP study was conducted with a view to understand the problems in details, to suggest mitigation measures and assist the local administration in solving the problem.

## 1.2 Objectives

The broad objectives of the RAP were as follows:

1. To understand the problems, circumstances and possible factors for elephant deaths through train accidents.
2. To know the biotic and abiotic influences on both sides of the railway track in the park.
3. To know the efficacy of scientific studies, administrative and legal steps undertaken by various agencies in the past and their role in reducing the problem.

4. Based on the study to suggest possible mitigation measures.
5. Assisting the Central & State Government in solving the problem.

### 1.3 Mortality of wild animals in Rajaji National Park

The railway track that runs between Haridwar and Dehradun is responsible for killing a large number of endangered wild animals in Rajaji National Park (Figure 1). Though proper data is not maintained on the mortality of wild animals except for the elephant, available figures show the gravity of the problem. Data on mortality of wild animals other than the elephant has been maintained since 1994 in the Haridwar range, for 1990 and from 1998 onwards in the Motichur range, and since 1990 in the Kansrao range. Since 1987, 18 elephants have been killed in train accidents. Records on mortality of other wild animals include 26 Sambar (*Cervus unicolor*), 19 Chital (*Axis axis*), three Wild boar (*Sus scrofa*), two Leopard (*Panthera pardus*), one Goral (*Nemorhaedus goral*) and one Python (*Python molurus*). Such cases are mostly left unnoticed due to little media attention, difficulty in spotting small animal carcasses and the activity of carnivores, which either consume the carcass or carry it away from the site of the accident.

The large-scale mortality of prey-base ungulate species like the Chital and Sambar due to train accidents in Rajaji National Park is really alarming as the Park supports large carnivore populations. The record of one Goral mortality on the track indicates that almost every kind of wild species is vulnerable to such incidents on the track. There are many other small species whose mortality goes totally unnoticed.

## 1.4 Project Area

The RAP was conducted between Haridwar railway station and Kansrao railway station and towards Doiwala railway station up to the last forest patch, covering almost 23 km of track stretch through the forest. The main vulnerable section of track for animal mortality falls between this area from Motichur Railway Station to Kansrao Railway Station and two km ahead of Kansrao towards Doiwala Railway Station (Figure 2). Based on the elephant accident reports, the track can be divided into two stretches:

1. Between Motichur railway station and Motichur railway crossing near Motichur range office and
2. Between Raiwala railway station and Kansrao railway station.

The railway track between Motichur railway station and Motichur railway crossing is laid in a north-south direction and between Raiwala railway station and Kansrao railway station in an east-west direction.

The river Ganga divides the Rajaji National Park (ca 820 sq. km.) into eastern and western portions. The total area of the western portion is 570 sq. km. and the eastern portion is 250 sq. km. (Kumar, 1995). Out of the total eight ranges, six fall in the western half and remaining two, in the eastern half. The railway track of the Haridwar-Dehradun section passes more than 18 km of forest stretch in the eastern and northern parts of the western half of the RNP. Administratively, these fall under three ranges of RNP namely, Haridwar, Motichur and Kansrao. Between Haridwar and Dehradun there are five railway stations, Motichur, Raiwala, Kansrao, Doiwala and Lachiwala. The distance between Haridwar and Motichur is 5 km, Motichur and Raiwala is 6 km, Raiwala and Kansrao is 11 km, Kansrao and Doiwala is 10 km, Doiwala and Lachiwala is 10 km, and

Lachiwala and Dehradun is 10 km. After the Raiwala railway station, the track bifurcates, one going to Dehradun, through the National Park area and the other to Rishikesh. The track crosses a major portion of the Park after Raiwala and upto Doiwala. The Kansrao railway station falls completely inside the park. This track links Dehradun to Haridwar as well as other important railway stations of northern India.

The rugged and undulating landscape in the western and southern sides of the park, all along the railway track is a part of the northern slopes of the Shivalik hill ranges. The flat area in the northern side is an extension of the Gangetic plain. There are numerous nallahs locally called 'Rau(s)', which emerge from hill ranges and flow in a northeasterly direction. These are seasonal water sources, which dry up during winter and the pinch period of summer. In the northern side several perennial water sources including the river Song and Suswa, their tributaries and distributory nallahs flow parallel to the railway track.

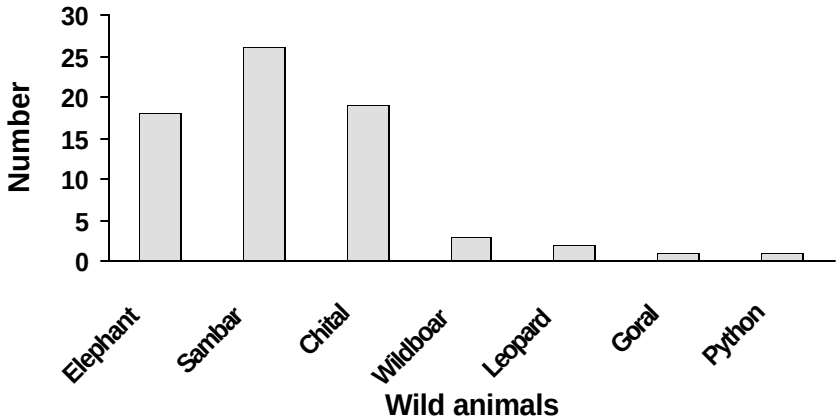


**Figure 1:** Wildlife mortality by train accidents in Rajaji National Park

There are three distinct seasons i.e. monsoon, winter and summer. The months of July to September receive maximum rainfall (Figure 3). Winter starts from November and ends in March. Summer lasts from April to June. The temperature varies between 45°C (maximum) during May to 3°C (minimum) during winter (Rodgers *et. al.*, 1990) (Figure 4).

According to Champion and Seth's (1968) classification, the vegetation of the study area (Figure 5) can be categorised as Tropical Moist Deciduous, Tropical Dry Deciduous and Subtropical Chir Pine. In the plain, Moist Bhabar dun Sal forest is dominated by *Shorea robusta* and *Mallotus philippinensis*. *Ehretia laevis* and *Miliusa velutina* are other common trees species. Around the raus there are mixed dry deciduous forests with species like *Adina cordifolia*, *Mitragyna parviflora*, *Terminalia tomentosa*, *Mallotus philippinensis*, *Cassia fistula*, *Bombax ceiba*, *Holarrhena antidysenterica,* etc.

In the hills, Dry Shivalik sal forest and Moist Shivalik sal forest are composed of tree species, such as *Anogeissus latifolia*, *Shorea robusta*, *Acacia catechu*, *Buchanania lanzan*, *Zizyphus xylopyra* etc. Predominant shrub species are *Colebrookia oppositifolia*, *Helicteres isora*, *Carissa opaca*, *Holarrhena antidysenterica*. Subtropical Shivalik Chir Pine Forests occur frequently on higher slopes.

The Asian elephant (*Elephas maximus*), nilgai (*Boselephas tragocamalus*), sambar, chital, barking deer (*Muntiacus muntjak*), goral, wild boar, tiger (*Panthera tigris*), leopard, jackal (*Canis aureus*), rhesus macaque (*Macaca mulatta*), common langur (*Presbytis entellus*) and Himalayan Yellow throated marten (*Martes flavigula*) are important mammals of the Rajaji National Park. More than 312 species of birds have been reported from the area (Pandey *et. al.*, 1994). It is also the

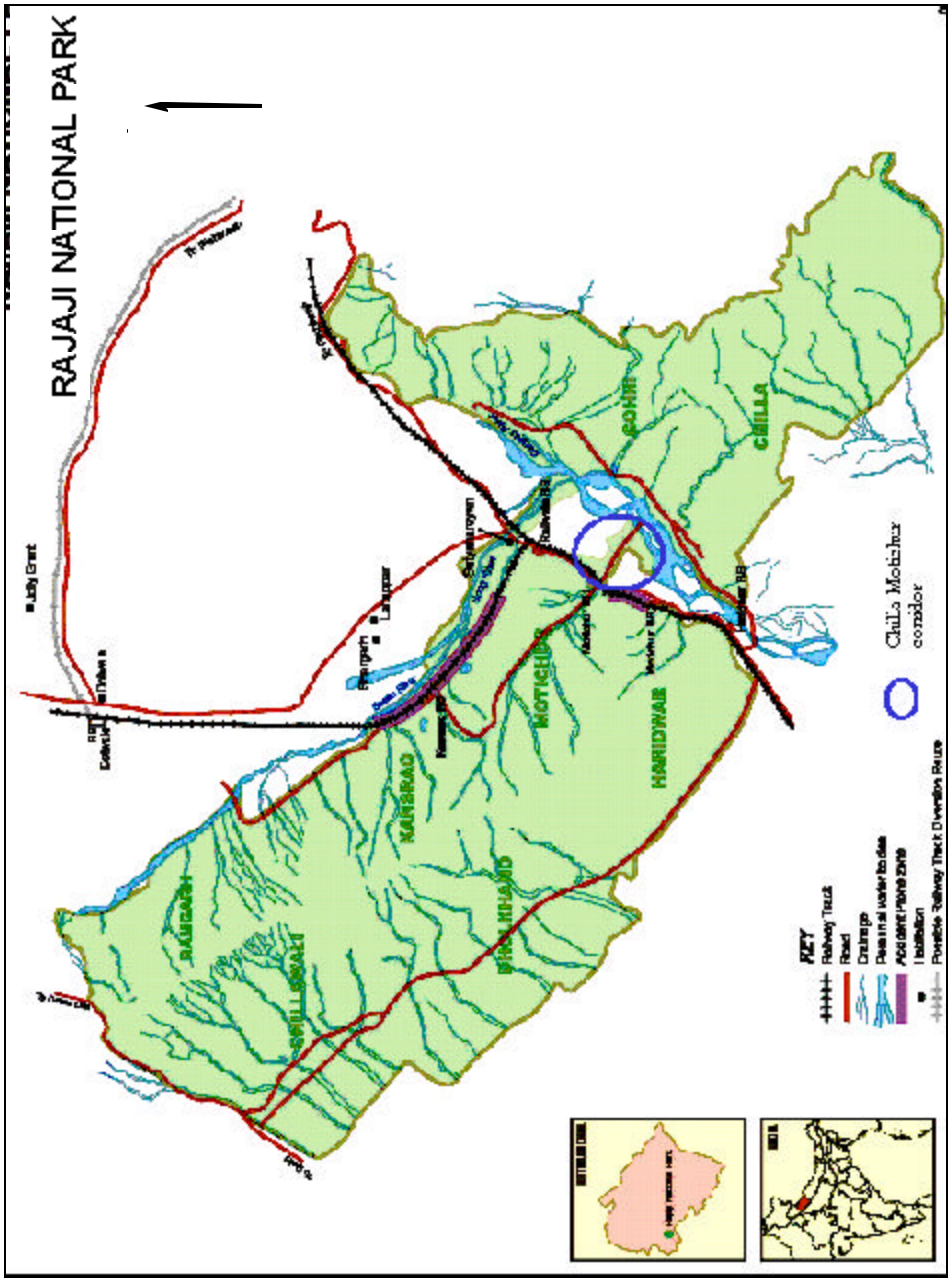


**Figure 2:** Rapid Action Project site, Rajaji National Park

western edge of the distribution range for the Great Hornbill (*Buceros bicornis*) and the Goldfronted Chloropsis (*Chloropsis aurifrons*) (Pandey *et. al.*, 1994).

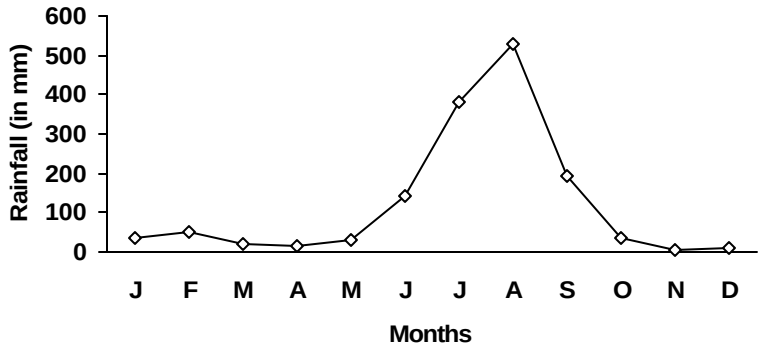


**Figure 3:** Mean monthly rainfall at Kansrao range office and Bhimgoda barrage Haridwar

Rajaji National Park being a part of the Rajaji-Corbett Elephant Reserve is an important area for conservation in north-west India (Figure 6). The Rajaji-Corbett Elephant Reserve holds 90% of the entire north-west elephant population (Singh, 1995). Elephant population in the eastern (c. 200 elephants) and western (c. 400-500 elephants) (Johnsingh and Williams, 1999) portions of the park (separated by the River Ganga) face various threats.

## 1.5 Methods

The RAP was conducted from 12th June 2001 to 5th July 2001 (24 days). The primary investigator had worked in the area for the last three years and was thoroughly familiar with the terrain. Data collection was done at

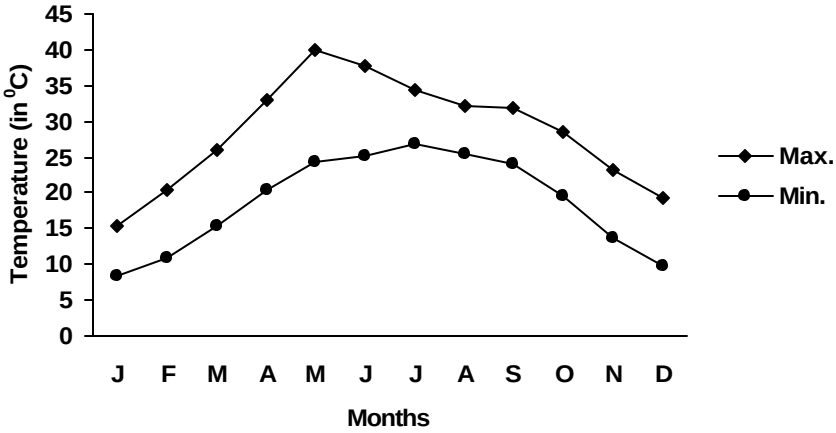


**Figure 4:** Mean monthly temperature of five years (1996-2000) at Dholkhand, RNP

three levels. Firstly, through field survey on the ground, secondly through questionnaire surveys from villagers, forest staff and railway staff and thirdly through literature surveys and collection of secondary information.

### 1.5.1 Field Survey

#### *1.5.1.1 Collection of information along the rail track*

The primary investigator walked approximately 25 km of track from Motichur to Kansrao and a little ahead. Information on elephant dung encounter rate was collected along the track (Figure 7). The distance between two dung piles was recorded with the help of a hip-chain. Records on presence of other elephant signs (feeding sign and foot mark) were also made. While collecting this information along with distance, records on telephone pole numbers were also maintained along the track for identification of areas of high movement. This information was collected only once on the track.

**Figure 5:** Mixed forest on the northern side of the railway track in Kansrao range

Information on turnings, mounds on the sides, slopes and altitudes were collected along the whole track stretch. In this case such areas were demarcated using telephone pole numbers along the track as markers. Records were also made on the availability of water bodies along the track on both sides.

Information on garbage disposal was also collected along the track. Speeds of certain trains were measured in the park area by calculating the time taken to travel from one fixed point to the other.

#### *1.5.1.2. Collection of information on transects*

To collect information on various factors on both sides of the railway track, 12 temporary line transects were laid, six on each side. Each transect was laid perpendicular to the track. The length of transects was kept at 1.5 km based on the distance of the forest edge on the northern side. On each transect six circular plots of 10 m radius were overlaid every 250 m. The total number of circular plots was 72, i.e. 36 on each side of the track.

Information on presence of elephant's food species (trees), elephant signs (dung piles, feeding sign), and disturbances (human presence, cattle presence, cattle dung) were collected in 10 m radius plots. Records were also made on the broad vegetation type and canopy cover. For elephant food species in the shrub, data were collected in five m radius circular plots within the bigger plots. Grasses were not taken into consideration due to their minimal contribution to the elephants' diet, as elephants are predominantly browsers in all seasons in Rajaji National Park (Williams, *et. al.*, 1998). Data on availability of water and agricultural crops were also collected while walking on transects and the distance was noted. On the same transects, data on dung piles were also collected in a two-meter belt for estimating the dung density in the area.

**Figure 6:** A group of elephants in Andheri block of Rajaji National Park browsing on *Mallotus* trees

**Figure 7:** Elephant dung ball on the railway track in Rajaji National Park area.

### 1.5.2 Questionnaire survey

Villagers, forest staff and railway staff were asked certain pre-designed questions. Villagers were asked questions on crop type, crop pattern, crop season, crop raiding by elephants, raiding group size, seasonal pattern of crop raiding, seasonal movement of elephants, availability of water, influences for elephants, elephant death in train accidents and reasons, their opinion on it etc.

Members of the forest staff were interviewed on mortality of elephants and other wild animals by train accidents. They were also questioned as to the possible reasons for these accidents, seasonal movements of elephants, availability of water and water bodies, efficacy of administrative and technical measures taken to reduce the mortality on the tracks, utilisation status of corridors by elephants, their opinion on this problem, etc.

Members of railway staff were interviewed on elephant mortality by train accidents, technical reasons, and measures taken by railways and their efficacy. They were also questioned on the implications and possibility of reducing train speed, implications and possibility of diverting the track, technical steps to be taken to reduce such accidents, losses to railway in accidents, their opinion on elephant mortality by train accidents etc.

The nine villages situated on the northern fringe of RNP that were surveyed, were Chidderwala, Chandi, Sergarh, Laltapper, Saheb Nagar, Chak Jogiwala, Khari Khurd, Nayabasti and Raiwala Dandi. A total of 56 villagers were covered for the questionnaire survey; a minimum of five from each village. 22 forest staff, from Haridwar, Motichur, Kansrao and Barkote ranges were covered. A total of 16 railway staff from Kansrao, Motichur, Doiwala and Dehradun railway stations were also covered for the questionnaire survey. The problem was also discussed with various forest officials including the Director and Deputy Director RNP, railway officials like the Divisional Railway Manager, Moradabad and Station Superintendent, Dehradun, scientists in the Wildlife Institute of India, Dehradun and NGOs. Their opinions on this matter were noted.

### 1.5.3 Literature survey and collection of secondary data

Secondary information was collected on elephant and other wildlife mortality by train accidents in Rajaji National Park and also on total elephant mortality from range headquarters and the park office. Records were made of the number of elephant deaths, age and sex of elephants, group size, date, time, and site of accidents and the trains involved in such accidents.

Rainfall data for the last ten years was collected from the Irrigation Department, Haridwar, Kansrao Range Office and the Wildlife Institute of

India (WII), Dehradun. Temperature data was collected from WII, for Dholkhand range. Information was collected from the Railway Department on the frequency of passenger and goods trains, and their departure and arrival times.

Literature related to elephant mortality by train accidents in Rajaji NP and other similar case studies were collected from WII, the Internet and from several other sources.

### 1.6. Data analysis

Data analysis was done using Microsoft Excel program. Plots having any disturbance indicators (human presence, cattle presence, cattle dung etc.) were considered disturbed and plots with no such indicators were considered undisturbed. To estimate disturbances and for area utilisation by elephants, percentage plots were taken as a unit.

# 2 TRAIN ACCIDENTS AND ELEPHANT MORTALITY-PATTERNS AND REASONS

## 2.1 Introduction

On the 18-km stretch of railway track that runs through Rajaji National Park, elephants are being killed regularly (Kumar, 1995; Johnsingh and Williams, 1999). Data available since 1987 shows the mortality of 18 elephants in train accidents until today. There are no such records available on elephant mortality before 1987 from RNP. Either such incidents did not occur in the past or such data was not collected.

Animals of all age groups and sexes are vulnerable to such incidents. In a single incident a maximum of three elephants have been killed. There

are at least three reported cases in which the animal was injured but survived. In one incident a calf was found close to its mother, the victim of an accident. Later on the calf was kept in Chilla Range and is now a full-grown adult.

The regular phenomenon of elephant mortality by train accidents in protected areas is a major wildlife conservation issue for the country. This is because this is not restricted to Rajaji, but there are several protected areas where mortality of wild animals is taking place due to trains. The recent incident of the mortality of a female elephant in North Bengal due to a train accident has raised the question about conversion of meter gauge into broad gauge tracks in protected areas. This has resulted in a PIL being filed at Kolkata High Court. These issues are very sensitive for conservation particularly when there is a growing demand for the doubling of certain rail tracks or the construction of new tracks inside PAs.

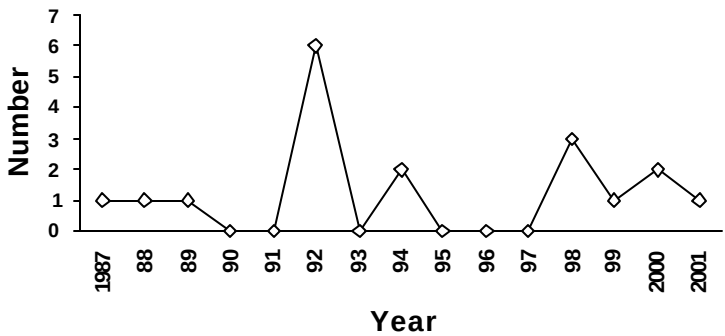


**Figure 8:** Trends of elephant mortality in train accidents in RNP

## 2.2 Pattern of elephant mortality

On average, since 1987, at least one elephant has been killed annually in RNP in train accidents (Figure 8). There is no pattern in annual mortality; it does not show increasing or decreasing trends.

### 2.2.1. Range-wise elephant mortality

When elephant mortality figures were plotted for all three ranges (Haridwar, Motichur and Kansrao) separately, no significant differences were found (Figure 9). However, when elephant mortality was plotted for these three ranges against the track stretch critical for accidents in each range this yielded a different result. Such analysis shows that the mortality figure is much higher in the case of Haridwar range in comparison to its track stretch (Figure 10).


**Figure 9:** Range-wise elephant mortality by train accidents in RNP

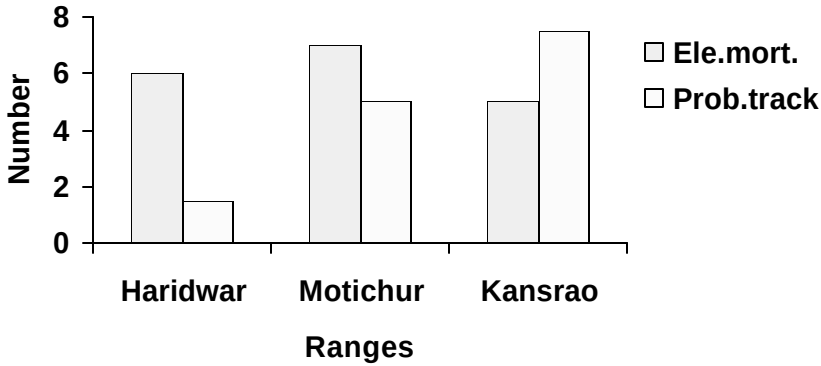


**Figure 10:** Elephant mortality in response to problematic length of railway track (in km) in different ranges

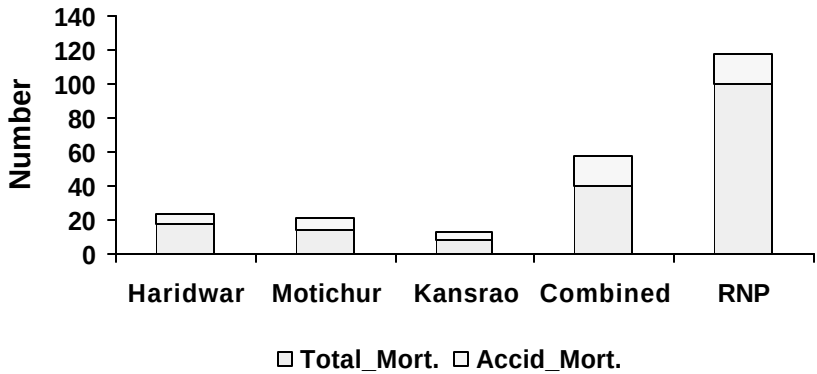


**Figure 11:** ELephant mortality by train accidents in comparison to the total mortality of elephants in RNP

### 2.2.2 Train accident mortality vs. total mortality

Elephant mortality due to train accidents were compared with the total elephant mortality in the Rajaji National Park. Mortality due to train accidents was found to be 18% of the total, a high figure due to a single reason (Figure 11). As mortality due to train accidents are occurring in only three ranges of RNP (the park has eight ranges overall), the data of total elephant mortality in those ranges were compared with it. Mortality by train accidents is 45% of the combined total mortality in these three ranges (Figure 11). Mortality by train accidents in Kansrao was the highest (63%) followed by Motichur (50%) and Haridwar (33%) as compared to the total mortality (Figure 11). This shows that elephant mortality by train accidents is locally alarming.

### 2.2.3 Seasonal pattern

A month-wise pooled data analysis of elephant mortality by train accidents shows a clear pattern. Out of the 18 elephant deaths, 14 died between the months of January and June (Figure 12). The figure was

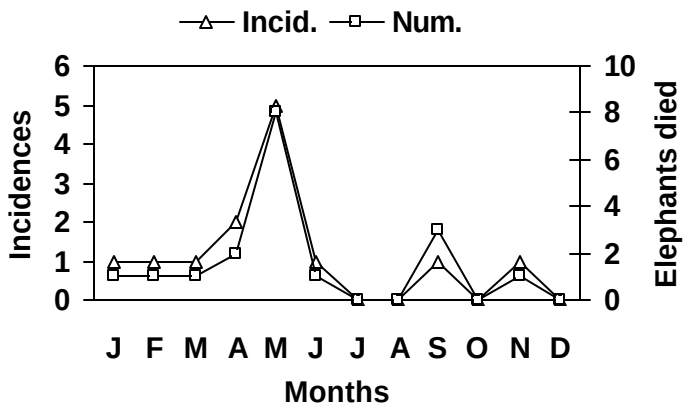


**Figure 12:** Seasonal trend of elephant mortality by train accidents in RNP

highest in the month of May. Incidents of accidents also showed the same pattern. Most of the mortality occurred during the summer period when there is scarcity of water in the area. The availability of perennial water sources on the northern side of the railway track might be a possible factor influencing elephant movement and causing accidents.

### 2.2.4 Patterns in age and sex classes

Elephant mortality by train accidents when plotted in different age and sex classes yielded notable results. The combined mortality in all age groups in case of females was found to be higher than males (Figure 13). Among adults, the mortality of females was found to be very high as compared to the mortality of males. Most of the females that died were in the breeding age class. This mortality of females in the breeding age group could have a great impact on the population.

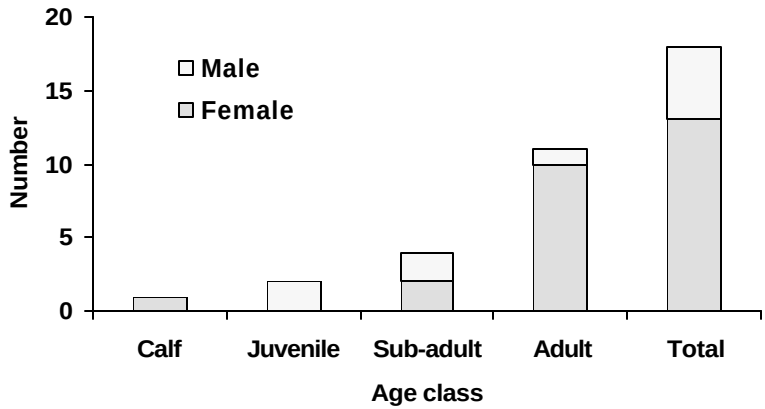


**Figure 13:** Mortality pattern in age and sex class of elephants by train in RNP

## 2.3 Possible factors responsible for accidents

### 2.3.1 Ecological factors

Accidents are taking place because elephants are crossing over the track from the southern to the northern side and again while coming back to the south. The RAP tried to determine the possible factors influencing such movements on the north side. Various ecological parameters were selected including rainfall, temperature, vegetation type, availability of food and water, crops, and disturbances to ascertain their role in accidents.

#### *2.3.1.1 Influence of rainfall and temperature*

In and around Rajaji most of the rainfall occurs between June and September. July and August are the months of highest rainfall. When elephant mortality due to train accidents are plotted against the mean monthly rainfall in the area, there is an inverse relationship between them (Figure 14). When rainfall increases after the month of June, accident

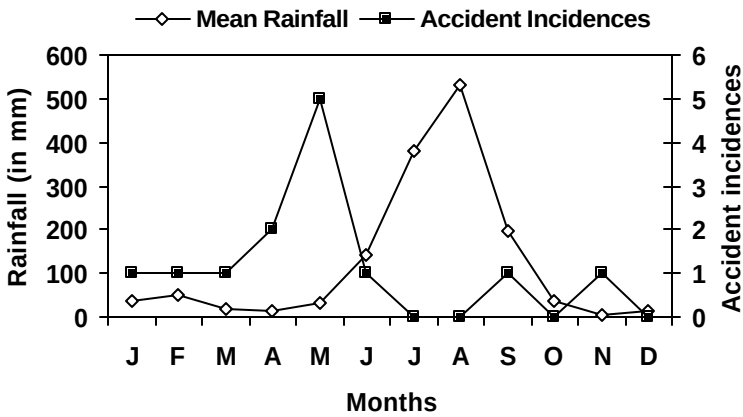


**Figure 14:** Mean monthly rainfall and elephant accident incidences by train

related mortality shows a decline and during the dry period when rainfall decreases, mortality increases. With an increase in rainfall, water availability increases throughout the park and elephant movement takes place in different areas (Thouless 1995). Congregation to certain areas for perennial water sources during summer (Funston *et. al.*, 1994; Williams et al., 1998) ends after rainfall, which might have an impact on mortality due to train accidents. Rainfall and water availability have been found to influence elephant movement (Easa 1988; Thouless 1996).

When the monthly mortality figure was plotted against the mean monthly temperature (available from Dholkhand range) both showed a similar peak in May (Figure 15). With an increase in temperatures from March, mortality also increases, while after July when there is decline in temperatures and a corresponding decrease in accident related mortality.

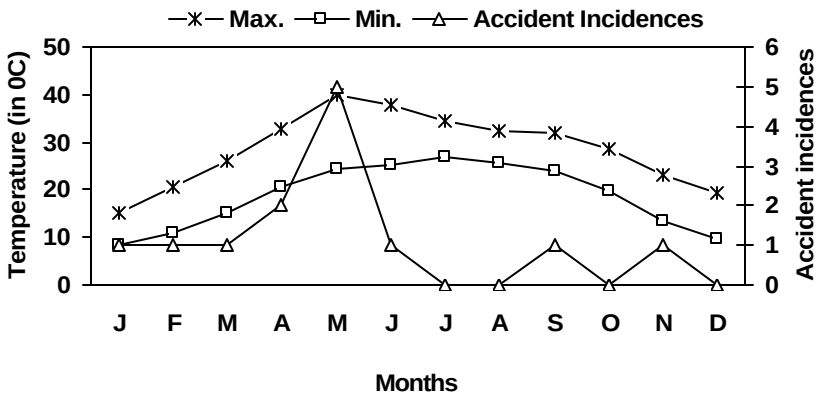


**Figure 15:** Mean monthly temperature and elephant accident incidences by train in RNP

The area north of the track is moist. The temperature on the southern side of the Shivalik is a little higher than on the northern side. During winter, elephant movements increase in the area south of the Shivalik ridge and in the summer north of the Shivalik ridge. This may possibly be due to the increase in temperatures south of the ridge and the drying up of water bodies.

#### *2.3.1.2 Vegetation and availability of food species*

The selection of food species commonly consumed by elephants was done based on previous studies in Rajaji National Park (Misra and Rodgers, 1990; Khan, 1995; Sunderraj et. al., 1995; Williams *et al.*, 1998). Sal (*Shorea robusta)* was not taken into consideration as a food species owing to its minimal utilization and also due to its high density in several areas as compared to others. Densities of food species in tree and shrub categories were calculated on both sides of the railway track. Broad vegetation classes were also noted in each plot. Vegetation was classified as one of four major types, Sal Forest, Mixed Forest, Mixed Forest (Sal dominated) and Mixed Forest (with Plantation).

Vegetation type on the southern side of the railway track was found to be dominated by Sal (*Shorea robusta*), whereas in the northern side vegetation was mostly Mixed (Figure 16). In the south, 75% of the total plots were of Mixed Forest dominated by Sal, 5% pure Sal Forest and 20% Mixed Forest. In the northern side, 77% of the plots were of the Mixed Forest type, 5% Mixed Forest with Plantation and 18% was either riverbeds or open ground.

A total of 13 food species among trees were recorded from the area. To the south of the railway track records were made of 11 different food species and to the north nine. The total combined food species density

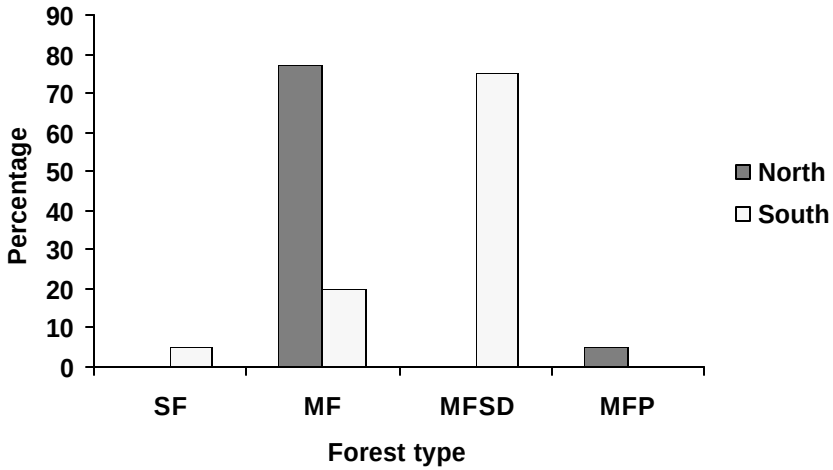


**Figure 16:** Broad forest type on both sides of the railway tracks in RNP

among trees on both sides of the track was 151/ha. The first five species density was 137/ha. *Mallotus philippensis* density was the highest (88/ha.) followed by *Ehretia laevis* (31/ha.), *Bridelia retusa* (9/ha.), *Ziziphus xylopirus* (5/ha.) and *Acacia catechu* (5/ha.). The total food species density among trees to the northern side of the railway track was 88/ha., out of which the first five species density was 62/ha. *Mallotus philippensis* density was the highest (26/ha.) followed by *Bridelia retusa* (12/ha.), *Ehretia laevis* (10/ha.), *Ziziphus xylopirus* (7/ha.) and *Acacia catechu* (7/ha.). To the south of the railway track total food species density among trees was 242/ha. The first five species density was 229/ha. Again *Mallotus philippensis* density was highest (156/ha.) followed by *Ehretia laevis* (54/ha.), *Ougeinia oojenensis* (8/ha.), *Bridelia retusa* (6/ha.), and *Lannea coromandelica* (5/ha.).

The density of food species among trees was found to be higher to the southern side of the track than the northern side through the park area (Figure 17). The food species among shrubs were also found in higher

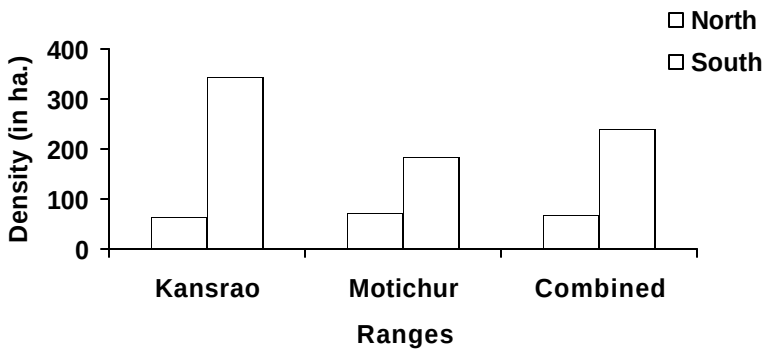


**Figure 17:** Elephant food species (tree) on both sides of the railway track in RNP

density to the southern side of the railway track in Motichur and in a combined analysis (Figure 18). In Kansrao the density on both sides of the track were found to be equal.

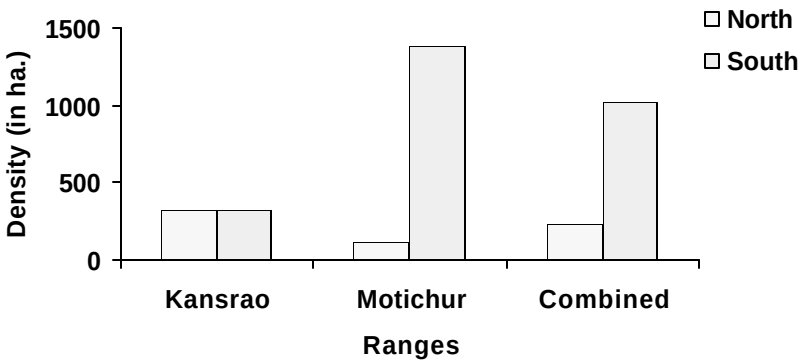


**Figure 18:** Elephant food species (shrub) on both sides of the railway track in RNP

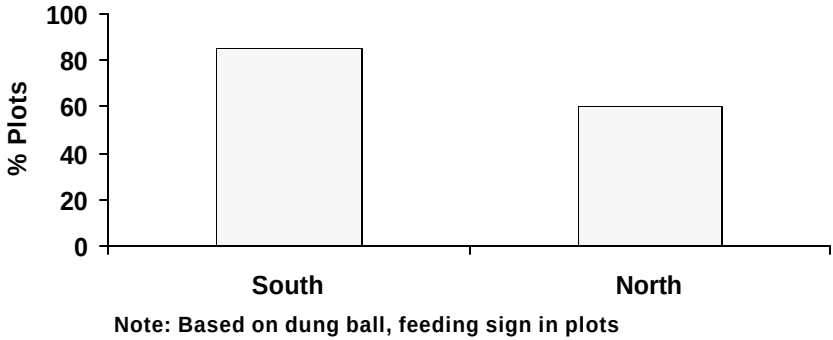


**Figure 19:** Utilization of the area by elephants on both sides of the railway track

### *2.3.1.3 Area utilization*

Data on secondary signs of elephant presence (feeding sign, dung piles) in plots were also collected. When any such sign was present, plots were considered to be utilized. Areas on both sides of the railway track were compared. To the southern side of the railway track 85% of the plots were found utilized, whereas in the northern side only 60% of the total plots were utilized (Figure 19).

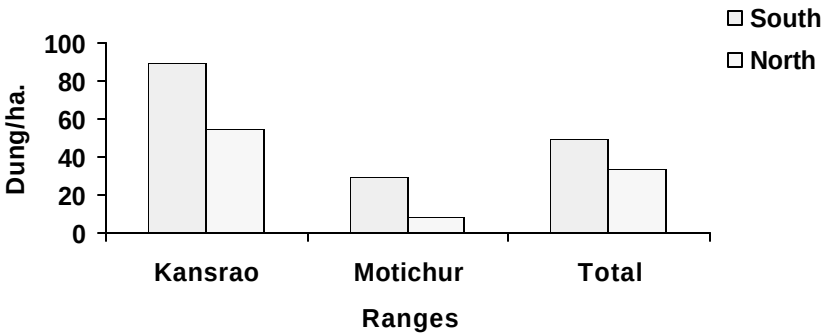


**Figure 20:** Utilization of area by elephants based on the dung density on both sides of the railway track

The density of elephant dung collected during each transect in a 2m belt were analyzed to compare the utilization by elephants. The dung density overall as well as in Motichur and Kansrao ranges were found to be higher on the southern side of the railway track than on the northern side (Figure 20).

#### *2.3.1.4 Availability of water*

On all six transects on the northern side of the railway track, perennial water bodies were found. The important perennial rivers are the Suswa (Figure 21) and the Song. There are several other perennial nallahs, which flow parallel to the railway track some of which are less than 15m away from the track at several places. One such nallah flows along the track between telephone pole number 41/2 and 43/15 on the north side at a distance of between 10 to 50m (Figure. 22). Transect no. 3 on the northern side crossed seven perennial nallahs.

**Figure 21:** River Suswa: a perennial source of water to elephants during the dry season

The distance of river Suswa near Kansrao Range office varies from 609m to 870 m at certain places. The river Suswa, after joining the river Song, flows parallel to the railway line on the northern side, at a distance of between one to two km. There are not less than five to six perennial nallahs, tributaries or distributaries of these rivers. The whole area on the northern side of the track is very moist due to the presence of water even during the summer season.

**Figure 22:** Nallah: a part of a perennial water body on the northern side of the railway track.

On the other hand on the southern side of the railway track, perennial water bodies were not found on any transects. Dry riverbeds are the features of the areas south of the railway track (Figure23). On the south-western side of the railway track there are two perennial water bodies that fall in the Motichur range. Motichur Rau, which has water during summer, is situated at a distance of four to five km from the track. The Koilpura waterhole is the other perennial water body situated at a distance of

**Figure 23**: Dried Rau: a common feature of the areas south of the railway track

seven to eight km from the track. In Kansrao range on the southern side of the railway track, there are two small perennial waterholes situated at a distance of 600-700m from the railway track (Figures 24 a & b). Fresh elephant signs such as dung piles and footmarks were found near these waterholes. These waterholes are approximately three km apart from each other. They are in a very bad condition. Water is spilling out and siltation has taken place. Apart from these waterholes, the whole area on the southern side is completely dry during the summer season.

The presence of perennial water sources on the northern side of the track might influence animals (Easa 1988; Thouless 1996) to cross over during the pinch period and thus increase the chance of train accidents. As water is available even during the summer season, density of elephants increases in this area. As a result of elephant congregation from various parts of the park and due to crossing over to the northern side for water the chances of elephant mortality here increases. The fact that most of

**Figure24a:** Perennial water hole on the southern side of the railway track in Bahera V block, Kansrao.

**Figure 24b:** Perennial water hole on the southern side of the railway track in Koilpura III block, Kansrao

the mortality occurs between January and June with the peak in May, supports the view that water is an influencing factor for elephant movement across the track.

#### *2.3.1.5 Influence of crops*

Information on crop pattern, crop damage, pattern of crop damage, season, elephant group size, movement of elephants, elephant number etc. was interpreted based on the questionnaire survey. There are several villages on the northern side of the park including; Chidderwala, Chandi, Sergarh, Laltapper, Saheb Nagar, Chak Jogiwala, Khari Khurd, Nayabasti, Raiwala Dandi. Sugarcane, wheat and paddy are the major crops of the area. The area under cultivation of crops varies in different places. Villages towards Doiwala on the boundary of the Kansrao range of RNP and Barkote range of Dehradun Forest Division have the largest area under sugarcane cultivation (Figure 25), followed by wheat.

**Figure 25:** Croplands close to the forest are major attraction for elephants.

Cultivation of paddy is minimal in these areas. Villages close to the Raiwala and Satyanarayan have the largest area under wheat cultivation followed by paddy and sugarcane. Sugarcane is planted during February and March and harvested during December and January. Sowing of wheat takes place in the month of December and it is harvested in April and May. Paddy is sown in the last week of June and harvested in October and November.

The questionnaire survey of villages and forest staff indicates that the number of elephants in the Kansrao and Motichur ranges (area north of the Shivalik ridge) increases between February and June. This is the time when congregation of herds takes place. During the rainy season only a few elephants are found in this area, which are mainly loners. The peak depredation period is between March and May (Figure 26). During this period there is involvement of both herds and loners. From July to December depredation intensity is very low. During this period damage

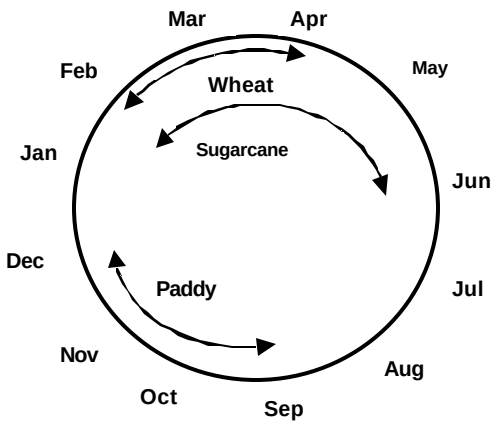


**Figure 26:** Crop depredation pattern in villages close to northern boundary

is caused mainly by loners. Depredation in the villages on the boundary of the Kansrao and Barkote ranges is high as compared to the villages close to Raiwala and Satyanaryan. Depredation of wheat was noticed as being the highest, followed by sugarcane and paddy. The peak period of wheat depredation was found to be between the months of February and April. Depredation of sugarcane takes place more or less throughout the year but is highest between February and June. Paddy depredation occurs during the months of September and December (very few). In the villages on the boundary of the Kansrao and Barkote ranges, wheat depredation is the highest followed by sugarcane. In villages close to Raiwala and Satyanaryan wheat depredation is the highest followed by paddy. The raiding group size also differs in different seasons. During February and June the raiding group size is larger (4-25 elephants) than in the monsoon and winter.

In villages, damages to banana trees and jackfruit have also been noticed. But these trees are few in number. Crop depredation patterns and season coincide with the elephant mortality period in the area. The peak depredation period is between the months of March and May during which time mortality by train accidents is also high.

#### *2.3.1.6 Impact of the disturbances*

For human disturbances, factors such as human presence, cattle presence, and cattle dung in plots were taken as indicators. Plots were classified as being disturbed if these indicators were present in them. When data was compared for either side of the track, no differences were found (Figure 27).

Food species densities both among trees and shrubs were found to be highest on the southern side of the track. This indicates that food species

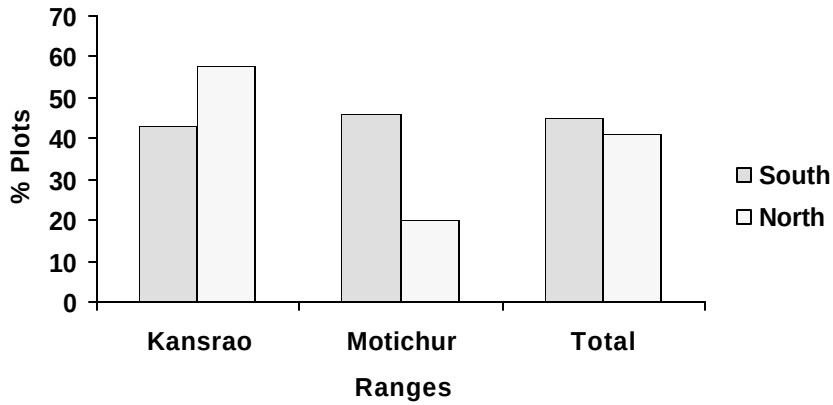


**Figure 27:** Disturbances on both sides of the railway track in RNP

do not have any role on elephant movement from the south of the track to the north. Dung density was also found to be higher on the southern side of the track relative to the northern side. There were no differences in disturbances on either side of the track. Rainfall showed an inverse relationship with elephant mortality due to train accidents; mortality decreasing as rainfall increased. Temperature showed a direct correlation with the monthly mortality trends of elephants due to train accidents; peak mortality coinciding with very high temperatures. Differences in water availability on both sides of the track during the summer season indicate that water might be the main influencing factor responsible for movement of elephants from the south to the north side. The crop raiding season also coincides with the maximum mortality period; crop raiding being high during the period of maximum mortality.

These things indicate that there is a possibility that after winter, when the water dries up, elephants are forced to look for perennial water sources (Williams et al., 1998). The Kansrao and Motichur ranges have such water sources but these are confined to the north of the railway track. The area to the north of the railway track is very moist. From January till June (the onset of rain) elephant congregation takes place in these two ranges and part of Haridwar. For water, elephants cross the track from south to the north and they also feed on crops on the fringe of the forest close to water sources. This makes them vulnerable to train accidents.

### 2.3.2 Technical factors

The RAP also looked at possibilities of several technical factors being responsible for elephant mortality.

#### *2.3.2.1 Altitude and gradients along track*

The altitude of Dehradun is higher than Haridwar by 342.81m. Haridwar is situated at 294.15 msl. and Dehradun at 636.96 msl. According to the railway department, maintaining slow train speeds in this sector is not practical due to altitudinal differences. In such a situation, the sudden application of brakes to stop the train at a minimum distance is impossible. Trains running at a speed of 50 km/hour require a minimum braking distance of between 600 m and one km depending on the situation. Sometimes animals come onto the track suddenly and even if drivers are alert, the possibilities of accidents are high.

At certain places the railway track is either at a lower or a higher level from the surrounding terrain. Between telephone pole number 46/1 and 46/7 the track is around seven to eight meters above ground level. These types of features sometimes cause problems.

### *2.3.2.2 Turnings*

The track turns at several places between Motichur and Kansrao. A minimum total of 11 such turnings were noticed between these two railway stations (Figure 28). On turnings, it is very difficult to see the animals from a distance and the possibility of accidents increase. Some of the turnings are relatively sharp creating a blind corner. Considerable vegetation growth (bushes) near the turnings further aggravates the problem. There are two records of elephant mortality on such problematic turnings between telephone pole no. 40/5 and 40/10. These two incidents happened in the Motichur range, one near pole number 40/7 and 40/8 and the other near 40/9.

### *2.3.2.3 Mounds*

Steep mounds along the track are a crucial factor to consider as well. Several accidents have taken place on parts of the track bordered by

**Figure 28:** Turning: a critical section on the track where chances of elephant mortality is high due to train accidents.

**Figure 29:** Mound; elephants are prone to be trapped in areas with such land features

such mounds, where animals were totally trapped. In the Haridwar range, near Motichur railway station, two such accident related elephant mortalities have taken place (Figure 29). The chances of being trapped are very high for large animals like elephants. In one incident near Motichur railway station 11 domestic buffalo died after being trapped on the tracks by steep mounds on either side (local villagers *pers. comm*.). The stretch of track extending for 1.2 km past the Motichur railway station has a combination of blind turnings and very steep mounds. These factors in combination with the urban sprawl to the east of the track increase the chances of elephants being trapped on the track when trains pass through, especially at night. This section from the Motichur railway station to the Motichur railway crossing is a part of the Chilla-Motichur corridor and is used by elephants to move to the eastern side of the track (Johnsingh, *et. al*., 1990).

#### *2.3.2.4 Speed of trains*

The speed of the train is very important in this section due to the presence of turnings and mounds and frequent animal movements across the track. While working on the railway track, the investigator noticed that trains were travelling at higher speeds than prescribed. The Shatabdi Express was found to be travelling at a speed of 72 km/hour and the speed of the Dehradun-Ujjain Express was measured at 66 km/hour. The lowest speed in this section for the Amritsar-Dehradun fast passenger that traveled at 56 km/hour. This is quite dangerous as trains running at such high speeds through the park increase the chances of accidents. These speeds were found to be higher than the speeds prescribed for trains in this section by the railway department as well. The speeds of the night trains (mainly responsible for elephant mortality) were not measured. The Dehradun-Ujjain express has been found to cause elephant mortality in the past.

#### *2.3.2.5 Frequency of trains*

The volume of rail traffic on the Haridwar-Dehradun section is high (Johnsingh and Williams, 1999). There are a total of 26 trains of which 16 are daily. There are additional trains each day of the week as well: one on Monday and Friday, two on Wednesday and Saturday, three on Tuesday and four on Thursday. These passenger trains and some goods trains also run on this route. Between Haridwar and Rishikesh there are 10 trains. These trains cross Rajaji up to Raiwala from where they divert for Rishikesh. The critical track section, after Motichur railway station, has a minimum of 27 passenger trains, and a maximum of 30 per day.

The RAP attempted to ascertain the role of increased train frequency on elephant mortality. In most cases, the trains that have been involved in accidents were those that have been in use for a considerable number of

years. However one cannot refute the impact of increased train frequency on elephant mortality.

### 2.3.3 Human factors

There are several human attributes that have an influence on the mortality of animals due to train accidents. Among them the disposal and throwing of food waste along the track inside the Park and human errors are important.

#### *2.3.3.1 Unmanaged disposal of food waste*

While collecting data on the railway track in Rajaji National Park, the RAP found waste disposed at more than 22 places from the Shatabdi Express (Figure 30). Several kinds of non-biodegradable substances were recorded along the track at many places. Passengers from other trains are also throwing waste material on park grounds. Waste includes mineral water bottles, cold drink cans, sauce pouches, tea bags,

**Figure 30:** Garbage disposed by caterers of Shatabdi Express along the railway track in park area is attracting wild animals.

polythene bags, residue of edible items and non-biodegradable substances. This waste attracts many wild animals including elephants, chital, and wild boar onto the track. Animals have been seen eating food waste and other articles on the track in the evening. Polythene bags have been recorded in elephant dung in the Kansrao area. Thus, waste disposal is not only dangerous as it attracts animals onto the track, thereby increasing the chances of animal mortality due to train accidents, but additionally, mortality caused by ingestion of plastic and polythene bags and subsequent intestinal blockage is also likely.

#### *2.3.3.2 Human errors*

Railway staff and train drivers interviewed during the RAP revealed that in most of the accidents, the relevant train drivers were from outside the Dehradun section. Drivers from the Dehradun section are well versed with the terrain. They know places with regular elephant movement and pass by carefully. In case of drivers from other sections, eg. Moradabad, lack of knowledge of the local terrain and the places of frequent occurrence of wildlife can lead to complacency in driving and therefore accidents.

# 3 IDENTIFICATION OF SECTIONS PRONE TO ACCIDENTS

## 3.1 Introduction

It is important to identify crucial areas of elephant movement and those prone to accidents for future management.

## 3.2 Movement zones

Based on the dung encounter rate along the track between Motichur railway station and Kansrao railway station, areas with frequent elephant

movement were identified (Figure 31). The first such zone was found after Motichur railway station towards Raiwala. One km of track stretch up to telephone pole no. 33/9 had a high dung encounter rate. The second such zone was between telephone pole no. 40/7 to 41/8. This place is approximately eight km from Motichur railway station and extended for nine kms. The third such zone (the highest among all) was found between telephone no. 43/11 to 49/2 up to Kansrao railway station. This stretch was around six km.

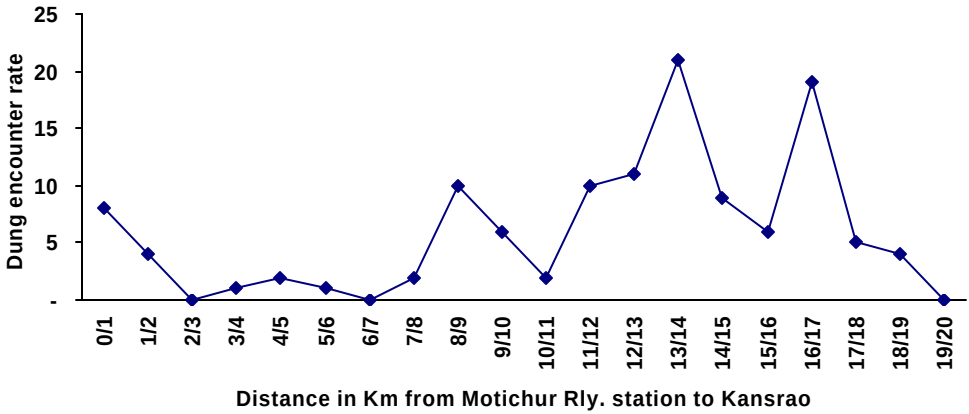


**Figure 31:** Crucial movement zones across the track in RNP (based on dung encounter rate)

### 3.3 Sections prone to accidents

In these areas, certain sectors were considered prone to accidents as they had mounds or turnings in them.

#### 3.3.1 Mounds

Mounds are features that are formed when the track climbs from a lower place to ground level and as a result, the land on both sides of the track is elevated and steep. If mounds are present and very steep, large

animals like elephants may get trapped when a train passes. Several elephant mortalities have occurred in the past due to such mounds.

Crucial mounds were identified at six places between telephone pole number 32/2 and 32/5; 32/8 and 32/10; 33/1 and 33/5; 39/16 and 40/2; 44/4 and 44/5; and 46/13. The most crucial mounds are near Motichur railway station between pole no. 32/2 and 32/5; 32/8 and 32/10; and 33/4 and 33/5. These sites are very narrow, as the gap between the track and the hillock is very small. Another important drawback is the presence of a concrete wall (7-8 feet high) on both sides, making it impossible for animals to climb up. This wall is made to prevent erosion of soil onto the railway track. The mound between pole no. 44/4 to 44/5 is approximately 10 m high and the gap between track and hillock on both sides is three metres. The mound near pole no. 46/13 is only five metres in length on either side of the track.

| **Sl. No.** | **Turnings on the railway track** | |
|---|---|---|
| | **From pole no.** | **To pole no.** |
| 1 | 33/1 | 33/4 |
| 2 | 36/1 | 36/6 |
| 3 | 37/4 | 37/7 |
| 4 | 40/5 | 40/10 |
| 5 | 40/11 | 41/3 |
| 6 | 42/2 | 42/4 |
| 7 | 42/8 | 42/12 |
| 8 | 43/1 | 43/5 |
| 9 | 43/11 | 44/1 |
| 10 | 45/8 | 45/16 |
| 11 | 47/7 | 47/15 |

**Table 1:** Turnings on the Railway track between Motichur to Kansrao Railway stations in RNP

### 3.3.2 Turnings

11 turnings have been identified between Motichur railway station and Kansrao railway station (Table 1). In the past, accident-related mortality has been recorded on a few such turnings. Details of the turnings have been given in Table 1.

### 3.4 Crucial Seasons

Data on the seasonal mortality pattern of elephants due to train accidents indicates that most of the mortality has occurred during the months of January and June (78% of the total). The peak period is the months of April and May.

### 3.5 Crucial trains

The trains which have been responsible for elephant related accidents are; Doon Express (both up and down), Mussorie Express (going to Delhi), Janta Express (going to Varanasi), Ujjain Express (going to Dehradun), Haridwar-Rishikesh passenger, Saharanpur - Dehradun

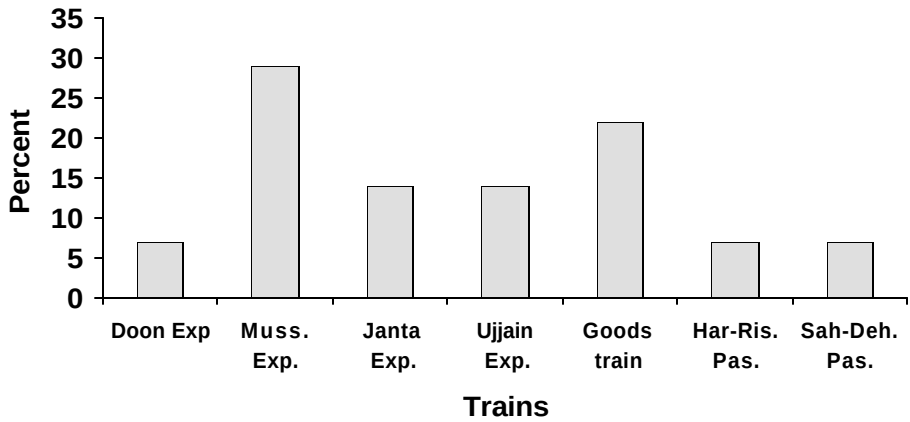


**Figure 32:** Precentage involvement of problematic trains in accidents in RNP

passenger (going to Dehradun) and goods trains (Figure 32). The Mussorie Express tops the tally, followed by the goods trains, Ujjain and Janata Express, Doon Express and two other passenger trains. All the trains pass through RNP in the evening or night and have been identified based on the information available from 14 accidents.

### 3.6 Crucial time period

Based on the information available on the accident time period in 11 individual cases, the time prone for accidents was identified (Table 2). All accidents have occurred between 6:30 p.m. and 5:30 a.m. The frequency of accidents has been highest around 10:00 p.m. Two accidents have happened at 7:00 p.m. Hence, the period between 6:00 p.m. and 6:00 a.m. is crucial as this is the time when animal movement across the track increases.

| Time of accidents | Accident frequency | Caution period |
|---|---|---|
| 06:30 p.m. | 1 | In Summer |
| 07:00 p.m. | 2 | 06:00 p.m. to 06:00 a.m. |
| 08:30 p.m. | 1 | |
| 08:45 p.m. | 1 | In Winter |
| 09:30 p.m. | 1 | 05:00 p.m. to 07:30 a.m. |
| 10:00 p.m. | 3 | |
| 02:10 a.m. | 1 | |
| 05:30 a.m. | 1 | |

**Table 2:** Crucial time period prone to train accidents in Rajaji National Park

# 4 ADMINISTRATIVE, TECHNICAL, AND LEGAL APPROACHES AND THEIR EFFICACY

## 4.1 Approach by the RNP Authorities

Previously, the Rajaji Park authorities and the Forest Department had taken several steps to reduce train accidents including:

### 4.1.1 Coordination with the Railway Department

On 10th November 1998, park officials organized a meeting with the concerned railway authority to find a solution to this problem. Scientists from the Wildlife Institute of India, Dehradun were also invited. Various mitigation measures were suggested. Among them the important ones were; to declare 18 km of track zone in RNP a "caution zone", to reduce the train speed to 20 km/hour in this zone, to remove the mounds on the both sides of the track and to clear bushes on the turnings.

Again, on 6th January 2000 another meeting was organized with railway officials. The meeting was also attended by the Additional Director General of Wildlife, the Ministry of Environment and Forest, scientists from WII, and representatives of the Friends of Doon Society. This time too, suggestions were made to reduce the train speed to 20 km/hour, particularly during the night. The RNP authority submitted a proposal to clear the mounds along the track. The cost of the proposal was Rs. 23.895 lakhs. The Railway Department was not ready to sanction this amount. Later on the proposal was submitted to the Ministry of Environment and Forest, as suggested by the Add. DG., Wildlife. Other issues raised were; replacing the present whistle by a low frequency (infra sound) whistle, to stop the waste disposal in RNP areas by Shatabdi caterers etc. Once again, there was no breakthrough in reducing train speeds in the 18 km caution zone.

The RNP authorities also raised these issues (to reduce the train speed, declaring the area as a caution zone and stopping the waste disposal) time and again through various letters written to GM, Northern Railway, New Delhi (20.10.98), DRM, Moradabad, (27.2.98, 17.2.99, 3.5.2000 and 7.6.2000) and Divisional Operation Manager, Moradabad (14.4.99 and 27.11.99).

### 4.1.2 Leveling of mounds along the track

On 7th October 1998 a team of RNP officials including the Wildlife Warden and Range Offices of Motichur and Kansrao did a joint survey of the track and identified certain mounds. A proposal of Rs. 23.895 lakhs was then submitted to the Ministry of Environment and Forest for funding. After obtaining funding from the Ministry, certain mounds in the Motichur and Kansrao belt were cleared by the RNP authority during the year 1999-2000 and 2000-2001.

After clearance of these mounds, no elephant deaths have taken place at those spots. But, since this happened very recently, it is still too early to establish any relationship between clearance of the mounds and accident-related elephant mortality.

### 4.1.3 Monitoring of tracks

Forest staff, as a part of their routine work, patrol the forest, including the track. The railway track is used as a footpath to go into the interior forest in Motichur and Kansrao. In case staff observe elephant movement near the track, they convey a message to the railway station. This is extremely helpful in reducing accidents. But during the night this is not always possible.

### 4.1.4 Legal action against the Railways

In the year 2000, after the death of an elephant due to a train accident, the Rajaji Park authority filed a case against the train driver and guard. This year after the incident of 29th May 2001, the Park authorities have taken legal action and issued a notice against the DRM (Moradabad), train driver and guard. The Deputy Director, RNP is investigating this case and after hearing from the railway officials may file a case against them.

## 4.2 Approach by the Railway Department

The Railway Department is also in favour of reducing such incidents on the track. These incidents cause severe losses to the railways and in certain cases there are chances of the train being derailed. In such situations there is always a possibility of loss of human life and property.

In case of any such incident the railways could face problems related to

a) Detention of the train
b) Damage to the track
c) Damage to wagons and coaches
d) Derailments of the train
e) Financial claims from passengers
f) Injury and death of passengers

In the case of detention, which has happened in the past, the railways have had to refund the passengers' ticket money. In such cases there is chance of loss of perishable items such as fruits, vegetables etc. In one case, the railway arranged for buses to carry passengers of the Shatabdi Exp. up to Haridwar to board from there and the money for catering was given to them without utilization. In the recent incident of 29th May 2001, a crane was sent from Moradabad to clear the track, the running cost of

which was very high. It is, therefore, clear that the railway authorities must view the accidents as avoidable and therefore take all steps to reduce them.

There are views that if the rate of accident-related elephant mortality is low in relation to mortality due to other causes and if the cost of mitigation is high, why not accept and live with the situation? The answer lies in what price society is willing to pay to avoid the death of a species revered by Indian ethos. A simpler answer may lie in attending to the problems, which the railways may have to face for reasons given above. And if a solution is not found now, the problem will intensify with increasing demand for passenger carrying capacity owing to Dehradun having become state capital of Uttaranchal.

### 4.2.1 Slowing down speeds

On this issue there is a difference of opinion between the railway authorities and conservationists. The railway authorities do not want to reduce train speed, as they say that it is not possible to do so in such a terrain. According to the railway authorities, they are maintaining a maximum speed of 50 km/hour for the Shatabdi and 45km/hour for the other trains in this 18km stretch. At a meeting on 10th November 1998, the then Operation Manager informed the others of this. But during the RAP, it was found that the speeds of trains are much higher than prescribed speeds. The Shatabdi Express was found running at a speed of 72 km/hour, Dehradun-Ujjain Express at 66 km/hour and the Amritsar-Dehradun fast passenger at 56 km/hour. If the railways have indeed given instructions to restrict the speed, the drivers are flouting such instructions.

### 4.2.2 Shifting of track

A couple of years ago there was a proposal from the Ministry of Railways

to divert the Haridwar-Dehradun section of the rail track. The plan was to take the track through Rishikesh to Doiwala through Jolly Grant (Figure 4.1). A survey was also conducted to know the financial implications and cost of construction. But officials found that this was not viable economically. The plan was also not related to the problem, but was totally business-oriented. The railways wanted to know whether diverting the track through Rishikesh and onto Doiwala could increase the railway income or not. However, this plan was dropped.

Diverting the track through Rishikesh to Doiwala could be a possible solution of the elephant mortality problem. However, before doing this, a proper investigation is required, as elephant movement has been noticed from this area as well. Few elephant groups from Rajaji National Park have been found crossing the Raiwala-Doiwala main road between Chidderwala and Laltapper through the forest of the Barkote range under Dehradun forest division. These elephants also cross the Rishikesh-Doiwala road and move up to the Tehri Forest Division. During the RAP several fresh dung piles were recorded on the Raiwala-Doiwala road. The forest patch along the Rishikesh-Doiwala is approximately 10km in length, and can face destruction in case of track diversion. But priority should be given to the conservation of an area of better habitat quality (especially for elephants) with fewer disturbances as compared to others i.e. Rajaji National Park.

### 4.3 Approach by other Govt. and Non Govt. Organizations

For a solution to this problem, conservationists in Government organisations and people from NGOs have done several things. The Ministry of Environment and Forests has shown concern and given funding support for alleviating the problem. The Ministry gave Rs. 23.895 lakhs to RNP for clearing the mounds along the track. The Add. DG.,

Wildlife and Director, Elephant Project have taken pro-active measures to solve this problem. Once, the then Honourable Minister, Ministry of Environment and Forest Mr. Suresh Prabhu wrote to the then Honourable Minister, Ministry of Railway Mr. Nitish Kumar to take action in this regard. He raised the issue of decreasing the train speed in this section of the track, to put signs for train drivers at places with frequent animal movements, to widen the narrow places around the track, and finally to divert the track from the park.

The Wildlife Institute of India, Dehradun has also played a role by giving technical support on this matter. NGOs like Friends of Doon Society have attempted to reduce the problem in RNP through their own activities. On many occasion, people from this organisation have written letters to various railway authorities for solving this problem. There is also a website on the Internet -- http://wild.allindia.com, that puts up elephant mortality in Rajaji in their NEWSFLASH. Through this site, the signatures of three lakh people were obtained and this was submitted to the Railway Minister on 26 May 1999. While these efforts are commendable, a practical solution has not bee found as of now.

The Wildlife Trust of India (WTI), approved an RAP on the problem in RNP within a few days of the latest incident of elephant mortality on 29th May 2001. On June 11th 2001 fieldwork was started by WTI. The guidelines & solutions that follow represent the end of Phase-I of the RAP. Phase-II will include field action by WTI in conjunction with the Government to implement a long-term solution.

# 5 GUIDELINES AND SUGGESTIONS

## 5.1 Ecological measures

### 5.1.1 Improvement and management of two natural waterholes

The two identified perennial waterholes on the southern side of the railway track in Kansrao range should be maintained and managed properly. One is in Koilpura- III block of Jamunkhata beat and the other is in Bahera-V block of Kansrao II beat. These waterholes are very important as several wild animals including elephants utilize them. In 1998-99, they were reinforced by concrete construction with the purpose of increasing their water holding capacity. But today they are in a very bad shape. Water is spilling out and siltation has taken place. These waterholes must be repaired immediately. Silt deposits should also be removed regularly, at least once a year, just before the onset of the dry period. As these waterholes have been found to be used by elephants and other animals (dung piles and footprints), it will be useful for wildlife in the pinch period and will help in reducing the movements of animals across the track to some extent. WTI will facilitate the desiltation of these two waterholes during the first year.

The construction of artificial waterholes on the southern side of the track will not be useful. The maintenance of artificial waterholes in the long run has been found to be very poor. From an ecological point of view artificial waterholes are not preferable, as it is a sort of alteration of the natural habitat which can have numerous direct and indirect effects, some of them adverse. When larger perennial water bodies are available on the northern side of the track, it is very difficult to restrict the elephants by constructing new artificial waterholes in the south. Hence it is not advisable to construct artificial waterholes for elephants. The possibility of lifting water from the north to south through pumps is also not advisable in the long run.

### 5.1.2 Restore Chilla-Motichur corridor

Between January and June, when elephant congregations takes place in the Kansrao and Motichur ranges, elephants have been found to cross the railway track on the northern side. However, due to blockage on the eastern side through the Chilla-Motichur corridor, their movement is found to be restricted to certain areas. As elephants are large ranging animals they require a larger area to move for their foraging requirements. If the Chilla-Motichur corridor is viable, they will have access to a larger area on the eastern side of park. This will reduce their frequent movement across the track and subsequently reduce the chance of accidents. Elephants have also been found crossing the Raiwala-Doiwala road and Rishikesh-Doiwala road up to Tehri forest division from the Kansrao area.

Wildlife Trust of India has offered to work for securing the Chilla-Motichur corridor.

## 5.2 Technical measures

### 5.2.1 Leveling of six important mounds

Six mounds have been identified in between Motichur and Kansrao railway track. Among them the three mounds close to Motichur railway station towards Raiwala should be leveled on a priority basis.

### 5.2.2 Clearing bushes along the track and at turnings

Turnings are sensitive areas and prone to accidents. Bushes should be cleared every year on each turning. Even along the track a minimum of six to seven meters of area on either side should be cleared. The Railway Department should take on this responsibility.

### 5.2.3 Providing wireless facilities to Motichur railway station

The wireless network systems in railway stations have been found helpful in averting train accidents. In case of elephant movements close to the

railway track information can be passed to the train driver and guard through VHF sets. Often, forest staff in Kansrao has relayed elephant movement information to station staff and this was then passed on to the drivers. While working for the RAP in the Kansrao range the investigator saw a group of elephants with a very small calf walking on the track. They were trying to cross the track from south to north but due to the small calf they were moving very slowly. Some of them started walking on the track. First the investigator tried to chase the animals from the track, but was not successful. Therefore the investigator chose the option of informing the Kansrao railway station. Travelling two km by tractor, the investigator reached Kansrao railway station and passed the information to the stationmaster. He in turn informed the driver of Ujjain Express through VHF set and asked him to stop the train at Kansrao station. The train arrived in a few minutes and stopped at the Kansrao railway station. In this manner, an accident was averted.

VHF sets are available in Kansrao, Raiwala and Doiwala railway stations but Motichur lacks such facilities. Being an accident-prone area these kinds of facilities should also be provided at Motichur railway station by the Railway Department to prevent such incidents in future.

### 5.2.4 Possibility of using special whistles

It has been established by research that elephants are capable of hearing low frequency sounds (infrasound) from long distances (Payne, 1998; Kurtus, 2001). The discovery of infrasonic communication between elephants (Payne, 1998) can be useful in the search for an alternate sound device in addition to the present whistles. Scientists are trying several devices to avoid animal accidents by railways and highways (Barlow, 1997). While looking for such a sound device, the hearing frequencies of other wildlife should also be addressed. WTI has written to scientists working in this field. However, lasting solution will take time.

## 5.3 Administrative measures

### 5.3.1 Decreasing train speeds in an 18 km caution zone

The railways should decrease train speeds in the 18km problematic zone, particularly for evening and night trains. During the RAP, trains were found travelling at much higher speeds than those prescribed by railway authorities. Altitude differences between the two railway stations were also checked to examine the possibility of reducing the train speeds. Raiwala is situated at a level 42.2 m higher than Motichur along a distance of six km, Kansrao is at a level 61.23 m higher than Raiwala along a distance of 11 km, and Doiwala is at a level 67.02 m higher than Kansrao along a distance of 10 km (Figure 33). With such a small difference in altitude there is a possibility of slowing down train speeds. DRM, Moradabad also showed willingness to check trains speed at different levels on a trial basis to determine the minimum running speed and braking distance.

If the present speeds of the trains are 45 km/hour to 50 km/hour, reducing their speeds to 20 km/hour or 25 km/hour from Motichur to Kansrao will

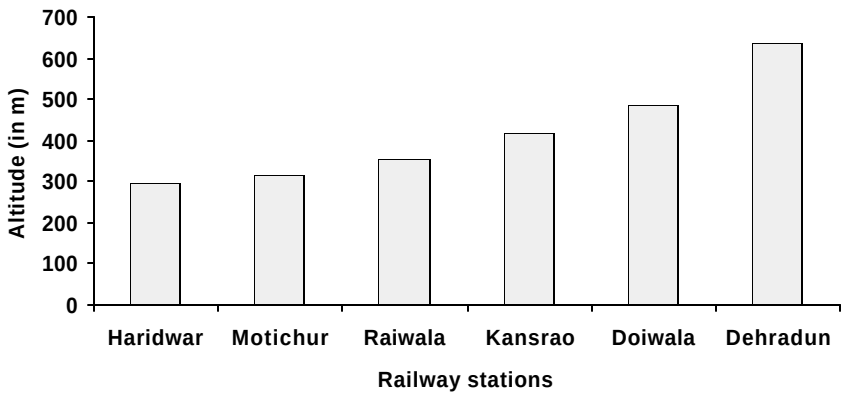


**Figure 33:** Difference in altitude between different railway stations in RNP

not make much difference in their schedule. The trouble prone area is only 18km and reducing the speed will only make a difference of nine minutes. Slowing down their speed will not impact the trains travelling between the Haridwar and Rishikesh sections very much, as they have to cross only six km between Motichur and Raiwala through the RNP area.

### 5.3.2 Rescheduling train timings of a few critical trains

The Railway Department should reschedule the timing of a few trains. The timing of 4309 (Ujjain-Dehradun Exp.), 4317 (Indore-Dehradun Exp.), and 9265 (Okha-Dehradun Exp.) should be rescheduled. Their arrival time at Dehradun is 19:00 hours, which should be advanced by an hour, so as to reach Dehradun by 18:00 hours. The arrival time of Saharanpur-Dehradun passenger should be advanced by 1 hour 30 minutes so that instead of reaching Dehradun by 20:00 hours it will reach by 18:30 hours. The departure time of 4266 (Dehradun-Varanasi Exp.) should be advanced by 30 minutes. This will mean that the train will leave Dehradun at 17:45 hours instead of 18:15 hours. However the problem of the Mussorie Express, which has caused the maximum number of accidents, will remain. This train starts from Dehradun at 21:15 hours. Trains travelling through the Haridwar-Rishikesh section particularly 371, 1 Haridwar-Rishikesh passenger, 5 Haridwar-Rishikesh passenger and 6 Haridwar-Rishikesh passenger should also be rescheduled.

### 5.3.3 Prohibiting running of Goods trains at night

Information available on the involvement of trains in accident show that a minimum of three incidents has been caused by goods trains in the night. Hence, in such a situation the railway could suspend goods trains during the night period in this section.

### 5.3.4 Focusing attention on problematic trains

The trains that have been found responsible for the accidents and elephant mortality should run carefully in the problematic sector at slow speeds and with experienced drivers. All trains running in the evening and night should do so carefully.

### 5.3.5 Using experienced drivers from the Dehradun sector

While talking to railway staff and train drivers, it was discovered that in most cases, the drivers involved in the accidents were from outside the Dehradun section. Drivers from the Dehradun sector know the area very well and cross carefully. So in this problematic section, particularly in the evening and night trains, experienced drivers from Dehradun section should be given priority.

### 5.3.6 Regulating garbage disposal

Garbage was found all along the track throughout the park area. Waste from the Shatabdi Express has been found at various places. Food items have been found attracting wild animals onto the track, which is an important cause of accidents. The railway department should warn the Shatabdi caterer to stop waste disposal inside the park area. If this does not deter them their contract should be canceled. For passengers of other trains, the railway department should make arrangements for announcements at the Haridwar and Dehradun railway stations before departure of the train, requesting them not to throw any waste or hazardous items within the park area. Posters should be put up to this effect at railway stations. These measures will help in reducing such problems in RNP. WTI will assist in mobilizing volunteers and create awareness on this issue.

### 5.3.7 Reducing biotic disturbances

Biotic pressures like lopping of trees by Gujjars (Johnsingh and Joshua, 1994; Singh, 1995) and sharing of crucial water bodies during pinch period by cattle in the park area (Williams et. al., 1998) may have its indirect impact on animal accidents by trains. Lopping of several of the elephant's food species is prevalent in the park area (Williams et. al., 1998). Water sources used by cattle, are avoided by elephants. All these things have forced elephants to explore other areas in which to increase their movement, hence it is very important to reduce such pressures from the park area. The Forest Department should take action and stop these activities in the elephants' prime habitat.

### 5.3.8 Organizing meetings and co-ordinating between Railways and Park staff

For a permanent solution to this problem, the interest and involvement of several concerned organizations is very important. There is a need to call a meeting involving park authorities, Department of Forests (Government of Uttaranchal), Ministry of Railways, Ministry of Environment and Forests and Ministry of Civil Aviation, Government of India, local public representatives and Commissioner of Railway Safety. Involvement of other organizations like Wildlife Institute of India, Dehradun, Wildlife Trust of India, New Delhi, Friends of Doon Society, Dehradun etc is also important. The Director, Project Elephant should take a lead role in arranging such a meeting.

To monitor the measures undertaken and for further coordination in this regard, meetings between the RNP authorities, railway officers at the regional level and NGO are required at regular time intervals.

## 5.4 Awareness

### 5.4.1 Use of signage in RNP

Wildlife signage has been found to be very effective in reducing wildlife-vehicle accidents on highways (Buckingham, 1997). Signage can be used in the accident-prone section of the track in the Rajaji National Park as well. Signage should be placed on both sides of the track before turnings, mounds and areas to alert train drivers. WTI will work in conjunction with the Forest Department and the railway authorities to erect six billboards along the track at pre-determined sites.

### 5.4.2 Putting posters in Running Rooms and at Railway stations

Posters related to wildlife conservation and wildlife mortality by trains in Rajaji National Park area should be placed in running rooms and railway offices at the Dehradun, Haridwar, and Moradabad stations. WTI will facilitate this.

### 5.4.3 Announcement at Dehradun and Haridwar Railway Stations

Before departure of any train from Dehradun to Haridwar and from Haridwar to Dehradun an announcement should made for train drivers and guards to travel carefully in the problematic zone of the park area. For train passengers, announcements should be made related to the garbage disposal problem in RNP.

## 5.5 Training and workshops

This is not a problem confined to the Rajaji National Park alone. There are several protected areas and forests where wildlife mortality are taking place due to train accidents. Hence, on a regional and national level there is a need to organize workshops involving all concerned forest officials, the railway authorities, NGO's and conservationists to share their information and offer suggestions.

There is also a need to organize formal workshops in the Rajaji National Park for train drivers, guards and other railway staff to make them aware of conservation and the importance of wildlife and animal mortality due to train accidents. Formal training should also be given to the ground level forest staff of RNP for tackling accident cases and to local vets for attending such cases. WTI will facilitate these workshops for the next few years.

### 5.6 Preparation of a database

In such a situation when wildlife mortality is taking place by train accidents throughout the country in several places it is very important to have a database on its various aspects. It will be of great assistance in the management of such areas in the future and sorting out of such problems at the Ministry level. These problems are more or less the same in all places. The database should include records on the total number of Protected Areas with railway networks, the length and type of track, important animals, animals facing problems, total mortality of animals, the number of trains travelling through, problematic trains, problematic track sections, reasons for accidents and other factors. It is suggested that Project Elephant undertake this responsibility.

### 5.7 Diverting the railway track

Most of the above-suggested measures are short to medium term solutions. A long-term solution is the diversion of the railway track through Rishikesh-Doiwala via Jolly Grant. As Dehradun is now the state capital of Uttaranchal, demand may soon come for doubling of the railway track to cope with increased passenger traffic. This will further aggravate the problem. Hence, based on a conservation priority, the track should be diverted out of the park.

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Between 1987 and 2001, 18 elephants were killed due to train accidents in Rajaji National Park in the northern Indian state of Uttaranchal. A Rapid Action Project undertaken by the Wildlife Trust of India to understand the circumstances and biotic and abiotic factors influencing these accidents resulted in this report that suggests possible mitigation measures and administrative and legal steps to solve the problem. Implementation of the recommendations of this report has led to five years of accident-free elephant movement on these tracks.

Wildlife Trust of India

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