

CHAPTER 2

STUDY AREA - SINGHALILA NATIONAL PARK, DARJEELING

2.1 Location in the Himalaya

The Himalaya is part of one of the most massive and complex mountain systems in the world. The ranges of this system extend from 70° east to 97° east longitude, and from 27° north to 37° north latitude and is approximately 2500 km in length with an approximate area of 236,000 km² (Khoshoo, 1993). Associated chains stretch westwards into Afghanistan (Hindu Kush), north into Soviet Central Asia (Pamirs) and east into Western China (Min Shan) and Northern Burma (Pakti Range) and geographically, the Himalaya is divided into the eastern, central, western and northwestern Himalaya (Mani, 1974). The main Himalayan system has three parallel ranges- the outer Himalaya, great Himalaya and middle Himalaya (Wadia, 1966). Darjeeling, a hill district in the state of West Bengal (India) is situated on the eastern part of the great Himalaya, and is also known as the Darjeeling Himalaya. The Singhalila National Park, is located on the northwestern border of Darjeeling (Figure 2.1), and it lies at 87° 59'-88° 53' east longitude and 26° 31'-27° 31' north latitude. Singhalila National Park was notified a National Park in 1986 and at present is under the jurisdiction of the Wildlife Division, Department of Forest, Government of West Bengal, India.

The altitude in Darjeeling varies from 100 m in the terai to 3600 m at Phalut on the Singhalila ridges, extending from the southern face of Mt. Kunchenjonza and also has a wide variety of forest types (Sudhakar *et al.*, 1993). A portion of the montane

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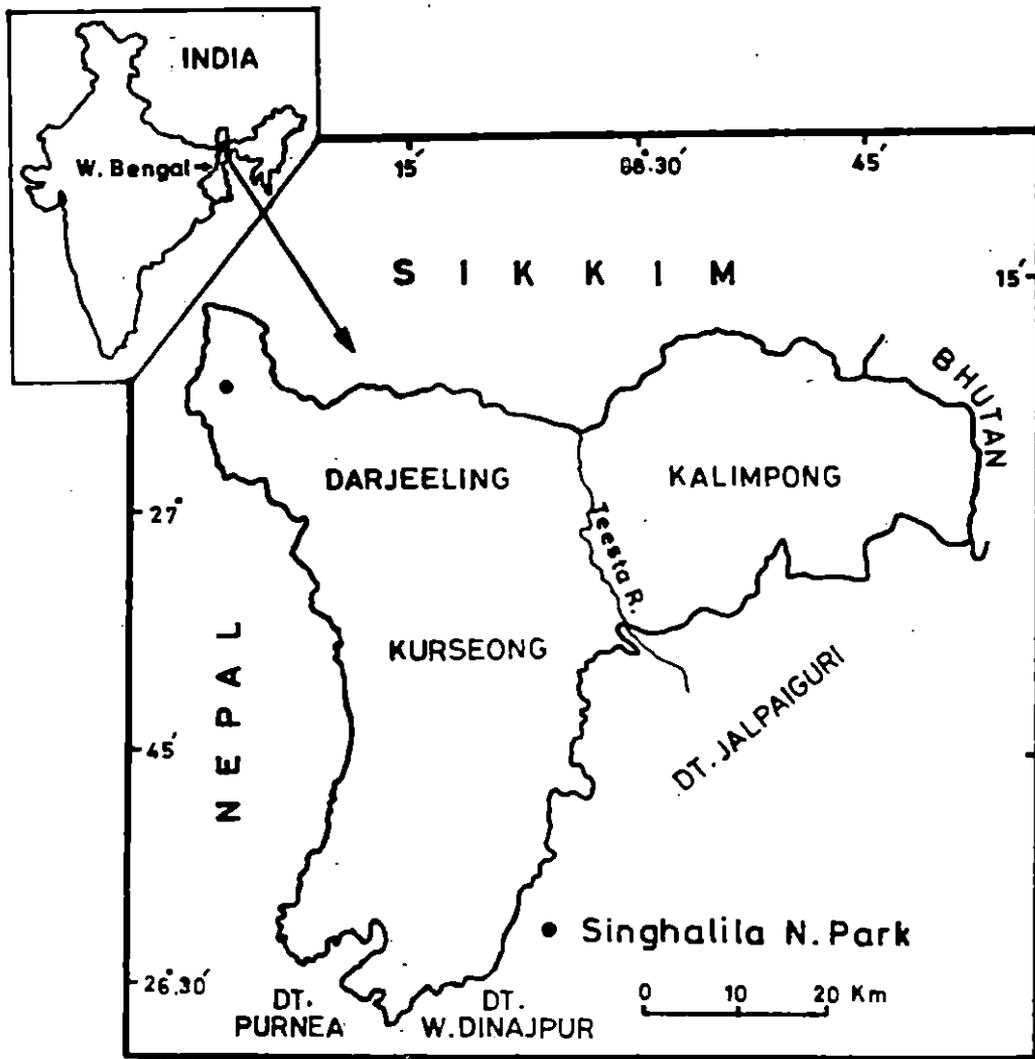


Figure 2.1 Map of Darjeeling showing the location of Singhalila National Park.

temperate and the subalpine types which fall within the Singhalila National Park forms an important refuge for the red panda.

2.2 Boundaries of the National Park

Singhalila National Park is bounded by the Rabongla Khola (Khola is a small stream) from Sikkim in the north while Nepal is on the south western border. The international border between India and Nepal is identified by a road running from Phalut down to Manebhanjyang (Figure 2.2). Singhalila National Park has an area of 108.7 km² with a core zone of 78.6 km² and a buffer zone of 30.17 km². Administratively, the National Park is divided into ranges which are further divided into beats and compartments. The boundary between the core and the buffer zones are formed by the compartment boundaries of Phalut 4, Sabarkum 3, 4, 10, 12, Siri 3, Sandakphu 4, 5, 6, 7, 10 and the lower MR road (Figure 2.2).

2.3 Climate

Moist temperate conditions of the area show variation with altitude. The annual mean temperature for the temperate zone varies from 0.5 °C to 18 °C and in winter from .5 °C to 10 °C. In the subalpine zone, the mean annual temperature is approximately 7 °C and in winter is the temperature remains below 1 °C. The mean annual rainfall in the Park is varies from zero to 773.5 cm. The average relative humidity readings vary from 70.% to 96%. Moderate storms accompanied by hail are common during March-April. The Singhalila National Park receives snowfall, which starts anytime between end of November to January and continues snowing intermittently till late February

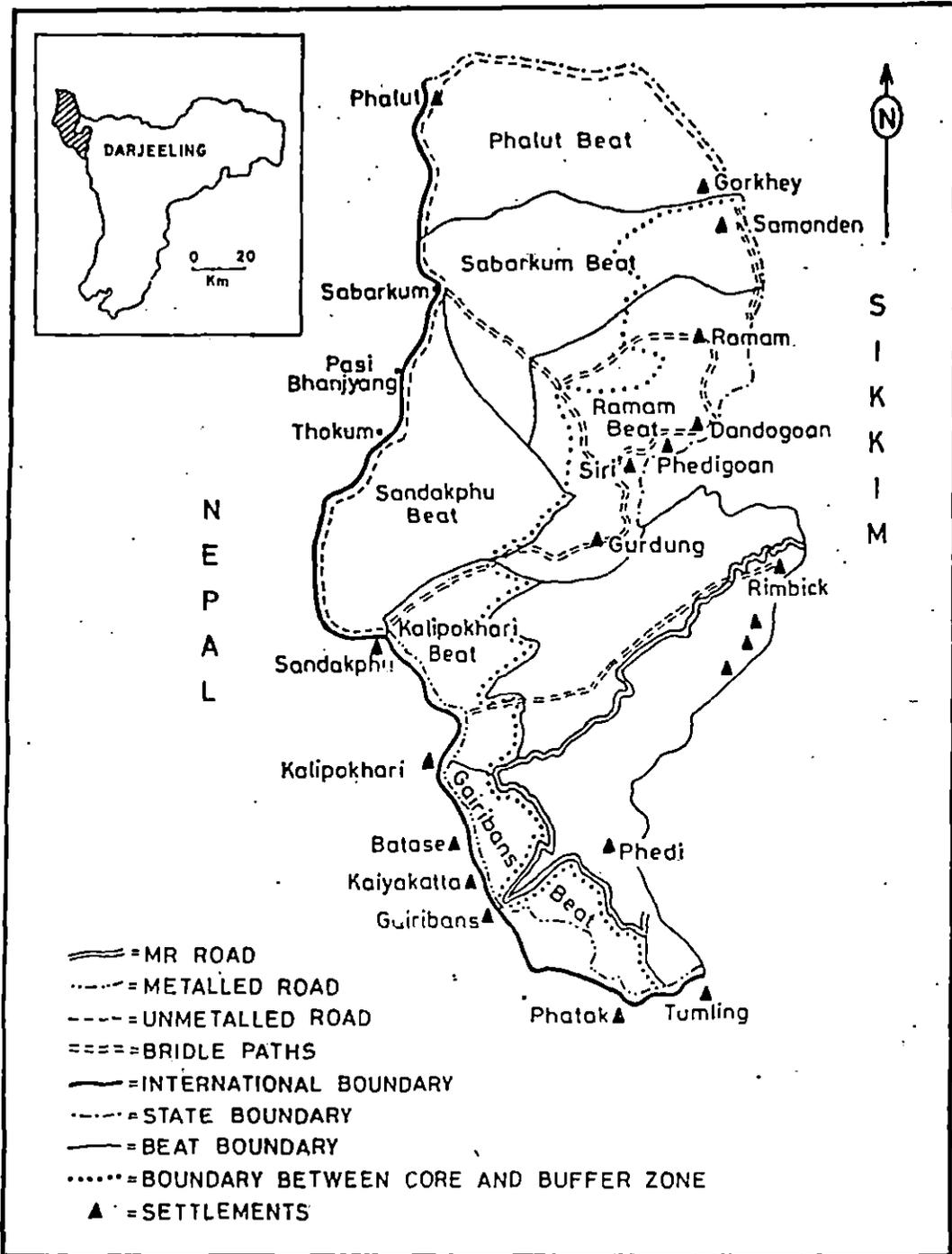


Fig.2.2 Map of Singhalila National Park, Darjeeling, showing administrative units (Beats), boundaries, settlements, roads and bridle paths.

Table 2.1 Details of temperature, humidity and rainfall recorded at Gairibans for the period of 1994-1996.

Months	Max. Temp. °centigrade	Min. Temp. °centigrade	Humidity %	Rainfall (mm)
Jan	1.00	0.50	70.80	155
Feb	3.00	2.00	91.58	164
Mar	8.00	7.00	89.85	524
Apr	12.00	11.00	87.52	1167
May	16.00	14.00	90.40	3857
Jun	18.00	16.00	91.50	5347
Jul	16.00	13.00	95.06	7735
Aug	15.00	13.00	96.70	5977
Sep	15.00	13.00	92.80	2235
Oct	11.00	10.00	95.85	512
Nov	7.00	4.00	80.11	185
Dec	4.00	2.00	85.39	0

and sometimes till mid April as observed in 1996. The snowfall is heavy and regular at the higher altitudes or the subalpine zone. In 1994, the place received its snowfall in mid- November. In 1995 and 1996 it was December and in 1997, the place received its first snowfall of the season in October.

2.3.1 Seasons: Four seasons have been distinguished mainly based on the monsoon or the rainfall in the area. The four seasons are:

2.3.1.1 Premonsoon (Spring): From March to May. This is the period just after the severe winter. During this season, the National Park experiences cool and sunny weather, clear sky, with maximum temperature ranging from 8 °C to 14 °C. Fog, frost and rainfall is minimum. The vegetation starts producing their new flush of leaves and trees like *Rhododendron* and *Magnolia* spp. flower during these months. These months approximately fall within the breeding period of the red panda.

2.3.1.2 Monsoon (Rainy Season)- From June to August. Monsoon sets in by late May and may last till early September during which the Park receives the maximum rainfall (Table 2.1). Fog and frost is very prevalent during this season. The Park also has maximum vegetative cover during this season. This season coincides with birth and lactation period of the red panda.

2.3.1.3 Postmonsoon (Autumn)- From September to November. The days remain clear, with pleasant amount of sunshine and moderate amount of rainfall (Table 2.1). The maximum temperature ranges from 5 °C to 15 °C. This is the time when a variety of ground vegetation like the *Primula* sp., *Areisma* sp., *Geranium* sp., *Saxifraga* sp., *Bistora* sp., *Senecio* sp. flower and edible fruits of *Sorbus cuspidata*, *Actinidia*

strigosa, *Holboellia latifolia*. Lactation and weaning period of the red panda occurs within this season.

2.3.1.4 Winter- December to February. Harsh and cold weather is experienced during this season with the temperature going down to less 0° C, with heavy snowfall especially in the subalpine region. The forest has the least vegetative cover during this season and breeding of red panda takes place during this season.

2.4 Vegetation

The park has an altitudinal range of 2400 m-3636 m and supports a variety of vegetation types and vegetation zones. The management plan (Anon, 1986) of the Singhalila National Park describes the composition of the vegetation under four heads namely the Upper Hill Forest, Oak-Hemlock Forest, Alpine Forest and the Bamboo brakes.

2.4.1 Upper hill forests: The composition of this forest type as described, more or less corresponds to Champion and Seth's East Himalayan Wet Temperate forests within an altitudinal zone of 2150 m to 2750 m. Three altitudinal zones were distinguished by the predominance of *Lauraceae*, *Quercus lamellosa* and *Quercus pachyphylla* distributed respectively in the zones of 1800 m to 2100 m, 2121 m to 2424 m and 2424 m to 2750 m (Anon, 1967). Champion and Seth (1968) named the three zones as Lauraceous forest, Buk oak forest and High level oak forest. Only the last two zones which are described as Buk oak forest and High level oak forest fall within the Singhalila National Park.

2.4.2 Oak Hemlock Forest: This type of forest is reported to be met within the upper portions of the Singhalila Range and is known to correspond to Champion's east Himalayan mixed coniferous forest of Moist temperate Himalayan group. This type is characterised by the composition of *Quercus pachyphylla*, *Betula utilis*, *Sorbus cuspidata*, *Castanopsis tribuloides* and *Rhododendron* spp. along with *Litsea elongata* and *Lindera neesiana*. Hemlock is described to be found on higher ridges from Rammam to Saberkum, Siri and Phalut. Silver fir is reported to grow from about 2878 m. The description of vegetation is a compilation of information obtained from sample plots in Rammam division and Sandakhpu (Champion and Seth, 1968).

2.4.3 Alpine Forests: This forest type corresponds to Champion's Himalayan dry temperate subalpine Birch-Rhododendron forest characterised by *Abies densa* along with its associates such as *Betula utilis* and *Rhododendron* species.

2.4.4 Bamboo brakes: Bamboo brakes described in the management plan correspond to Temperate bamboo brakes under Himalayan Moist Temperate Group of Champion and Seth (1968). These are vast patches of bamboo which are secondary growth after biotic disturbance in the area.

2.5 Fauna

The National Park has major mammalian fauna like the red panda, *Ailurus fulgens*, Himalayan black bear, *Selenarctos thibetanus*, Leopard cat, *Felis bengalensis*, Clouded leopard, *Neofelis nebulosa*, Barking deer, *Muntiacus muntjak*, Serow, *Capricornis sumatraensis*, Yellow throated marten, *Martes flavigula*, Great eastern horseshoe bat, *Rhinolophus luctus*, Rhesus maque, *Macaca mulatta*, Wild boar,

Sus scrofa, Himalayan mouse hare, *Ochotona roylei*. The frequency of mammals encountered on different transects during this study is presented in Table 2.2.

Singhalila National Park is very rich in its avifauna and has many interesting galliform species like the satyr tragopan, *Tragopan satyra*, kaleej pheasant, *Lophura leucomelana*, blood pheasant, *Ithaginis cruentus*, common hill partridge, *Arborophila torquela* and the red breasted hill partridge, *Arborophila mandellii*.

2.6 Geomorphology

Being a part of the Himalaya which has been a subject to large tectonic movements in recent geological periods, the rocks of the Singhalila are much folded and faulted and consistently lie in inverted succession. The formation of the area belongs to the Darjeeling gneiss and Daling stage of archaean age (O'Malley, 1907 and Mani, 1974).

2.7 Nature and distribution of water sources

The rivers like Rangit and Rammam drain water from the Singhalila range. Phalut, Sandakphu, Sabarkum and Tonglu blocks form the catchment area of number of streams such as Rithu khola, Singhpratap khola, Devithan Khola, Gurdun khola which pass through the park area. Siri khola and Lodhama drain water from various blocks of the Singhalila and Tonglu range. The Rammam river which originates from Phalut receives water from Singpratap khola and Lodhama khola before it joins the great Rangit river. These kholas (large streams) are perennial and retain water for a considerable period of the year and provide water to the people and wildlife of the area. During monsoon many rain fed streams are also seen within the area. In winter, some of these water bodies freeze.

Table 2.2 Frequency of encounter of major mammals in the study area during 24 monitorings of the transects in the study area

Species	Gairibans			Kaiyakatta-Kalipokhari				Sandakphu			
	1	2	3	4	5	6	7	8	9	10	11
<i>Felis bengalensis</i>	7	11	2	2	12	9	1	4	0	5	4
<i>Capricornis sumatrensis</i>	1	7	1*	0	0	0	0	0	0	0	0
<i>Muntiacus muntjak</i>	4	3	0	10	2	2	4,3*	5	2	2	4
<i>Macaca mulata</i>	2*	0	1*	0	2*	1*	1*	1*	0	0	0
<i>Selenarctos thibetanus</i>	0	1	0	0	1	0	0	1*	0	0	0
<i>Ochotona roylei</i>	0	0	0	0	0	0	0	0	1	1*	0
<i>Sus scrofa</i>	3	0	1*	2	3,1*	4	0	0	1	0	0
<i>Martes flavigula</i>	0	0	2*	0	3*	2*	0	0	0	1*	0

* = direct sightings

2.8 Roads

A motorable road runs from the town of Darjeeling to Manebhanjyang via Sukhiapokhari (13 km). From Manebhanjyang, a jeepable road (52 km) runs uphill to the northern most corner of the National Park- Phalut via Tonglu, Gairibans, Kalipokhari and Sandakphu. The road is mettaled till Sandakphu and unmetalled from Sandakphu onwards. A road known as MR road runs between Rimbick and Dootheria. Another road connects MR road with Kaiyakatta, which continues till Kalipokhari and is also known as MR road. This road is a good jeepable road which is not used. Apart from these, there are a number of bridle paths such as the ones running between Sandakphu-Gurdung, Phalut-Gorkhey, Molley-Siri (Figure 2.2). A good network of smaller human paths within the forest and also a good number of trekkers' paths are present in the Singhalila National Park.

2.9 Settlements

A number of human settlements are found in and around the National Park. Ten out of these fringe the western border of the park and are Nepalese settlements. These are Tumling (2949 m), Phatak (2992 m), Jaubari (2900 m), Gairibans (2625 m), Kaiyakatta (2879 m), Batasay (2971 m), Kalipokhari (3100 m), Bikheybhanjyang (3200 m), Sandakphu (3626 m), Phalut (3600 m). Other settlements which are in the buffer zone of the National Park include Rammam (2300 m), Siri (2200 m), Gurdung (2300 m), Samanden (2300 m). Gorkhey (2380 m) is the only settlement within the core area of the National Park (Figure 2.2). Molley (3200 m) and Phalut (3600 m) donot not any permanent residents. These places have trekker huts for tourists and

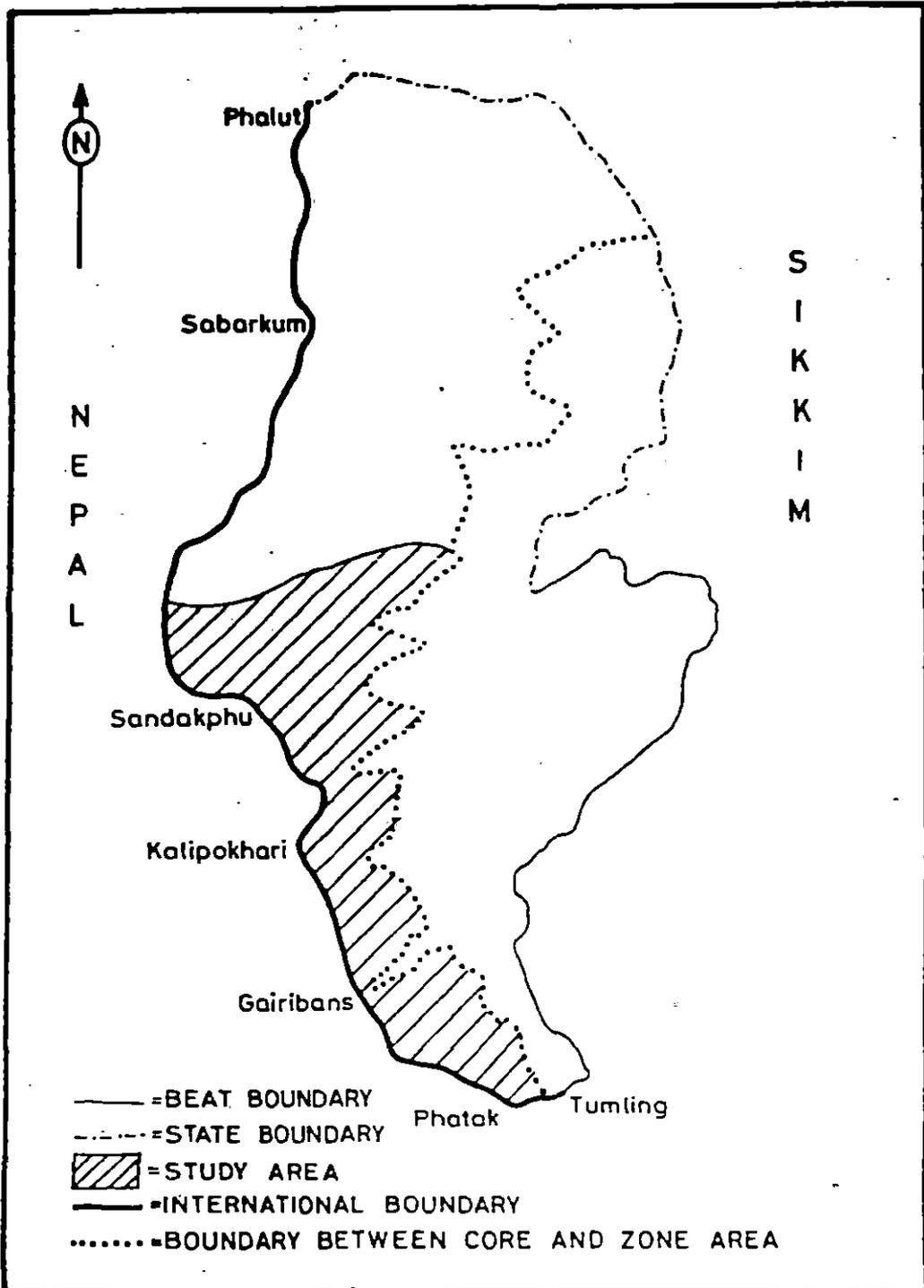


Fig.23 Map of Singhalila National Park, showing the intensive study area.

is a good thoroughfare for the local travellers travelling from Nepal, Sikkim to near by villages like Siri Khola, Rimbick, Bijanbari and vice versa.

2.10 Tourists

Darjeeling, being a hill station has always been a very popular tourist resort and the Singhalila area in Darjeeling is popular as a trekking area. The number of tourists visiting Singhalila National Park is found to be increasing yearly. Accommodation for the tourists or trekker huts within the National Park are found at Gairibans, Sandakphu, Phalut, Gorkhey and Molley. In the buffer zone, tourists accommodation are found at Siri, Rammam and Rimbick. These huts are run by the Tourist Department. Apart from these, there are a number of local lodges and hotels which are mushrooming along with the increase in tourist inflow to Singhalila.

2.11 Intensive Study Area

An intensive study area was selected after a year's preliminary survey. The Intensive study area comprised of Gairibans beat (site 1), Kaiyatta-Kalipokhari area (site 2) and Sandakphu area (site 3) is depicted in Figure 2.3. These sites were selected on the basis of the following criteria:

1. Relatively high encounter rate of red panda and red panda evidences.
2. The sites covered all the representative vegetation types of the Singhalila National Park.
3. Logistic and infrastructure facilities were also taken into consideration while selecting these sites. The research base at Gairibans was accessible by vehicle

which was helpful in terms of getting food supply, equipment, and better communication. The other potential study site could have been in Gorkhey and Phalut but these areas were far flung, and very remote with relatively poor communication facilities. The Intensive study area was about 25 km² and lied within the core area of the park (Figure 2.3).

2.11.1 Description of the study sites

2.11.1.1 Site 1 (Gairibans):

The area ranges from 2550 m-3000 m with wet temperate evergreen forest, temperate evergreen deciduous forest, pure bamboo patches, pure Rhododendron patches and plantations. Prominent water bodies are Bhote khola, Rithu khola and Pul khola. Three human settlements which are, Tumling, Phatak and Gairibans fring the western border of Site 1. One trekker hut and a number forest quarters are also present at Gairibans.

2.11.1.2 Site 2 (Kaiyakatta-Kalipokhari):

It ranges within an altitudinal range of 2670 m-3100 m with the same vegetation types as Site 1. Major water sources are Kaiyakatta khola, Kalipokhari khola. There are three human settlements (Kaikatta, Batase and Kalipokhari) on the western border. There are no Government trekker huts here but a number of local hotels and lodges are found. A forest check post has recently been established by the Wildlife division.

2.11.1.3 Site 3 (Sandakphu):

The site ranges between an altitude of 3200 m-3636 m with subalpine forest, pure bamboo patches, plantations and blank areas. There are two human settlements along the border of this site and three trekker hut at Sandakphu. Apart from these, a number of other Government rest houses and staffs are also present at Sandakphu.

2.11.2 Vegetation zonation with elevation:

Four vegetation zones are present in the study area. At the lower elevations, from 2550 m (in Gairibans)-2800 m, the zone is dominated by *Quercus* spp. (Oak) in association with *Rhododendron* spp. (specifically *R. arboreum*, *R. griffithianum*, *R. cinnabarium*), *Acer*, *Magnolia*, *Litsaea* spp. with understorey of *Arundinaria maling*. Broad-leafed deciduous forest is found between an elevational range of >2800 m-3100 m. The vegetation is mainly composed of deciduous trees such as *Sorbus*, *Acer* (Maple), *Vitex* spp. in association with *Quercus* sp. towards the lower elevation of this zone. However, in the higher reaches of this zone, *Quercus* sp. is not found. The deciduous trees are found in association with the *Rhododendron* spp. like *falconeri* and *arboreum*. The understorey is composed of both *A. maling* and *A. aristata*. Above this zone is the broad-leafed coniferous forest which is found between an elevational range of >3100 m-3300 m. *Abies densa* (Silver fir) and *Tsuga brunoniana* (Hemlock) are the conifers present in this zone and prominent deciduous trees found are *Betula utilis* (Birch), *Sorbus cuspidata*, *Acer* sp., *Andromeda* sp. and *Melliosma* sp. with an understorey of the *A. aristata*. Above this is the coniferous zone, with an association of *A. densa*, *B. utilis* and *Rhododendron* spp.