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Status Survey of Fauna :
NANDA DEVI NATIONAL PARK
(Mammals and Birds)

B. S. Lamba

Zoological Survey of India

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ZOOLOGICAL SURVEY OF INDIA

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STATUS SURVEY OF FAUNA :
NANDA DEVI NATIONAL PARK

by

B. S. LAMBA

Zoological Survey of India

Calcutta



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PREFACE

The present contribution deals with the endangered and threatened species of wild mammals and birds of Nanda Devi National Park and their status. It also outlines the methodology developed and adapted to determine the status of concerned species. An ecological assesment of the habitat has also been attempted by briefly describing the topography, glacier and stream systems, geology, climate and vegetation.

Originally, it was planned to employ the most advanced techniques like arial photography and thermal scanning to overcome the hurdles of inaccessibility of the area. But these plans had to be shelved on account of a large number of domestic sheep and goats that were being inducted in the park area by expedition parties (for transporting expedition rations) and shepherds from surrounding villages (for grazing). On account of similarity of shape and size, it would have been extremely difficult to distinguish these domestic goats and sheep from wild Tahr and Ghoral in an aerial viewing, specially in thermal scanning, More over Indian Air Force, on whom we had been banking for Helicopter fecility, expressed their inability to spare their Helicopters on account of their own busy flight shedules. Mid-course corrections had thus to be made to revert to the primitive and more time consuming methodology of actual head-counts by beating/flushing the animals. This setback resulted in abondoning the status survey of all but nine species of mammals and birds.

In spite of the best efforts of the Project Personnel, a number of lacunae remained. The diversity of disciplines involved, difficult and inhospitable terrain, limitations of project resources and inability to employ advanced techniques, all combined together resulted in this shortfall. But, it is sincerely hoped that the study will serve as a model (of course to be surpassed and excelled by others in the field) for studies on wildlife in other such areas in the country, faced with similar problems.

Calcutta
25th March, 1987

B. S. LAMBA

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INTRODUCTION

India's richness in biological diversity is manifest in its magnificent wildlife. Unfortunately this unique living resources has suffered heavily, over the past hundred years or so, on account of socio-economic pressures in the wake of human population explosion. For the sake of so called developmental activity unimaginative changes were made in established land use practices which resulted in large scale destruction of wildlife habitat. This habitat destruction coupled with ruthless exploitation has played havoc with wildlife population throughout the country.

Since the turn of century at least 30 species of mammals and 14 species of birds of the Indian subcontinent have severely been threatened with extinction. One species of mammals i.e. Cheetah, *Acinonyx jubatus* and two species of birds, viz., Pink-headed Duck, *Rhodonessa caryophyllacea* and Mountain Quail, *Ophrysia superciliosa* have already become extinct. Many species e.g. Tiger, Leopard (Panther), Lion, Sloth Bear, Chinkara, etc., have become extinct locally where formerly these were common (I. B. W. L., Expert Committee Report, 1970).

On account of difficult terrain and inhospitable climate the wildlife species inhabiting the Himalayas were relatively less exposed to human exploitation till about the second quarter of the century. With the opening up of the Himalayan hinterland firstly for development plans for the hill areas, especially construction of roads in these hitherto remote areas, large scale deforestation for providing more farmland to the landless and construction of huge multipurpose hydel projects ; and secondly for construction of border roads and deployment of security forces along the northern frontiers especially after Indian independence most wildlife species in hitherto remote and inaccessible himalayan hinterland have also been ruthlessly exploited (Lamba, 1978). As a result, the wildlife populations have been drastically reduced. Many a species have disappeared from vast stretches of their former habitat territory. A number of them are threatened of their very existence.

Unfortunately no base-line data exists on the population densities of these threatened species. Personal observations of the well known explorers like Kinloch (1892), Younghusband (1896), Hedin (1898, 1903), Stebbins (1912), Burrard (1925), Stockley (1928, 1936), Schaffer (1933, 1937, 1950), Shipton (1936, 1938) and Ali (1949) indicated great abundance of these species during their visits. Recent observations of Dang (1964a & b, 1967), Schaller (1977), Lamba (1979) Lavkumar (1978), Green (Pers. Comm.), and Geston (Pers. Comm.) point an alarming picture of the state of existence of the wildlife in the Himalayas. Many species have become locally extinct and exist only in small, protected or inaccessible pockets of their extensive former habitat. Nanda Devi

National Park is one such protected and inaccessible area in the Himalayas. It still holds sizeable populations of the following species of endangered and threatened mammals (7 species) and birds (8 species) that have already disappeared in the neighbouring areas :—

MAMMALS :

1. The Snow Leopard or Ounce, *Panthera uncia*.
2. The Brown Bear, *Ursus arctos*.
3. The Himalayan Black Bear, *Selenarctos thibitanus*.
4. The Musk Deer, *Moschus moschiferus*.
5. The Himalayan Tahr, *Hemitragus jemlahicus*.
6. The Bharal or Blue Sheep, *Pseudois nayaur*.
7. The Serow, *Capricornis sumatraensis*.

BIRDS :

1. Himalayan Golden Eagle, *Aquila chrysaetos daphanea*.
2. Eastern Steppe Eagle, *Aquila rapax nipalensis*.
3. Black Eagle, *Ichinaetus malayaensis perniger*.
4. Himalayan Bearded Vulture or Lammergeir, *Gypaetus barbatus aureus*.
5. Himalayan Snowcock, *Tetragallus himalayensis himalayensis*.
6. Western Tragopan or Western Horned Pheasant, *Tragopan melanocephalus*.
7. Himalayan Monal Pheasant or Impeyan, *Lophophorous impejanus*.
8. Koklas Pheasant, *Pucrasia macrolopha macrolopha*.

It was primarily to study the status of these species that this project was started in April 1981.

STUDY AREA

Location

Long before Eric Shipton and H. W. Tilmen, the duo of great explorer-mountaineers, set foot on its virgin soil in 1934, to penetrate into Nanda Devi (Rishi) Valley had been the cherished dream of all mountaineers worth their salt. So great was the challenge thrown by its rugged and difficult terrain to the skills and stamina of the explorer that it attracted mountaineers from all over the world. Many attempts were made but W. W. Graham, who reached Trisul Nullah in 1883 and Dr. T. G. Longstaff who peered down the valley from Longstaff Col. in 1903 were partially successful.

The Nanda Devi National Park, comprising an area of about 800 km² is situated between 30°16'-30°32' N latitudes and 70°44'-80°02' E longitudes. It covers an altitudinal range varying from 2100 m to 7817 m. The park is a cup-shaped valley surrounded by high mountain wall studded with almost seventy, named and unnamed, high peaks, rendering it an

almost impregnable fortress. Some of the better known peaks from west to east are Dunagiri (7066 m), Changbang (6864 m), Kalanka (6931 m), Nanda Devi East (7434 m), Nanda Devi West (7817 m or 25,645'-the second highest peak of the Himalayan Range in Indian territory) and from east to west are Nandakhat (6631 m), Devstan (6678 m), Maiktoli (6805m), Mrigthuni (6855 m), Trisul (7120 m) and Bathartoli (6352 m).

The park lies in Chamoli district of Uttar Pradesh. Its northern boundary starts from confluence of Rishiganga and Dauliganga rivers then it runs along the Lata ridge, Dunagiri, Changbang, Kalanka Peak and finally enters the crest of Rishi Pahar. The eastern boundary runs along the boundary between Chamoli and Pithoragarh districts, from the crest of Rishi Pahar to Nanda Devi East Peak and then upto the point where boundaries of Pithoragarh, Almora and Chamoli meet. From this point the southern boundary runs along the boundaries of Chamoli and Almora districts where it passes through Nandakhat and Malthuni Peaks upto the point where inter-district boundary turns abruptly to the south and then runs along the ridge to the Nanda Ghunti peak. From here the western boundary runs along the ridge to the Raunti peak and along Raunthigad river upto the confluence of Rishi Ganga and Ravitgad rivers and then further along Rishi Ganga upto the point where Rishi Ganga meets Dhauliganga (Figure 1-map).

Accessibility

The area remains under a thick carpet of snow for more than half of the year and hence accessible only for a limited period of about five months (i.e. from June to October) in a year.

There are only two entry points to the park area, viz., Lata Kharak above Lata Village and lower Rishi Gorge near Village Reni. Both the villages of Lata and Reni are located on the Joshimath-Malari motor road.

The trek originating from the first entry point i.e. Lata Village and passing through the high mountain passes of Lata Kharak and Dharansi descends to Dibrugheta in the Rishi Valley.

The trek originating from Reni Village, running along Rishi Ganga river through the almost vertical "Rishi Gorge" too leads to Dibrugheta and from Dibrugheta onwards there is a single common trek upto the base of Nanda Devi Peak.

The Lata trek although more strenuous of the two is considered less hazardous and is more popular (Plate I photo A). Nevertheless the Nanda Devi trek is considered to be one of the toughest in the world and attracts a large number of mountaineers and trekkers from all over the world.

The Lata trek leads from Lata Road-head via Delta Kharak (2750 m), Lata Kharak (3700 m), Dharansi (4150 m), Dibrugheta (3350 m) Deodi (3300 m), Ramani (3500), Bujgarh (3950), Pataalkhan or Tilchauni (4100 m), to Sarsopatal or the Nanda Devi base camp (4200 m) (Fig. 2),

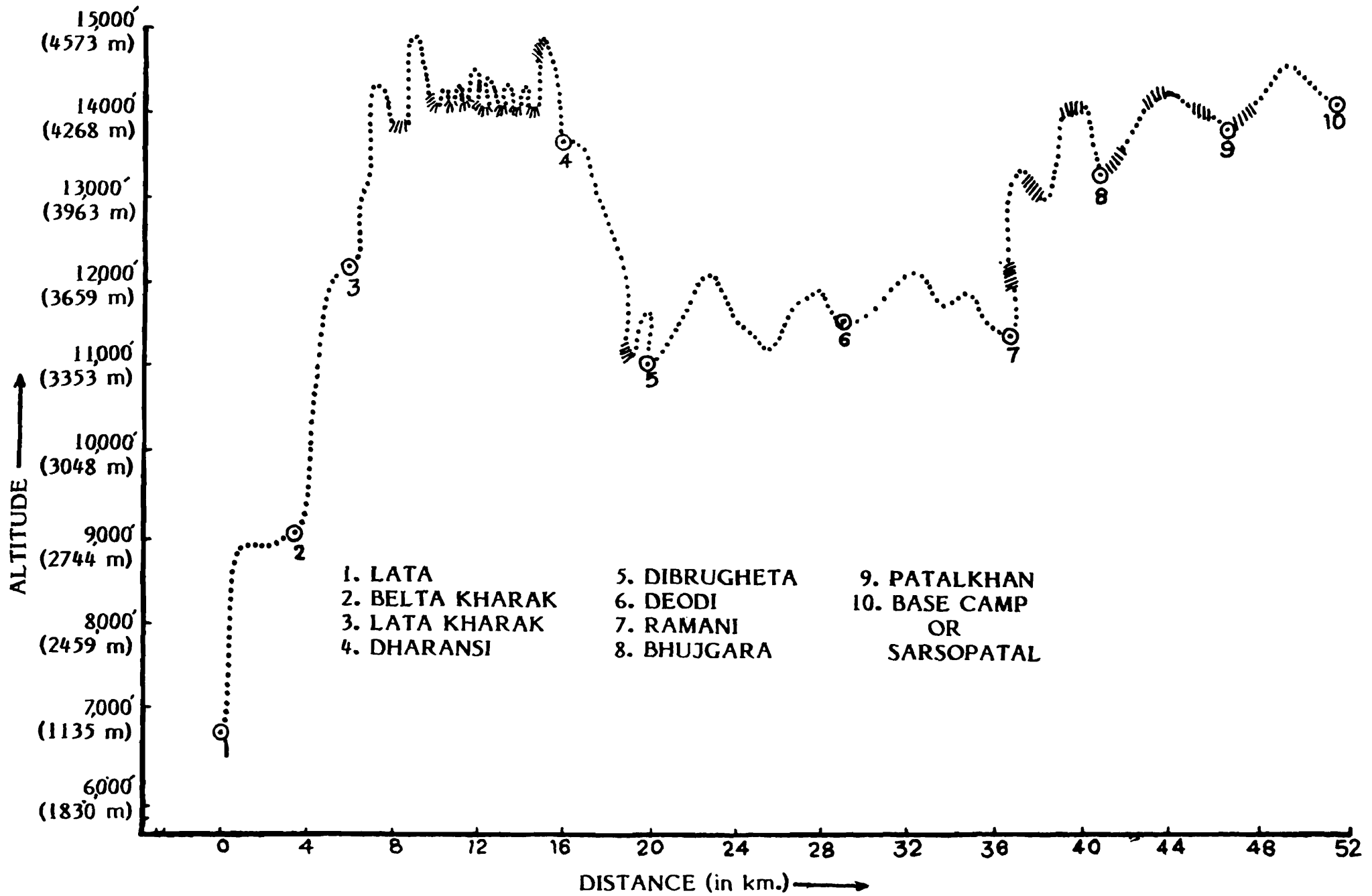


Fig. 2 Map of Nanda Devi Trek : A Graphic representation

The various diversions which lead to the base camps of various other peaks, viz., Dunagiri, Changbang, Kalanka, Hanuman and Trisul of the main trek, are also shown in the figure 1 (map). A lot of physical endurance and mountaineering skill is required to reach the Nanda Devi base camp (Plate I photo B). At several places, as shown in the figure 2 by dark oblique lines, along the trek one requires additional support of 'fixed ropes' for a safe passage.

Topography

As already stated, the park area is a cup-shaped structure which is demarcated by a high enclosing mountain range offering icefalls and corniced ridges to the outer world. The area is segmented by a series of parallel ridges with a north-south trend in the north and south-north trend in the south, emanating from the encircling mountain ramparts. The most important is the Devistan-Rishikot ridge which divides the Rishi Gorge at the base of Nanda Devi and separates the 'Inner Sanctuary' or 'Upper Rishi Gorge' from the rest of the Rishi Gorge or 'Outer Sanctuary' or 'Lower Rishi Gorge'. The Inner Sanctuary is a vast glacial zone intermingled with numerous alpine meadows (Plate II photo A) and is further divisible into the North Inner 'Sanctuary' and South Inner 'Sanctuary' by Nanda Devi mountain. Whereas Outer 'Sanctuary' is mostly a thickly forested zone of which the north facing slopes are more forested than the south facing slopes.

Major Glacier and Stream System

The upper-half, particularly the inner surface of the cup-shaped park sporting numerous high peaks, embraces a major glacier system. It consist of Ramani Glacier (Gl.), Changbang Gl. and North Rishi Gl., in the north and South Nanda Devi Gl. South Rishi Gl., Trisul Gl., Bethartoli Gl., Ronti Gl. and Nanda Gunti Glacier in the south. The northern system is by and large at a lower altitude with a bigger area. The southern glaciers are more active than their northern counterparts though, like all Himalayan glaciers, they have been retreating and their lower stretches are collapsed heaps of rubble and glacial debris (Plate II photo B) with the lateral morains forming high, distinctive ridges above the subsiding glaciers.

Each glacier system gives rise to ablation streams, the North Rishi and the South Rishi streamlets which flow along the precipitous cliffs of Nanda Devi and originate from the North Rishi Gl. and South Rishi Gl., respectively. A short distance below their confluence, the Rishi stream flows into its stupendous upper gorge, cutting at right angles across the Devistan-Rishikot Ridge.

Clearing the upper gorge, the east to west flowing Rishiganga receives the tumultuous Ramani stream, racing down a precipitous gorge which drains the Ramani glacier basin on the north and a little further downstream, the Trisul torrent joins the Rishiganga from the south, draining

the extensive basins of the Trisul and Bethartoli glaciers. The Ramani and the Trisul glacier systems form an important and conspicuous feature of the 'Outer Sanctuary'

The Rishi stream continues along its chasm receiving various torrents from both sides, some by narrow impassable gorges, others as graceful waterfalls, to finally enter the awe-some lower gorge guarded by overhanging cliffs, and skirt the Lata peak to merge with the Dhauliganga near Reni Village. The Rishi Gorge cuts all the ridges at right angles, and is therefore difficult to negotiate. Except for this narrow, steep-sided gorge the entire basin is well above 3500 m (Figure 1-map).

TREKS AND CAMP SITES

There are two main entrances to the Park, (i) The Dharansi Pass beyond Lata village and (ii) The Rishi Gorge in village Rini. The treks originating from both these entry points join at Dibrugheta at the foot of the Dharansi Pass.

As already stated the park area is broadly divisible, topographically, into four major segments. From Dibrugheta onwards four different treks lead to these four major segments of the park, in fact, to the base camps of the major peaks situated in these segments. These four major segments being :

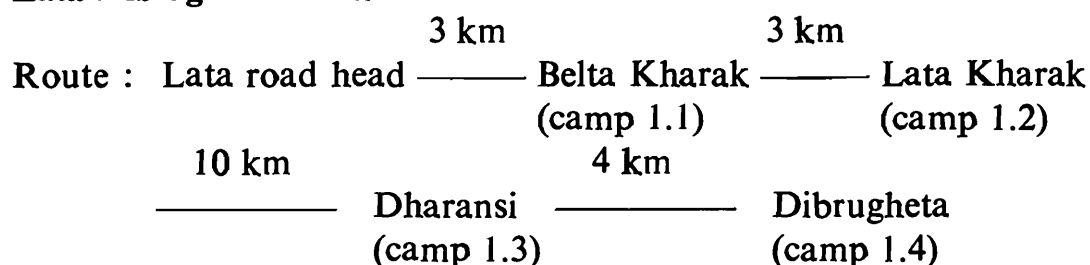
- (i) South Inner 'Sanctuary' ; (ii) North Inner 'Sanctuary' ;
- (iii) South Outer 'Sanctuary' ; (iv) North Outer 'Sanctuary'

The various treks, as detailed below, have been indicated in the map (Fig. 1).

- Trek a —To *Sarsopatal/Main Nanda Devi Base Camp* in South Inner 'Sanctuary'
- Trek b —To *Tala Base Camp/North Rishi Glacier* in North Inner 'Sanctuary'
- Trek c —To *Trisul Base Camp/Trisul Area* in South Outer 'Sanctuary'
- Trek d —To *Common Base Camp for Dunagiri, Changabang, Kalanka* etc in North Outer 'Sanctuary'

The trek through Dharansi Pass (4253 m.), originating from Lata (Village) road head, is more strenuous and physically demanding but less hazardous. The trek through Rishi Gorge, originating from village Rini, presents a much greater risk of physical injury as it involves travelling along a high and narrow ledge of an almost vertical rockface over a number of Kilometres. Both these treks join at Dibrugheta, from where the four main treks into the Park originate from.

A brief description of all these treks is attempted in the following pages.

1. **Lata-Dibrugheta Trek****Camp Belta Kharak (2700 m/9,020')**

The first camp site along the main trek about 3 km from Lata road head. It is situated on the NW facing slope of about 30°. As it takes only 2-3 hours to reach this camp from the road head, trained mountaineers do not stay here for the night ; instead they proceed directly to the next camp i.e. Lata Kharak. For others, who need gradual acclimatisation and adjustment to high altitude, a stay for a night or two is indicated.

Camp Lata Kharak (3700 m/12,136')

From camp-1.1 onwards, it is tiring and steep uphill trek (more than 1000 m. in 3 km or so) to Lata Kharak, but one is well rewarded by the glorious views of the snowy peaks of Ronti, Nanda Ghunti and Bethartoli across the Rishi Ganga. This camp site is an open, broad grassy ridge which is covered with flowers during summer and with snow during winter. It is always windy and cold. The ending tree-line with *Rhododendron* spp. is an another remarkable feature of this place. Almost every party/individual heading for the Nanda Devi Park spends a night or two here. From here fine views of the northern face of Bethartoli Himal and Trisul massif extending to south can also be seen.

Camp Dharansi (4150 m/13,612')

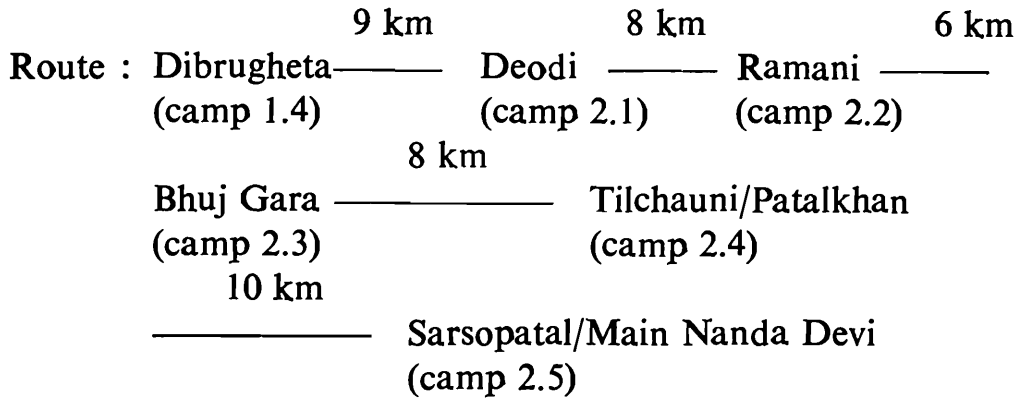
To reach Dharansi from camp 1.2, one has to go uphill for about 10 km along trek across the Dharansi Pass (4253 m.). When approaching the Pass one gets the first glimpses of Dunagiri (7068 m) and immediately after crossing it, Nanda Devi West (7817 m.) can be seen. From Dharansi the trek trails across the Malathuni Pass (4238 m), where the western face of Hanuman Peak (6076 m) can be viewed. The camp site is situated high above, to the north of Rishi Ganga, comprises of remains of a retreating glacier consisting of scree and boulders, but is surrounded by numerous luxurient alpine meadows which provide good habitat for Bharal or Blue Sheep (*Pseudois nayaur*), during summer. In 1981, i.e. during our first trip, we witnessed here the snow fall as late as on 17th August.

Camp Dibrugheta (3350 m/11,000')

From camp Dharansi one has to trek about 4 kms and cross the Malathuni Pass, followed by a fairly steep descend of about 750 m. through snow, scree, boulders, grass, shrubs and dense forest of Fir trees to a mountain stream before finally heading to the hospitable mea-

dows of Dibrugheta. Where normally a camp is established amongst the fir trees near the river. During summer, Dibrugheta is covered with fritillaries, anemones, potentillas etc.

2. Trek—a Dibrugheta-Sarsopatal Trek.



Base Camp

This is supposed to be the main trek in the park area, it takes about 7-10 days to reach Sarsopatal from the road head covering a distance of more than 60 kms.

Camp Deodi (3300 m/10,700')

From Dibrugheta the track rises steeply at first for about 300-400 m, then it is a long west-east traverse across several mountain ridges well above Rishi Ganga till one crosses a wooden bridge over Rishi Ganga just before Deodi. The tree canopy cover here is purely of Birtch trees, *Betula utilis*.

Camp Ramani (3600 m/11,808')

From Deodi it is an 8 km trek through juniper and rhododendron forests to Ramani which is situated just at the left bank of Rishi Ganga. Shortly after leaving Deodi, if one happens to be the first in the season, one should have provisions for crossing the fairly broads south to north flowing torrentious Trisul Naullah either by carrying an Aluminium Ladder (folding type) or by constructing a temporary log bridge.

Camp Bhuj Gara (3950 m/12,956')

This is the most dangerous portion of the trek. Although it is only c. kilometer from Ramani to Bhuj Gara but the passage is not safe without additional support of 'fixed ropes' From Ramani the trek rises steeply at first through Rhododendron-Birtch forest and then on a steep and open grassy slope for about 500 m till one reaches at Bina-ki-Dhar (Pass). Perhaps, it is the only place along the trek from where the glorious views of the both the Upper and the Lower Rishi Gorge can be scanned. From Bina-ki-Dhar onwards though the trek is less sternuous yet more hazardous and technical from the mountaineering point of view.

Camp Tilchauni/Pataalkahan (4100 m/13,448')

As one treks towards Tilchauni, Nanda Devi is coming ever closer. Tilchauni is about 8 km from the camp 2.3. The area is mostly rocky

and stony throughout with practically no vegetation. A little short of Tilchauni, there is a small but almost vertical ridge to go across which is locally called as Vekunth-ki-Siri (ladder to the Heaven). Once one has crossed this, it is believed that all hazards of the trek are over as one is in the sacred abode of the Goddess 'Nanda Devi' Having reached Tilchauni, one is rewarded with many magnificent views such as : SW face of Nanda Devi peak, North Rishi Glacier and confluence of south and north Rishi Ganga etc.

Camp Sarsopatal or the main Nanda Devi Base Camp (4200 m/13,776')

From Tilchauni to Sarsopatal is a pleasant, slow but steady trekking through alpine meadows for about 10 km in the world's most fascinating wilderness. It is always cold and windy at Sarsopatal. This area of about 10-15 km² forms one of the best and preferred habitat of Bharal in the Park. A helipad is there for air lifting facilities.

3. Trek—b Dibrugeta-Tala Base Camp

Route : Upto Tilchauni (camp 2.4) as for Trek a.

8 km	10 km
Tilchauni ——— Gufa Camp ——— Tala Base Camp	
(camp 2.4)	(camp 3.2) (camp 3.3)

Probably the longest trek in the park area covering a distance of more than 70 kms from the Lata road head.

Camp Gufa Camp (4200 m/13,776')

From Tilchauni one has to descend for about 1000 m through boulders, stones and scree, and cross the fast flowing south Rishi Ganga with the help of either a fairly long Aluminium Ladder or the artificially constructed rope bridge using a pully system, before one finally arrives at the Gufa Camp. The essential mountaineering equipments required here are : climbing ropes, pittons, pitton-hammers, carabanners etc. The Gufa (Cave) is situated above the south Rishi Ganga and is a natural solid structure of sand and stones.

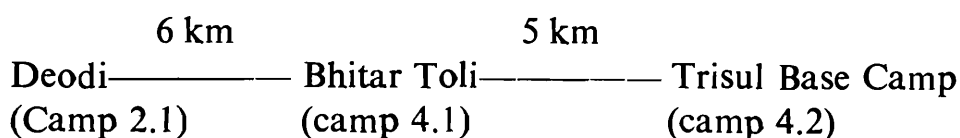
Camp Tala Base Camp (4750 m/15,580')

As the name suggests Tala (Lake) is the only natural lake available in the park. The 10 km trek from Gufa to Tala is an exhausting one on account of varied factors such as : its passage through the base of the North Rishi Glacier, the gradual increase in altitude and absence of vegetation etc. But the rewards of trekking to Tala are no less glorious. As one crosses the North Rishi Glacier one comes across the most delightful views of North Faces of the Nanda Devi West and Nanda Devi East Peaks along with the magnificent North Rishi Glacier, which leaves an everlasting impression. If one happens to be a little above the Tala camp in a north-western direction for about a few hundred

feet unforgettable views of north-east faces of Kalanka and Changabang Peaks are etched in the memory for ever.

4. **Trek—c** Dibrugheta-Trisul Base Camp

Route : Upto Deodi (camp 2.1) it is the same as that of the Trek—
a b ; and the rest as follows :



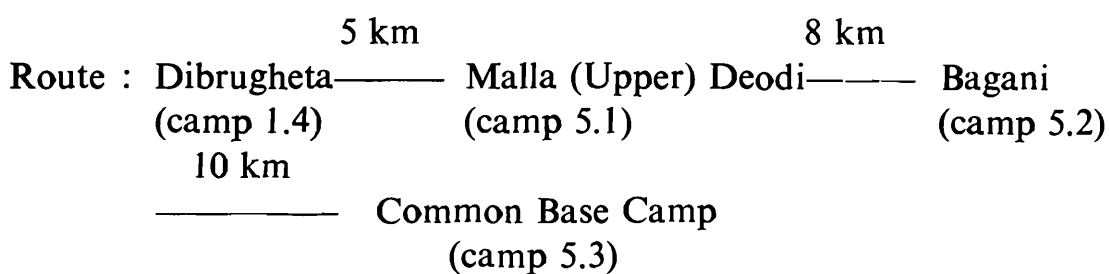
Camp Bhitar Toli (380 m/12,464')

A 6 km, comparatively easier and gradual, trek from Deodi through the Birtch-Rhododendron forest, first along the south-north flowing torrentious Trisul nullah and then along the SW-NE flowing Bhitar Toli nullah. The birtch-tree line ends at the camp itself and provides charming views of north face of Bhitar Toli Peaks.

Camp Trisul Base Camp (4200 m/13,776')

From camp 4.1 onwards though it is a gradual trek but it is more hazardous, for a kilometer or so, as it passes through a permanent scree-chute zone before the final arrival at the camp 4.2. Interestingly, unlike the other base camps the Trisul Peak is not visible from here on account of its southern extension.

5. **Trek—d** Dibrugheta-Common Base Camp of Dunagiri, Changabang and Kalanka Peaks.



Camp Malla (Upper) Deodi (3850 m/12,268')

As already stated under the Trek-a that from Dibrugheta to Deodi one has to cross a number of ridges, and while doing so one comes across a north to south flowing nullah known as 'Tulpani Nullah' Having crossed this nullah, which finally feeds the east to south flowing Rishi Ganga, instead of going towards Deodi (of Trek-a) one takes north-eastern turn and finally heads to Malla or Upper Deodi.

Camp Bagani (4300 m/14,454')

To reach Bagani from Malla Deodi one has to negotiate an eight kilometer up and down trek across several ridges. Bagani is situated on

a north-east-facing hill-slope of about 45°. In fact, it is a good grassy slope with sporadically distributed *Salix* spp. bushes.

Camp Common Base Camp (4750 m/15,580')

It is about 10 km² steadily uphill trek from Bagani to the common Base Camp. Shortly after leaving Bagani for the Base Camp one gets a panoramic view of Changabang Peak and having reached at the Base Camp that of the Dunagiri, Kalanka, and Changabang together. Altitudinally, it is the highest Base Camp that we visited in the Park.

Geology

Yugi Maruo (1979), a geologist from the University of Ryukyu, Japan, who had accompanied the Indo-Japanese Nanda Devi Expedition has described the geological formation along the Rishi Ganga as follows :

“Lithostratigraphy And Structural Features Along the Rishi Ganga.

“The crystalline rocks of the Vaikrita group and lower part of the Tethys sediments are well exposed along the Rishi Ganga with monoclinial structure dipping to NE-E or to SE (Fig. 2). They are tentatively subdivided into four formations from tectonically lower position as follows :

1. Lata Formation
2. Ramani Formation
3. Kharapatal Formation
4. Martoli Formation

“The Lata Formation thrusts onto the Munsiri Formation of Valdiya (1978) and comes into contact with the Ramani Formation along a NNE-SSW trending transverse fault. However apparently a direct continuation of the Lata Formation to the west is overlain by an affinity of the Ramani Formation in the Alaknanda valley (Heim and Gansser, 1939). The boundary between the Ramani Formation and the Kharapatal Formation was presumed to be a thrust fault, and the Kharapatal Formation, in turn, is thrust over by the Martoli Formation. A number of thin dykes and sills of aplitic granite have intruded into upper part of the Ramani and Lower and middle part of the Kharapatal Formation. Middle and upper parts of the Kharapatal Formation show predominantly sedimentary aspects, although they have been metamorphosed to have the greenschist facies assemblages. The author would place the lower limit of the Tethys sediments at the base of the Kharapatal Formation.....

“Lata Formation

“Rocks of the formation occur in the lower course of the Dhauli Ganga and of the Rishi Ganga. In the lower half of the formation, garnetiferous mica schists and garnet mica quartzose schists predominate, and mica quartzites are subordinate constituent. They are fine to medium grained

and well cleaved, and alternate in various scale from several to some tens of cms. Between the confluence the Rishi Ganga and the Dhaul Ganga and Bhangiul, they are mylonitised and are associated with some coarse augen gneisses a few metres thick. A schistose amphibolite about 10 m thick occurs along with the augen gneiss near the confluence. Some thin bands of calc-silicate schist are intercalated in the mylonitic zone. Highly sheared sericite-chlorite quartzites at Tapoban are likely to belong to the Munsiri Formation and the probable Vaikrita thrust runs at Bhangiul with about N50° W trend and about 30° NE dip. Apparent thickness of the lower half of the formation is about 3500 m.

“A thick series of mica quartzites overlies the alternations of the garnet schists conformably. The quartzites are fine to medium grained and cleaved parallel to bedding plane. Medium grained garnet mica quartzose schist are interbanded in various horizons of the quartzites. The quartzites are cut by a NNE-SSW trending fault at Debrugheta. Observed thickness of the series of quartzites is about 3500 m in the present area.

“The quartzites are certainly the direct eastern extension of what Heim and Gansser (1939) described in the north of Joshimath along the Alaknanda valley where they estimated the thickness to be 9500 m. There the thick quartzite overlies garnet mica schists and is overlain by a highly metamorphosed sedimentary series of gneisses, augen gneisses and calc-silicate rocks (Heim and Gansser, 1939). They believed a normal succession from the garnet mica schist to at least the top of the quartzites.

“In the schists and quartzites of the Lata Formation, foliation planes marked by preferred oriented micas are approximately parallel to bedding planes where they are recognizable. The foliations rotate gradually from N50°W strike and 30°-40°NE dip near Bhangiul to NS strike and about 40°E dip nearing the transverse fault. Gentle undulations with axes of roughly NW direction weakly develop on the foliation planes.

“The NNE-SSW trending transverse fault is likely to be the southern extension of the Malari fault of Shah and Sinha (1974) and Gairola (1975). In a Landsat imagery a NNE-SSW directing lineament from Malari to Debrugheta is clearly recognizable. The lineament can be traced further to the south, to the Wan valley where MCT shows an acute bend in tectonic map of Valdiya (1978). Heim and Gansser (1939) described abnormal strikes of NNE, which are almost perpendicular to the normal strikes, over the distance of 20 km. in the Wan valley. The Malari-Debrugheta fault may extend to the Wan valley, and it may be a right lateral fault of regional scale.

“*Ramani Formation*

“Across the Malari-Debrugheta fault highly metamorphosed rocks of the Ramani Formation are distributed on both sides of the Rishi Ganga. It is composed of pelito-psammitic gneisses, calc-silicate gneisses and migmatite with abundant feldspar porphyroblasts and quartzo-feldspathic leucosomes. Aluminosilicate (Kyanite and sillimanite) bearing garnet

mica gneisses and garnet mica quartzose gneisses prevail in lower part and some thin layers of calc-silicate banded gneisses are intercalated. The gneisses are partly transformed into K-feldspar porphyroblast augen feldspathic gneisses or to migmatites with tourmaline and garnet bearing quartzoleucosomes. The transition from the gneiss to the migmatite is gradational, as sporadic feldspar porphyroblasts and quartzo-feldspathic leucosomes are gradually becoming frequent. As the amount of leucosomes increases, sillimanite tends to appear in melanocratic portion.

The amount of the migmatites and augen gneisses increase upwards, and it is almost entirely composed of the migmatites and augen gneisses in the middle part of formation. The leucosomes diminish gradually in upper part of the formation, and the migmatites pass into well cleaved fine to medium grained pelito-psammitic gneisses with some intercalations of mica quartzite and calc-silicate banded gneisses.

“A pile of the calc-silicate banded gneisses of about 1500 m thick occur at the top of the formation. The gneisses are characterized with minutely alternating banding structure of a millimeter to some tens of centimeter. The bandings are composed of fine grained black layers which contain minute flakes of biotite and is characteristically rich in microcline, medium to coarse grained layers of green color, for which diopside and green hornblende are responsible and of white marble layers. These layers often show rhythmic alternations, and it might reflect original sedimentary structure having thin beds of different carbonate contents.

“Foliation planes of gneisses and migmatites fluctuate from N20°E strike and 40°-50°SE dip to N60°E strike and 30°SE dip in lower part, while the foliation shows rather consistent strikes of about N20°E and dips of about 30°SE in middle and upper part of the formation. Small scale open folds with axes of M80°W to N70°E are observed on the foliation planes throughout the formation.

“*Kharapatal Formation*”

“Rocks of the Kharapatal Formation belonging to the Tethys sediments exposed in the upper course of the Rishi Ganga and in the basal part of the Nanda Devi massif. It consists predominantly of well cleaved black pelitic schists in the lower and middle part of the formation. Some layers of mica quartzites alternate with the black schists in the lower part, and seams of calc-silicate schist with garnet and actinolite porphyroblasts are intercalated in the middle part of the formation. The black schists appear to be ferruginous with numerous tiny grains of magnetite under the microscope, and are very rich in biotite. It is probably responsible for characteristically black appearance of the schists.

“In the upper part grey to black, fine grained calcareous phyllites are interbedded with sericitequartz pelitic phyllites. These phyllites are characterised with occasional biotite and chlorite spots of microscopic scale. Peculiar spotted phyllites with abundant sieve-like biotite

porphyroblasts which were called the Budhi schist in the Kali valley (Heim and Gansser 1939) were collected from a talus below the wall on the right bank of the Dakhni Nanda Devi glacier.

“Grain size and grade of metamorphism of the rocks within the Kharapatal Formation visibly decrease structurally upwards. In the lower part the schists are medium grained and metamorphosed to the amphibolite facies, while they are fine grained and weakly metamorphosed, and their original sedimentary textures are partly preserved in the middle and upper parts. Apparent thickness of the Kharapatal Formation is about 3500 m.

Foliation planes of the schists and phyllites are parallel to bedding planes where they are discernable. The foliation planes strike about N20°E and dip 20°-30° to SE in the basal part, and they rotate gradually to N50°W strikes and about 25°NE dips around the base camp. Micro-foldings with axes of N70 W to EW weakly develop on the schistosity planes throughout the formation. The lower and upper boundaries have been intensely mylonitised, and magnetite mineralization has taken place in the upper contact with the Martoli Formation.

“*Martoli Formation*

“Both the Nanda Devi Main and the East peaks and their southwestern face are composed of calcareous sandstones, white sericite quartzites and green to dark grey phyllites. Earlier Heim and Gansser (1939) sketched from a distance a succession of these rocks on the eastern face of Nanda Devi East peak. They also described a direct extension of the succession in the upper course of the Gori Ganga, and named it as the Martoli Formation (Heim and Gansser, 1939, Gansser 1964). Gansser (ibid) estimated the thickness of the Martoli Formation to be about 4000 m in the Gori Ganga, while the apparent thickness in the present area is about 2000 m. It is likely that only the lower half of the Martoli Formation described by Heim and Gansser (1939) is distributed in the present area.

“Gansser (ibid) believed that the Martoli Formation conformably overlies his Budhi schist formation which is likely to correspond to the upper part of the Kharapatal Formation in the present area. However the writer observed a large scale overturned fold with an axis of about N 50 W in the lower part of the formation..... Such a structure is not seen in any part of the Kharapatal Formation, and the boundary zone between the formations is intensely mylonitized. The boundary runs with about N50W strike and 15°-20° dip to NE, being almost concordant with the structure of the Kharapatal Formation. It may be mentioned that the Martoli Formation thrusts on to the Kharapatal Formation in the present area.

The calcareous sandstones occur below an altitude of about 6200m and above 6800 m on both the western ridge which stretches from the Main peak and the eastern ridge which extends from the East peak.... They

are mostly fine grained, well bedded and their calcite contents vary considerably one bed to another. The sandstones are featured with their brownish yellow weathered surface. Around the crest of the overturned fold on the east ridge, the sandstones are isoclinally folded in smaller scale with horizontal axes of about N50W direction. Well developed axial plane cleavages of the folds which cut the bedding plane almost in the right angle strike N50W and dip about 15° to NE.

“The sericite white quartzites are distributed at an altitude of about 7300 m on both of the ridges and on the top of Main peak. A large block of conglomerate similar to the Nanda Kot conglomerate of Heim and Gansser (1939), i.e., pale green quartzose matrix and rounded quartzite cobbles and boulders of pinkish color, was collected on the side moraine of the Dakhni Nanda Devi Glacier near the base camp. The conglomerate is acutely and isoclinally folded. From the structures the conglomerate is expected to be interbedded in the calcareous sandstones occur below the altitude of 6200 m.

“The green to grey phyllites occur between the altitudes of 6200m and 6800 m on both of the ridges. They are fine grained sericite quartz phyllites and contain sporadically detrital calcite grains of size up to several millimeter, and are intercalated often by calcareous seams. The phyllites are intensely folded and crenulation cleavage develops cutting the bedding planes obliquely.

“*Tourmaline Leucogranite*

A series of dykes and sills of aplitic granites have intruded into the calc-silicate banded gneisses of upper part of the Ramani Formation and lower and middle part of the Kharapatal Formation. They are mostly a few meter thick and relatively thicker aplitic granites, about ten to thirty meter, are observed in the lower part of the Kharapatal Formation near Pathal Khan. The granites diminish upwards and none is found on the southern flank of the Nanda Devi massif.

“They are medium to coarse grained muscovite leucogranites and consistently contain a fair amount of tourmaline. A small amount of biotite is occasionally present. The granites show faintly developed foliation in some places, but they are mostly free from deformation indicating their post-tectonic emplacement. As will be described later a certain effect of contact metamorphism by the leucogranites is discernible in the lower part of the Kharapatal Formation.

“*Mineral Assemblages and Metamorphic Grade*

In the successions of metamorphic rocks described above, metamorphic grades will be deduced from mineral assemblages commonly present in pelitic rocks. Observed mineral assemblages in respective part of the formations.... Among the aluminosilicates (Als) and ferromagnesian minerals which can be plotted on the Thompson projection (Thompson, 1957), sillimanite (Sil), kyanite (Kya), staurolite (Sta), almandine garnet

(Gar), biotite (Bio), muscovite (Mus) and chlorite (Chl) were observed in the present area.

“Specimens collected from the Lata formation yield only mineral association Gar-Bio which does not indicate any specific metamorphic grade. However Heim and Gansser (1939) reported Kya-Gar-Mica schists from the Alaknanda Valley below the thick quartzite series. It may show that the absence of Kyanite in the present area can be ascribed to unfavourable composition of the rocks rather than unfavourable metamorphic condition to form Kyanite, and that the rocks of the Lata formation belong to the Kyanite almandine high grade...of Winkler's scheme (1976). Similarly assemblage Kya-Gar-Bio in lower and upper parts of the Ramani Formation and lower part of the Kharapatal Formation represent the Kyanite almandine high grade (IV).

“In specimens having assemblage Sil-Kya-Gar-Bio in the Ramani Formation, Kyanites are often included in the Garnets, and the garnets are surrounded by aggregations of fibrolite and biotite.... It may show that the polymorphic transition from Kyanite to sillimanite have taken place and Kyanite is present in metastable state. The assemblage Sil-Gar-Bio in the migmatite represents the sillimanite almandine high grade (V).

“In the specimens having assemblage Sil-Sta-Gar-Bio, muscovite is absent. It is likely to indicate that muscovite has been used up in the reactions $Sta + Mus + Quartz + Als + Bio + H_2O$ proposed by Hoschek (1969), or $Sta + Mus + Quartz - Als + Gar + Bio + H_2O$ suggested by Thompson and Norton (1968). The reactions mark a transition from the almandine medium grade to the almandine high grade (Winkler, 1976). In the same specimen garnet crystals which coexist in contact with staurolite have elongate sieve-like skeletal shape similar to that of staurolite.... It may point out that the latter reaction have actually taken place as staurolite being replaced by garnet.

“Likewise in the specimens having assemblage Kya-Sta-Gar-Bio, in lower part of the Kharapatal Formation, muscovite is absent. Two types of Kyanite were recognized in this case. The one type of Kyanite is oriented to the direction of the foliation and slightly deformed. The other is not oriented, not deformed and is rich in inclusions with helicitic texture,... thus featuring post-tectonic crystallization concerning to the regional metamorphism which formed the foliation. Some of the post-tectonic Kyanites show cruciform twins...which are very common in staurolite, and it suggests that the Kyanites replaced staurolites in post-tectonic stage. Accordingly it is probable that either of above mentioned reactions which mark the transition from the almandine medium grade (III) to the almandine high grade took place in the post-tectonic stage. This can be explained by the post-tectonic emplacement of the leucogranites in lower part of the Kharapatal Formation.

In middle part of the Kharapatal Formation, neither kyanite nor staurolite is seen. Mineral associations Gar-Bio and Bio-Chl probably represent the almandine low grade (II) of Winkler (1976). In upper part

part of the Kharapatal and in the Martoli Formation, garnet is no longer present. It can be supposed to be below the almandine stability field (I).

“Thus...so called normal metamorphism is seen in the successions from middle part of the Ramani Formation to the Martoli Formation, where metamorphic grades decrease upward gradually from the sillimanite almandine high grade (V) to the low grade (I). No significant gap or jump in the metamorphic grade is seen at the tectonic boundaries between the respective formation. While metamorphism seems to be reverse in the lower half of the Ramani Formation and from the Ramani Formation to the supposedly underlying Lata Formation, where metamorphic grades decrease downward from the sillimanite almandine high grade (V) to the Kyanite almandine high grade (IV)”

Climate

The Nanda Devi complex is situated at the turning point where the Himalayan chain changes its N. W. to S. E. trend to a west to east trend and the entire southern mountain-wall with its extensions to the west and east along the Trisul II Jatropani ridge and the NandaKot range beyond the Traill's Pass respectively exposes a continuous southern aspect to the lower foothills and the sun. These slopes, as also the western watershed ridge of Trisul and Bethatoli and its westward bifurcation of Nanda Ghunti, cause considerable updrafts of warm air throughout the year, resulting in high precipitation and heavy cloud cover during the rainy season these ranges receive the full blast of the S. W. Monsoon and rainfall is extremely heavy. The monsoon effect starts being felt in the third week of June and from within the “Park” we daily witnessed fantastically tumultuous cloud formations over the mountain walls on our south and west, with spectacular displays of lightning. We concluded that the Pinder, Mandakini and Birahi Ganga Rivers between them must contribute a very large proportion of the Alakananda waters.

The eastern mountain divide had daily cloud build-ups, but these were far less spectacular than along the southern wall, a fact which is explained by the drier climate of the Milam area, lying as it does beyond the main Himalayan range. The same was true of the northern wall, though Dunagiri dominating the Dhauri gorge pulls up considerable warm air. Its influence creates the late afternoon cloud and mist on the Lata ridge and the Dharasi Col. The snow conditions, with thick snow cornices overhanging the southern ridge and the more active glaciers like the Nanda Devi South, the Rishi South and the Trisul Glaciers, suggest heavier snow-falls on the southern side. Our observations during the expeditions and photographs of the outer side of the “Park” substantiate our conclusions. Among its other unique qualities, the park, by virtue of its configuration, enjoys a sub-climate of its own. There is obviously a mass of cold air on the basin which as our preliminary and amateurish observations revealed, exerts a significantly powerful effect on the precipitation of the Almora and Chamoli Districts.

The cold air on the basin creates a dry climate with low annual precipitation. Inside the park, the snowline was well above 4500 m as against the heavy winter snow on the Dharasi Col and the Malthuni ridge considerably below this altitude. Snow was thicker and generally at lower altitude on the southern side of the park than the northern, which conforms to the general conditions on the south and north aspects of mountains in the northern hemisphere. The entire northern side of the park receives more direct sun rays and is consequently warmer, with more rapid thawing of snow.

While the glacial basins and upper slopes experience strong diurnal winds, the gorge itself, unlike other major Himalayan valleys, is very sheltered. This surprised us till we were able to watch the cloud movements from higher slopes and saw how flanking ridges diverted the air currents up their sides. The Malthuni and the Rishikot ridges dramatically demonstrated their influence on the warm air blowing into the gorge. While strong winds were a regular feature on the higher slopes from a couple of hours after sunset almost to sundown, the nights were invariably calm. The diurnal winds produced clouds in the afternoon and there was usually a light drizzle or sleet towards the evening. Twice in the last week of May we had light snow all over the park, and there was wide-spread snowfall as late as on 17th June. The snow, however, rapidly melted. With the onset of the monsoon stream in the third week of June, there was considerable inflow of warm air up the gorge resulting in light mist over the high meadows and this warm air had a profound effect on the wintry conditions which lingered on late into summer. Under its influence, the winter snow rapidly melted. While considerably curtailing the hours of insolation, the mists and low clouds in June kept the soil moist—a factor not found in the drier inner Himalayan valleys or on the Tibetan Plateau. Thus, the Nanda Devi Park, though receiving little precipitation, supports a lush vegetation than other secluded valleys.

A very distinctive feature of the weather around Nanda Devi is the fact that unlike other major Himalayan peaks the great mountain has very little cloud formation on it in the afternoons. Even in June and July when the monsoon stream was well set in the area, and while expeditions had withdrawn from lower peaks like Trisul it was possible to operate on Nanda Devi a full fortnight later. On most days, when clouds obscured all the other summits around, they formed only around the great peaks' base and on the very summit itself. This advantage of a longer operative season on Nanda Devi offers significant advantages to be borne in mind if any control of expedition activity is planned. The fact that the day Tilman ascended the mountain in 1934, the Almora area received exceptionally heavy rainfall is worth recording here.

Vegetation

The park is very rich in Flora. The information compiled from the publications of the Botanical Survey of India and other expedition reports

reveal that more than 200 species of plants (eight species of Pteridophytes; five species of Gymnosperms; One hundred eighty eight species of Angiosperms-grow in the park. Of these, about 15 species e.g. *Aconitum* spp., *Circeaster agrestis*, *Epipogium aphyllum*, *Listera* sp., *Meconopsis aculeata*, *Nardostachys grandiflora*, *Orchis latifolia*, *Podophyllum hezandrum*, *Saussurea obvallata* (to mention a few) are considered rare and endangered.

Altitudinally, the vegetation of the park can be classified broadly into three categories :

1. Sub alpine forest
2. Moist alpine scrub
3. Alpine meadows

The sub alpine forest comprises three different canopies : Upper, Middle and Lower or the ground cover (Plate III photo A). The upper canopy is formed of *Abies pindrow*, *A. spectabilis*, *Rhododendron campanulatum* and *Betula utilis* tree species; the middle canopy consists of comparatively smaller tree like shrubs *Rosa*, *Viburnum* and *Jasminum* etc.; and the ground cover is composed of various herbs and grass species. This forest type is generally met with in the Lower Rishi Gorge at an altitude of about 3500 m and is restricted only upto Ramani in the east.

The moist alpine scrub forest consists of several pure strands of *Betula* and *Rhododendron* species (Plate III photo B).

The alpine meadows (Plate IV photo A & B) are composed of numerous shrubs (e.g. *Rhododendron anthopogon*, *Juniper* and *Salix* species), herbs (e.g. *Aconitum*, *Cynanthus* and *Polygonum* species) and grasses (e.g. *Dantonina*, *Fostuca* and *Poa* species).

METHODOLOGY

At the time of proposing the project it was planned to make use of the remote sensing methods like aerial photography by low flying aircraft and simultaneous thermal scanning (the facilities which exist in India with National Remote Sensing Agency) for locating the pockets in which the concerned species of Mammals still survive in good numbers. The pockets thus located were to be studied in detail by ground checks. These advance techniques have the greatest advantage of instantaneous recording of the scene which can be studied and analysed at leisure in the laboratory, and counting of large or small scattered groups of animals or individuals can be done easily which is otherwise not so easy and quick by using direct observation techniques while the animals keep moving.

This technique has been successfully used elsewhere for similar status surveys on Brown Bear (Erickson and Sniff. 1963), white tailed Deer *Odocoileus virginianus* (Croon et al. 1968), Rocky Mountain Mule Deer, *Odocoileus hemionus* (Parker, 1972) and Moose, *Alces americana* (Garvin et al, 1964).

For Birds actual counts by flushing or by mapping their calls in breeding season was envisaged.

But after visiting the study area it was discovered that a large number of goats and sheep were still being brought in the area for grazing and transportation (Expedition-ration) by shepherds of the surrounding villages. On account of similarity in shape and size it would have been extremely difficult to distinguish these sheep and goats from the wild mammals like Tahr and Bharal on a thermal scanner. Moreover, Indian Air Force expressed their inability to spare their Helicopter for aerial photography on account of their busy flight schedule. These unforeseen developments compelled us to follow the slow and primitive but still the most reliable methodology of actual counts by beating/flushing the animals (both mammals and birds).

As already stated, the study area remains snow bound for more than six months in a year and is approachable only from June to October. Thus the observations made were restricted to this period only. A base camp was established every summer at Lata Village. From the base camp one or two (2-7 weeks) expeditions were made on foot. The observation teams stayed in tents in study area (Plate V photo A).

For computing the absolute densities of individual species it was decided to calculate their habitable area and then to conduct head counts in representative habitat covering at least 33% of the total habitable area. Accordingly a graphic map of all valleys situated in the main Rishi Ganga Valley, right from the point of its twin origin, viz., the North Rishi Glacier and South Rishi Glacier up to the confluence of Rishi Ganga and Dhauli Ganga along with its larger and smaller off shoots was prepared. This graphic representation covered in addition to location the size of the individual valley and its vegetation cover.

It was further decided that an adequate number of each type of valley would be flushed with the help of beaters for actual counts. Then the absolute densities of each concerned species will be computed for the whole area.

For recording and analysing of the results computer-oriented Data-Input Formats were designed and developed with the help of National Informatics Centre, Electronics commission, New Delhi.

The photographic records of these studies were also prepared and maintained with the aid of 35 SLR cameras of 'Asahi Pentax', 'Nikon' and 'Canon' makes and Telephoto lenses of 50-1000 mm focal length.

OBSERVATION

Six, 2-7 weeks, expeditions, totalling 167 days, were made to the study area during 1981-84. As many as 35 localities (including 14 repeatedly explored localities) situated between 2750 m and 4750 m were explored by establishing 69 camps (fig. 1 map).

SALIENT FEATURES OF THE FAUNA

The park was found to be very rich in fauna. The fauna of the park exhibited adaptations to a number of high altitude ecological factors like atmospheric cold, aridity, intense isolation, radiation and the snow cover, progressive attenuation of air and humidity with increase in altitude. As a result their bodies are covered with dense and long hairs/feathers, etc., which protect them from the severe atmospheric cold. The colour of their body is usually dull and light which provides resistance to these animals against intense insolation and radiation. Thus, indeed, these animals have a resilience which the low land animals often lack.

Mammals :

As many as 14 species of mammals belonging to eight families and five orders were observed in the park (Plate V photo B and Plate VI photo A & B). A systematic list of these species is given in Appendix-I.

The most notable feature about mammalian fauna of the park is the survival of some thin populations of the much depleted species like *Snow Leopard, Panthera uncia* ; Brown Bear, *Ursus arctos* Himalayan Black Bear, *Selenarctos thibetanus* ; Musk Deer, *Moschus moschiferus* ; Himalayan Tahr, *Hemitragus jemlahicus* ; Blue Sheep, *Pseudois nayaur* and Serow, *Capricornis sumatraensis* in this pocket of their extensive formal range.

Birds

The bird fauna of the park is rich and diverse. Eighty species were observed and listed (Appendix-II). The most notable feature about the avifauna of the park is again the survival of some populations of the much depleted species, e.g., Himalayan Golden Eagle, *Aquila chrysaetos daphanea* ; Eastern Steppe Eagle, *Aquila rapax nipalensis* ; Black Eagle, *Ichinaetus malayaensis perniger* ; Himalayan Bearded Vulture, *Gypaetus barbatus aureus* ; Himalayan Snowcock, *Tetrao galus himalayensis himalayensis* ; Western Tragopan, *Tragopan melanocephalus* ; Himalayan Monal Pheasant, *Lophophorous impejanus* and Koklas Pheasant, *Pucrasia macrolopha macrolopha*.

ENDANGERED AND THREATENED SPECIES

The following endangered and threatened species of mammals (seven species) and birds (eight species) were found to exist in the park.

(a) Mammals

1. The Snow Leopard or Ounce, *Panthera uncia*.
2. The Brown Bear, *Ursus arctos*.
3. The Himalayan Black Bear, *Selenarctos thibetanus*.
4. The Musk Deer, *Moschus moschiferus* (photo 4).
5. The Himalayan Tahr, *Hemitragus jemlahicus*.
6. The Bharal or Blue Sheep, *Pseudois nayaur*.
7. The Serow, *Capricornis sumatraensis*.

(b) Birds

1. Himalayan Golden Eagle, *Aquila chrysaetos daphanea*.
2. Eastern Steppe Eagle, *Aquila rapax nipalensis*.
3. Black Eagle, *Ichinaetus malayaensis perniger*.
4. Himalayan Bearded Vulture or Lammergeir, *Gypaetus barbatus aureus*.
5. Himalayan Snowcock, *Tetra gallus himalayensis himalayensis*.
6. Western Tragopan or Western Horned Pheasant, *Tragopan melanocephalus*.
7. Himalayan Monal Pheasant or Impeyan, *Lophophorus impejanus*.
8. Koklas Pheasant, *Pucrasia macrolopha macrolopha*.

Due to constraints detailed in the foregoing chapter on methodology it was not possible to cover the whole of the park area as a single unit. The area was, therefore, ecomapped on the basis of valley types (i.e. length, terrain & vegetative cover).

The valleys were broadly classified into three categories i.e. "Small", "Medium" and "Large" depending upon their length. The vegetation covers were also broadly divided into three categories i.e. "Tree, Shrubs and Grasses", "Shrubs and Grasses" and "Grasses" (Fig. 3). To arrive at the exact number of each valley type in respect of its vegetation cover the following codes were assigned to each valley type and its vegetation cover.

A. Valley type	Code
Smaller	= 1 (Approx. upto 1 km length)
Medium	= 2 (Approx. upto 2 km length)
Larger	= 3 (Approx. upto 3 km length or more).

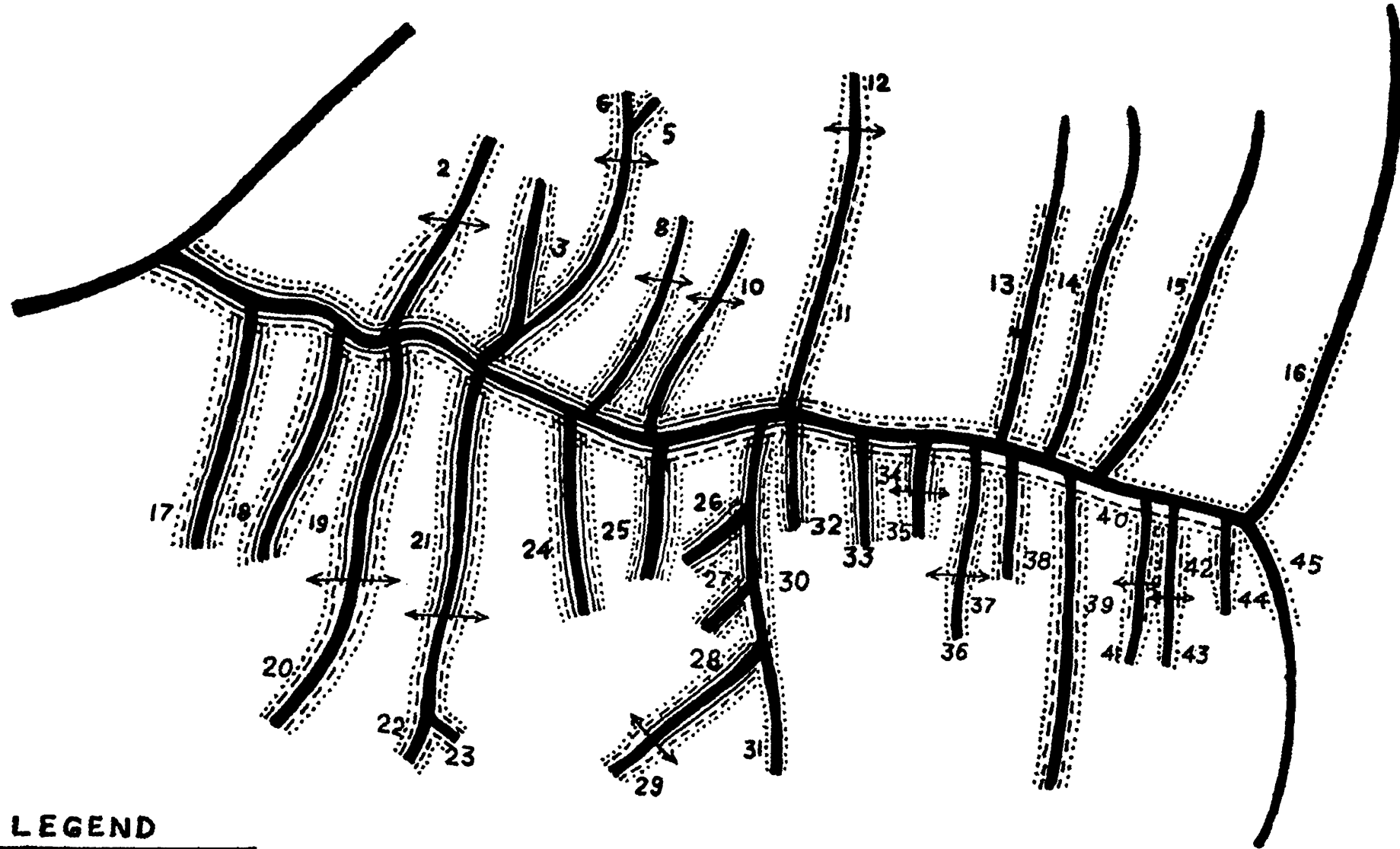
B. Vegetation cover	Code
Trees, Shrubs and Grasses	= i
Shrubs and Grasses	= ii
Grasses only	= iii

By doing so the following nine different combinations of valley types in respect of its vegetation cover were developed.

Combinations developed

<i>Explanation</i>	<i>Combination (code)</i>
1. Small valley with Tree, Shrub & Grass cover	1-i
2. Small valley with Shrub & Grass cover	1-ii
3. Small valley with Grass cover only	1-iii
4. Medium valley with Tree, Shrub & Grass cover	2-i

**Fig.3. GRAPHIC REPRESENTATION OF VALLEYS WITH VEGETATION COVER
IN NANDA DEVI NATIONAL PARK**



LEGEND

NULLAH VALLEY	— (thick solid line)
TREE CANOPY	— (thin solid line)
SHRUBS	- - - (dashed line)
GROUND COVER (dotted line)

<i>Explanation</i>	<i>Combination (code)</i>
5. Medium valley with Shrubs & Grass cover	2-ii
6. Medium valley with Grass cover only	2-iii
7. Large valley with Tree, Shrub & Grass cover	3-i
8. Large valley with Shrub & Grass cover	3-ii
9. Large valley with Grass cover only	3-iii

The exact number of each valley-type (VT) in respect of its vegetation-cover (VC) derived from the above mentioned combinations are given in Table-1, and the proportion of each vegetation-cover, e.g. Tree, Shrub and/or Grass cover, are detailed in Table-2.

Table-1. Representing number and classification of valleys.
Note : T = Tree cover, S = Shrub cover, & G = Grass cover.

Valley type (VT)	Vegetation cover (VC)			Total
	TSG = i	SG = ii	G = iii	
Smaller valley = 1	1-i = 6	1-ii = 6	1-iii = 4	16
Medium valley = 2	2-i = 7	2-ii = 5	2-iii = 5	17
Large valley = 3	3-i = 6	3-ii = 4	3-iii = 2	12
Total	19	15	11	45

Table-2. Representing vegetation cover of the valleys.
(The proportion of vegetation cover i.e. Tree, Shrub and Grass are expressed in terms of their distribution over the length of valleys).

Note : A=Full length of valley, B=Approx. 2/3 length of valley, C=Approx. 1/3 length of valley and O=absent. N=Nullah/valley ; R=Right ; L=Left (and a,b,c & d part of) ; VT=Valley type/category, VC=Vegetation cover.

Code. No.	Name of the valley (Nullah)	Vegetation cover			VT-VC
		Tree	Shrub	Grass	

Valleys situated in the North

1.	Dharansi Nullah	a	A	A	A	2-i	
2.	"	"	b	O	O	A	2-iii
3.	Dibrugheta Nullah	R	B	A	A	A	2-i
4.	"	"	La	A	A	A	2-i
5.	"	"	Lb	O	A	A	1-ii
6.	"	"	Lc	O	A	A	1-ii
7.	Tulapani	Na	B	A	A	A	2-i
8.	"	Nb	O	O	A	A	1-iii
9.	Unnamed	Na	A	A	A	A	2-i

1	2	3			4
		1	2	3	
<i>Valleys situated in the North</i>					
10.	„ Nb	O	O	A	2—iii
11.	Bagni Na	C	A	A	3—i
12.	„ Nb	O	O	A	1—iii
13.	Patal Khan Opp. NR	O	B	B	3—ii
14.	„ „ „ NL	O	B	B	3—ii
15.	North Rishi Glacier N	O	B	B	3—ii
16.	Nanda Khat N	O	O	C	3—iii
<i>Valleys situated in the South</i>					
17.	Morna N	A	A	A	3—i
18.	Pungrani N	A	A	A	3—i
19.	Ronti Na	A	A	A	3—i
20.	Ronti Nb	O	A	A	2—ii
21.	Dudganga Na	A	A	A	3—i
22.	„ Nb	O	A	A	2—ii
23.	„ Nc	O	A	A	1—ii
24.	Ringual Sangul N	A	A	A	2—i
25.	Deodi NL	A	A	A	1—i
26.	Bethartoli Na	A	A	A	2—i
27.	„ Nb	O	A	A	1—ii
28.	„ Nc	A	A	A	1—i
29.	„ Nd	A	A	A	1—i
30.	Trisul Na	B	A	A	3—i
31.	„ Nb	O	O	A	2—iii
32.	Ramani NL	A	A	A	1—i
33.	„ NR	A	A	A	1—i
34.	Bujgara NLa	A	A	A	1—i
35.	„ NLb	O	O	A	1—iii
36.	„ NGc	O	A	A	2—ii
37.	„ NRb	O	O	A	1—iii
38.	Patakhani NL	O	A	A	1—ii
39.	„ NR	O	A	A	3—ii
40.	Sarsopatal NL _{1a}	O	A	A	2—ii
41.	„ NL _{1b}	O	O	A	2—iii
42.	„ NL _{2a}	O	A	A	2—ii
43.	„ NL _{2b}	O	O	A	2—iii
44.	„ NR	O	C	A	1—ii
45.	Devstan N	O	O	C	3—iii

Status (Absolute densities) :

On account of shortage of time it was not possible to flush 33% of the habitable area (valley types) of each species to compute the absolute densities. However, based on the above detailed classification of the valleys and the sightings of endangered and threatened species in these

valleys, status of the concerned species was arrived at as summarised in the tables given below :

ENDANGERED AND THREATENED MAMMALS :

1. The Snow Leopard :

Table-3. Representing the status of the Snow Leopard

Note : VT—VC=Valley type in respect of its vegetation cover.

VT—VC	Total Individuals observed	Number of observations	Average number of Individuals observed X	Total number of each VT—VC Y	computed value of Individuals for each VT=VC= N=X×Y
1—i	—	—	—	—	—
1—ii	—	—	—	—	—
1—iii	2	2	1	4	4
2—i	—	—	—	—	—
2—ii	—	—	—	—	—
2—iii	1	1	1	7	7
3—i	—	—	—	—	—
3—ii	1	1	1	6	6
3—iii	—	—	—	—	—
Total	4	4	1	Status = N = 17	

2. The Brown Bear :

The bare open peaks above the tree line are the usual haunt of these animals. Emerging from their winter sleep in the spring, they follow the melting snows up to their perpetual level. Although this species was not sighted by any of our expeditions but enquiries made from shepherds at the high altitude revealed two sightings of this animal during the study period i.e. 1981-84.

3. The Himalayan Black Bear :

Table-4. Representing the status of the Himalayan Black Bear.

VT—VC	Total Individuals observed	Number of observa- tions	Average number of Individuals observed X	Total number of each VT—VC Y	Computed value of Individuals for each VT—VC $N=X \times Y$
1—i	4	3	1.3	6	7.8
1—ii	—	—	—	—	—
1—iii	—	—	—	—	—
2—i	5	4	1.2	7	8.4
2—ii	—	—	—	—	—
2—iii	—	—	—	—	—
3—i	3	2	1.5	6	9.0
3—ii	—	—	—	—	—
3—iii	—	—	—	—	—
Total	12	9	1.3	Status = N = 25.2	

4. The Musk Deer :

Table-5. Representing the status of the Musk Deer.

VT—VC	Total Individuals observed	Number of observa- tions	Average number of Individ- uals observed X	Total number of each VT—VC Y	Computed value of Individuals for each VT—VC = $N=X \times Y$
1—i	3	2	1.5	6	9.0
1—ii	4	3	1.3	6	7.8
1—iii	—	—	—	—	—
2—i	5	2	2.5	7	17.5
2—ii	4	3	1.3	5	6.5
2—iii	—	—	—	—	—
3—i	11	4	2.7	6	16.2
3—ii	—	—	—	—	—
3—iii	—	—	—	—	—
Total	27	14	1.9	Status = N = 57.0	

5. The Himalayan Tahr :

Table-6. Representing the status of the Himalayan Tahr

VT—VC	Total Individuals observed	Number of observa- tions	Average number of Individuals observed	Total number of each VT—VC	Computed value of Individuals for each VT—VC = $N = X \times Y$
			X	Y	
1—i	—	—	—	—	—
1—ii	6	1	6.0	6	36.0
1—iii	14	3	4.6	4	18.4
2—i	—	—	—	—	—
2—ii	9	2	4.5	5	22.5
2—iii	8	1	8	5	40.0
3—i	—	—	—	—	—
3—ii	6	1	6	4	24.0
3—iii	11	3	3.6	2	7.2
Total	55	9	6.1	Status = N = 148.1	

6. The Bharal or Blue Sheep :

Table-7. Representing the status of the Bharal or Blue Sheep.

VT—VC	Total Individuals observed	Number of obser- vations	Average number of Individuals observed	Total number of each VT—VC	Computed value of Individuals for each VT—VC = $N = X \times Y$
			X	Y	
1—i	1	1	1	6	6.0
1—ii	12	3	4	6	24.0
1—iii	19	3	6.3	4	25.2
2—i	—	—	—	—	—
2—ii	19	3	6.3	5	31.5
2—iii	13	2	6.5	5	32.5
3—i	—	—	—	—	—
3—ii	73	1	73	4	292.0
3—iii	43	3	14.3	2	28.6
Total	180	16	11.2	Status = N = 439.8	

7. The Serow :

It prefers an altitude ranging from 1850 m in thickly wooded gorge. It can be seen in the mornings and evenings when it comes out to graze on the rank herbage of more open slopes. Enquiries made from local people confirm its existence in the lower Rishi Gorge, the area which, somehow, couldnot be visited by our expeditions.

ENDANGERED AND THREATENED BIRDS

1. Himalayan Golden Eagle :

It is a resident of Himalayas, occurs from 1850 m to 5500 m. During the whole study period it was observed only twice : Once near Lata Kharak (3750 m) and another time near Dharansi (4200 m). This small sample size does not permit us to compute its status.

2. Eastern steppe Eagle :

Winter visitor, stays at wider altitudinal range from 3050 m to 7930 m in the Himalayas. It was sighted only once near Lata Kharak on 17th August, 1981. Before we arrive at any conclusion regarding its status more data is needed.

3. Black Eagle :

Resides over a wide altitudinal range from 305 m to 3355 m in the Himalayas. Seen flying near Belta Kharak only on five occasions (2700 m). Hence, more data is required to arrive at its status.

4. Himalayan Bearded Vulture :

Table-8. Representing the status of the Himalayan Bearded Vulture.

VT—VC	Total Individuals observed	Number of obser- vations	Average number of Individuals observed X	Total number of each VT—VC Y	Computed value of Individuals for each VT—VC= N=X×Y
1—i	18.0	10	1.8	6	10.8
1—ii	10.0	7	1.4	6	8.4
1—iii	9.0	5	1.8	4	7.2
2—i	26.0	10	2.6	7	18.2
2—ii	2.0	2	1.0	5	5.0
2—iii	2.0	1	2.0	5	10.0
3—i	1.0	1	1.0	6	6.0
3—ii	3.0	2	1.5	4	6.0
3—iii	3.0	2	1.5	2	3.0
Total	74.0	40			Status = N = 74.6

5. Himalayan Snow Cock :

Table 9. Representing the status of the Himalayan Snow Cock.

VT—VC	Total Individuals observed	Number of obser- vations	Average number of Individuals observed	Total number of each VT—VC	Computed value of Individuals for each VT—VC= N=X×Y
			X	Y	
1—i	—	—	—	—	—
1—ii	—	—	—	—	—
1—iii	11	3	3.6	4	14.4
2—i	—	—	—	—	—
2—ii	—	—	—	—	—
2—iii	4	1	4.0	5	20.0
3—i	—	—	—	—	—
3—ii	12	4	3.0	4	12.0
3—iii	22	3	7.3	2	14.6
Total	49	11		Status=N=61.0	

6. Western Tragopan :

Although a Himalayan resident, it was not observed in the park area. The only possible habitat of this pheasant in the park is the dense forested area below Dharansi.

7. Himalayan Monal Pheasant :

Table 10. Representing the status of the Himalayan Monal Pheasant

VT—VC	Total Individuals observed	Number of obser- vations	Average number of Individuals observed	Total number of each VT—VC	Computed value of Individuals for each VT—VC= N=X×Y
			X	Y	
1—i	1	1	1.0	6	6.0
1—ii	—	—	—	—	—
1—iii	—	—	—	—	—
2—i	20	8	2.5	7	17.5
2—ii	—	—	—	—	—
2—iii	41	24	1.7	5	8.5
3—i	—	—	—	—	—
3—ii	1	1	1	4	4.0
3—iii	—	—	—	—	—
Total	63	34	1.8	Status=N=36.0	

8. Koklas Pheasant :

Table 11. Representing the status of the Koklas Pheasant.

VT—VC	Total Individuals observed	Number of obser- vations	Average number of Individuals observed X	Total number of each VT—VC Y	Computed value of Individuals for each VT—VC= N=X×Y
1—i	4	2	2.0	6	12.0
1—ii	—	—	—	—	—
1—iii	—	—	—	—	—
2—i	20	6	3.3	7	23.1
2—ii	—	—	—	—	—
2—iii	—	—	—	—	—
3—i	24	7	3.4	6	20.4
3—ii	—	—	—	—	—
3—iii	—	—	—	—	—
Total	48	15	3.2	Status=N=55.5	

RECOMMENDATIONS :

The status, as apparent from the foregoing computation, of all the wildlife species in general and endangered and threatened species in particular is pathetically poor. Large scale disturbance is caused in the park area by the outside agencies like expeditions porters, unauthorised grazing of sheep and goats, and poaching. The crying need of the hour is to stop these disturbances forthwith. The following measures, if adopted, may help to restore the wildlife of the park to its original glory as recorded by Shipton (1936, 1938).

1. Effective policing of the area to prevent unauthorised grazing and poaching.

2. Limiting the number of expeditions in the area in a year and, if possible, air lifting of the supplies to the base camp.

Further, management plans of the individual species of endangered and threatened wildlife can be drawn up after adequate scientific studies on the food productivity of and maximum carrying capacity of the area in respect of these species.

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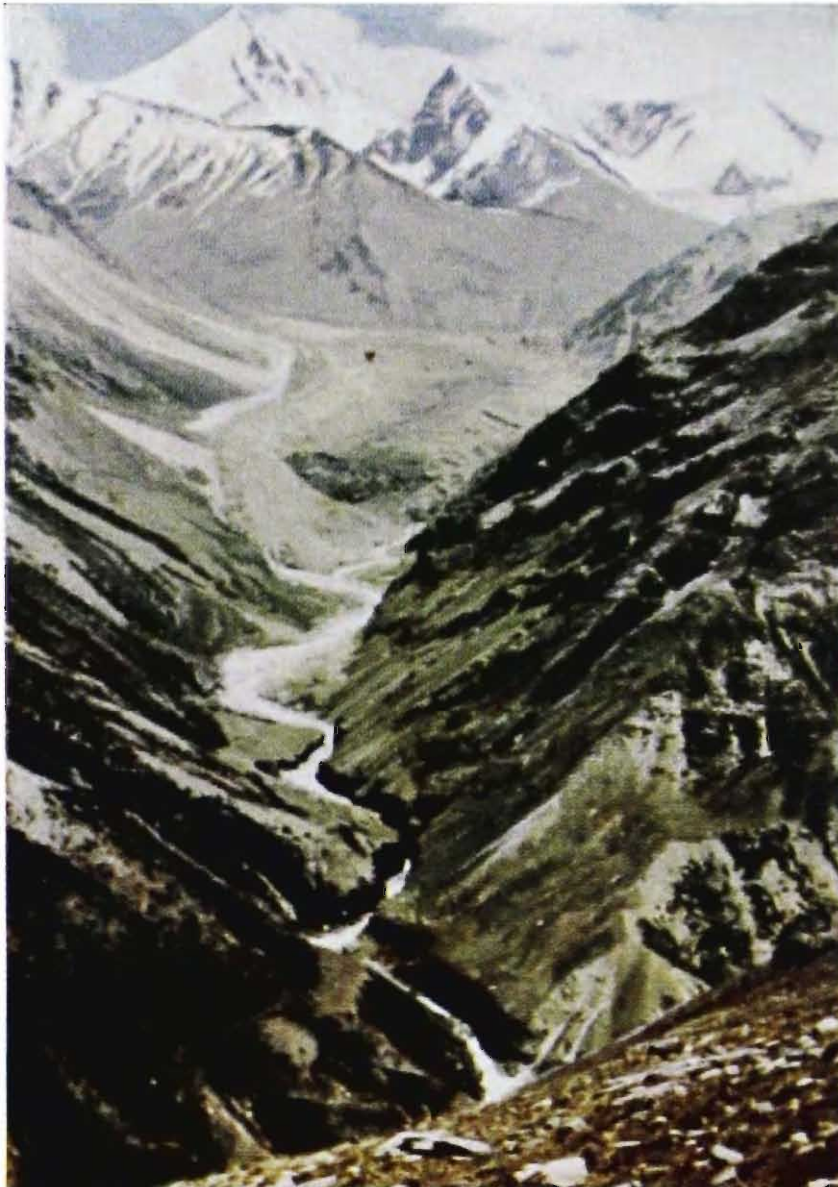
- A. The Lata Trek although more strenuous of the two, is considered less hazardous and is more popular.

PLATE-I



- B. A lot of physical endurance and mountaineering skill is required to reach the Nanda Devi Base Camp.

PLATE-II



A. The inner sanctuary is a vast glacial Zone intermingled with numerous alpine meadows.



B. Like all Himalayan glaciers, they have been retreating and their lower stretches are collapsed heaps of rubble and glacial debris.

PLATE-III



A. The sub alpine forest comprised three different canopies : Upper, Middle and Lower.



B. The moist alpine scrub forest consists of several pure stands of *Betula* and *Rhododendron* species.

PLATE-IV

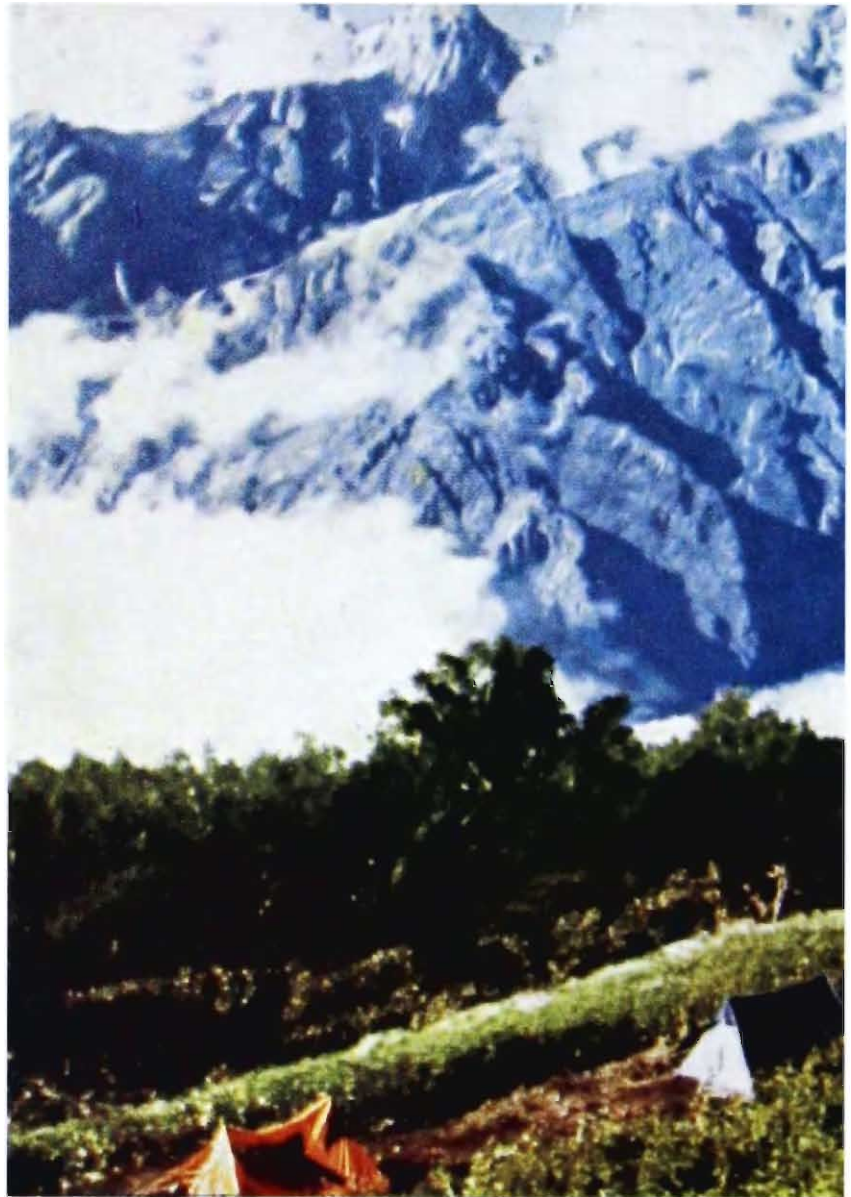


A. The alpine meadows are composed of numerous shrubs, herbs and grass.



B. A close-up view of the above.

PLATE-V



A. The observation teams stayed in tents in the study area.



B. Yellow-bellied Weasel, *Mustela kathiah*.



A. Goral, *Nemorhaedus goral goral*.



PLATE-VI

B. Musk Deer,
Moschus moschiferus.

APPENDIX—I

MAMMALS

Class

Order PRIMATES

Family CERCOPITHECIDAE

1. **Presbytis entellus schistaceus** (Hodgson), Langur (Entellus Monkey).

Ellerman and Morrison-Scott. (1951). Checklist : 205.

Status : Common.

Distribution : Restricted to the Lower Rishi Gorge (The outer sanctuary). Often seen in birch forests and other patches of forest in the Park.

Order CARNIVORA

Family URSIDAE

2. **Selenarctos thibetanus** (G. Cuvier), Asiatic Black Bear.

Ellerman and Morrison-Scott. (1951). Checklist : 239.

Status : Uncommon.

Distribution : Mostly found in the Lower Rishi Gorge. Leaves plenty of foot prints in the soft ground.

Family MUSTELIDAE

3. **Mustela kathiah** Hodgson, Yellow-bellied weasel.

Ellerman and Morrison-Scott. (1951). Checklist : 259.

Status : Common.

Distribution : Everywhere in the Park. Often seen among boulders at 4000-4400 m.

Family FELIDAE

4. **Panthera pardus** (Linnaeus), Leopard.

Ellerman and Morrison-Scott. (1951). Checklist : 316.

Status : Uncommon.

Distribution : Found in the Lower Rishi Gorge. Difficult to observe on account of its nocturnal and shy habits. Leaves plenty of foot prints in the river bed and soft ground.

5. **Panthera uncia** (Schreber), Ounce or Snow Leopard.

Ellerman and Morrison-Scott. (1951). Checklist : 320.

Status : Rare.

Distribution : Mostly found in the Upper Rishi Gorge (Inner sanctuary). Very difficult to sight this highly endangered field on account of its nocturnal and shy habits, limited populations and distribution. Often leaves plenty of foot prints in the soft ground and snow.

Order ARTIODACTYLA

Family BOVIDAE

6. **Capricornis sumatraensis** (Bechstein), Serow.

Ellerman and Morrison-Scott. (1951). Checklist : 399.

Status : Common.

Distribution : Confined to lower part of the Lower Rishi Gorge. It prefers thickly wooded gorges and can often be seen in the mornings and evenings when it comes out to graze on the range herbage of the more open slopes.

7. **Hemitragus jemlahicus** (H. Smith), Himalayan Tahr.

Ellerman and Morrison-Scott. (1951). Checklist : 403.

Status : Uncommon.

Distribution : Mostly found above the tree line on the cliffs & hedges of Dharansi Col. and its adjoining ranges in the Park.

8. **Naemorhedus goral** (Hardwicke), Goral.

Ellerman and Morrison-Scott. (1951). Checklist : 401.

Status : Uncommon.

Distribution : Found only on the outer slopes of the ridges, forming Park boundary, in the NW of the Park.

9. **Pseudois nayaur** (Hodgson), Bharal or Blue sheep.

Ellerman and Morrison-Scott. (1951). Checklist : 410.

Status : Very common.

Distribution : Throughout in the Upper Rishi Gorge (the Inner sanctuary) area of the Park. Frequently seen on the alpine meadows in the mornings and evenings when they come out for grazing.

Family CERVIDAE

10. **Moschus moschiferus** Linnaeus, Musk Deer or Kastura.

Ellerman and Morrison-Scott. (1951). Checklist : 353.

Status : Common.

Distribution : Throughout the Park in the sub-alpine birch forest. Difficult to observe on account of its concealing habits. Leaves several "Latrine" sites (distinct groups of pellets).

Order LAGOMORPHA

Family LEPORIDAE

11. **Ochotona roylei** (Ogilby), Royle's Pika.

Ellerman and Morrison-Scott. (1951). Checklist : 450.

Status : Very common.

Distribution : Throughout the Park Frequently observed among boulders between 3500m and 4450m.

Order RODENTIA

Family MURIDAE

12. **Alticola roylei** (Gray), Royle's High Mountain Vole.

Ellerman and Morrison-Scott. (1951). Checklist : 670.

Status : Uncommon.

Distribution : Occasionally seen, feeding on grasses, at Upper Deodi (3850m) in the Park.

13. **Mus booduga** (Gray), Little Indian Field Mouse.

Ellerman and Morrison-Scott. (1951). Checklist : 609.

Status : Uncommon.

Distribution : Occasionally seen at Latakharak (3700m) in the Park.

APPENDIX—II

BIRDS

Order FALCONIFORMES

Family ACCIPITRIDAE : Hawks, Vultures.

1. **Aquila chrysaetos daphanea** Severtzov, Himalayan Golden Eagle.

Salim Ali and Ripley (1978), H. B. No. 166, vol. 1 : 273.

Baker (1928), FBI No. 1746, Vol. 5 : 68.

Distribution : Normally from c. 1850 m to c. 5000m.

2. **Aquila rapax nipalensis** Hodgson, Eastern Steppe Eagle.

Salim Ali and Ripley (1978), H. B. No. 169, vol. 1 : 278.

Baker (1928), FBI No. 1748, vol. 5 : 70.

Distribution : Mostly upto 2500 m.

3. **Ictineatus malayaensis perniger** (Hodgson) Black Eagle.

Salim Ali and Ripley (1978), H. B. No. 172, vol. 1 : 283.

Baker (1928), FBI No. 1755, vol. 5 : 83.

Distribution : Mostly upto c. 2700 m.

4. **Gyps himalayensis** Hume, Himalayan Griffon Vulture.

Salim Ali and Ripley (1978), H. B. No. 181, vol. 1 : 302.

Baker (1928), FBI No. 1709, vol. 5 : 13.

Distribution : Normally between 600 and 2500 m.

5. **Neophron percnopterus ginginianus** (Latham), Indian Scavenger Vulture.

Salim Ali and Ripley (1978), H. B. No. 187, vol. 1 : 312.

Baker (1928), FBI No. 1715, vol. 5 : 23.

Distribution : Usually from c. 2000 m up along the Himalayas locally.

6. **Gypaetus barbatus aureus** (Hablizl), Himalayan Bearded Vulture or Lammergeier.

Salim Ali and Ripley (1978), H. B. No. 188, vol. 1 : 314.

Baker (1928), FBI No. 1716, vol. 5 : 26.

Distribution : Normally between 1200 and 4000 m.

Family FALCONIDAE : Falcons.

7. **Falco tinnunculus tinnunculus** Linnaeus, European Kestrel.

Salim Ali and Ripley (1978), H. B. No. 222, vol. 1 : 365.

Baker (1928), FBI No. 1740, vol. 5 : 61.

Distribution : Recorded between 1000 and 3500 alt.

Order GALLIFORMES

Family PHASIANIDAE : Pheasants, Partridges.

8. **Lerwa lerwa** (Hodgson), Snow Partridge.

Salim Ali and Ripley (1969), H. B. No. 227, vol. 2 : 6.

Baker (1928), FBI No. 1993, vol. 5 : 433.

Distribution : Common between 3000 and 5000 m.

9. **Tetraogallus himalayensis himalayensis** G. R. Gray, Himalayan Snowcock.

Salim Ali and Ripley (1969), H. B. No. 232, vol. 2 : 13.

Baker (1928), FBI No. 1989, vol. 5 : 426.

Distribution : Normally between 4000 and 5500 m.

10. **Alectoris chukar chukar** (J. E. Gray), Chukor Partridge.

Salim Ali and Ripley (1969), H. B. No. 236, vol. 2 : 18.

Baker (1928), FBI No. 1972, vol. 5 : 402.

Distribution : Usually between 1200 and 5000 m.

11. **Lophophorus impejanus** (Latham), Impeyan or Himalayan Monal Pheasant.

Salim Ali and Ripley (1969), H. B. No. 290, vol. 2 : 88.

Baker (1928), FBI No. 1928, vol. 5 : 335.

Distribution : Found between 2600 and 5000 m altitude.

12. **Pucrasia macrolopha macrolopha** (Lesson), Koklas Pheasant.

Salim Ali and Ripley (1969), H. B. No. 305, vol. 2 : 113.

Baker (1928), FBI No. 1911, vol. 5 : 310.

Distribution : Common between 1500 and 4000 m.

Order CHARADRIIFORMES

Family CHARADRIIDAE

13. **Scolopax rusticola rusticola** Linnaeus, Woodcock,

Salim Ali and Ripley (1969), H. B. No. 411, vol. 2 : 292.

Baker (1929), FBI No. 2167, vol. 6 : 252.

Distribution : Normally between 2500 and 3700 m.

Order COLUMBIFORMES

Family COLUMBIDAE : Pigeons, Dove.

14. **Columba leuconota leuconota** Vigors, West Himalayan Snow Pigeon.

Salim Ali and Ripley (1969), H. B. No. 513, vol. 3 : 120.

Baker (1928), FBI No. 1858, vol. 5 : 224.

Distribution : Chiefly between 3000 and 5000 m.

15. **Columba hodgsonii** Vigors, Speckled Wood Pigeon.

Salim Ali and Ripley (1969), H. B. No. 520, vol. 3 : 131.

Baker (1928), FBI No. 1867, vol. 5 : 234.

Distribution : Commonly found between 1800 and 4000 m.

16. **Streptopelia orientalis orientalis** (Latham), Rufous Turtle Dove.

Salim Ali and Ripley (1999), H. B. No. 530, vol. : 142.

Baker (1928), FBI No. 1870, vol. 5 : 238.

Distribution : Upto c. 2500 m.

17. **Streptopelia chinensis suratensis** (Gmelin), Indian Spotted Dove.

Salim Ali and Ripley (1969), H. B. No. 537, vol. 3 : 152.

Baker (1928), FBI No. 1873, vol. 5 : 242.

Distribution : Normally upto c. 2500 m.

Order CUCULIFORMES

Family CUCULIDAE : Cuckoos.

18. **Clamator jacobinus serratus** (Sparrman), Pied Crested Cuckoo.

Salim Ali and Ripley (1969), H. B. No. 570, vol. 3 : 194.

Baker (1927), FBI No. 1472, vol. 4 : 167.

Distribution : Summer visitor, straggling upto c. 4000 m.

19. **Cuculus canorus canorus** Linnaeus, Cuckoo.

Salim Ali and Ripley (1969), H. B. No. 578, vol. 3 : 208.

Baker (1927), FBI No. 1451, vol. 4 : 135.

Distribution : Normally between 600 and 4100 m.

Order STRIGIFORMES

Family STRIGIDAE : Owls.

20. **Bubo bubo bengalensis** (Franklin), Indian Great Horned or Eagle-Owl.

Salim Ali and Ripley (1969), H. B. No. 627, vol. 3 : 273.

Baker (1927), FBI No. 1660, vol. 4 : 414.

Distribution : Normally from c. 1500 m. to c. 2500 m.

Order APODIFORMES

Family APODIDAE : Swifts.

21. **Collocalia unicolor** (Jerdon), India Edible-nest Swiftlet.

Salim Ali and Ripley (1970), H. B. No. 685, vol. 4 : 29.

Baker (1927), FBI No. 1608, vol. 4 : 346.

Distribution : Normally upto c. 2200 m.

22. **Chaetura sylvatica** (Tickell), Whiterumped Spinetail Swift.

Salim Ali and Ripley (1970), H. B. No. 692, vol. 4 : 37.

Baker (1927), FBI No. 1606, vol. 4 : 344.

Distribution : Normally upto biotope c. 1700 m.

Order CORACIIFORMES

Family UPUPIDAE : Hoopoe

23. **Upupa epops ceylonensis** (Reichenbach), Ceylon Hoopoe.

Salim Ali and Ripley (1970), H. B. No. 765, vol. 4 : 128.

Baker (1927), FBI No. 1581, vol. 4: 311, 312.

Distribution : Normally upto c. 2200 m.

Order PICIFORMES

Family CAPITONIDAE : Barbets.

24. **Megalaima virens marshallorum** Swinhoe, Himalayan Great Barbet.

Salim Ali and Ripley (1970), H. B. No. 777, vol. 4 : 147.

Baker (1927), FBI No. 1427, vol. 4 : 106.

Distribution : Normally between c. 1000 and 3000 m.

Family INDICATORIDAE : Honeyguides.

25. **Indicator xanthonotus radcliffi** Hume, West Pakistan Orange-rumped Honeyguide.

Salim Ali and Ripley (1970), H. B. No. 793, vol. 4 : 165.

Baker (1927), FBI No. 1450 (Part), vol. 4 : 131.

Distribution : Found between 1500 and 3000 m.

Family PICIDAE : Woodpeckers.

26. **Picus squamatus squamatus** Vigors, Himalayan Scalybellied Green Woodpecker.

Salim Ali and Ripley (1970), H. B. No. 807, vol. 4 : 182.

Baker (1927), FBI No. 1337, vol. 4 : 7.

Distribution : Found between 1000 and 3300 m.

27. **Picoides himalayensis himalayensis** (Jardine & Selby), Garhwal Pied Woodpecker.

Salim Ali and Ripley (1970), H. B. No. 837, vol. 4 : 217.

Baker (1927), FBI No. 1360, vol. 4 : 32.

Distribution : Found between 1000 and 3000 m.

Order PASSERIFORMES

Family ALAUDIDAE : Larks.

28. **Calandrella cinerea dukhunensis** (Sykes), Rufous Short-toed Lark.

Salim Ali and Ripley (1972), H. B. No. 886, vol. 5 : 21.

Baker (1926) FBI No. 1222, vol. 3 : 326.

Distribution : Seen only once in Dibrugheta.

Family HIRUNDINIDAE : Swallows.

29. **Delichon nipalensis nipalensis** Moore, Nepal House Martin.

Salim Ali and Ripley (1972), H. B. No. 932, vol. 5 : 76.

Baker (1926), FBI No. 1144, vol. 3 : 230.

Distribution : Normally between 2000 and 4000 m.

Family LANIIDAE

30. **Lanius tephronotus tephronotus** (Vigors), Eastern Tibet Greybacked Shrike.

Salim Ali and Ripley (1972), H. B. No. 945, vol. 5 : 92.

Baker (1924), FBI No. 716, vol. 2 : 297.

Distribution : Common between 2700 and 4500 m.

Family DICRURIDAE : Drongos.

31. **Dicrurus leucophaeus longicaudatus** Hay, Indian Grey Drongo.

Salim Ali and Ripley (1972), H. B. No. 965, vol. 5 : 119.

Baker (1924), FBI No. 775, vol. 2 : 362.

Distribution : Normally upto 3000 m.

32. **Uicrurus hottentotus hottentotus** (Linnaeus), Haircrested or Spangled Drongo.

Salim Ali and Ripley (1972), H. B. No. 973, vol. 5 : 131.

Baker (1924), FBI No. 782, vol. 2 : 370.

Distribution : Usually upto c. 1400 m., occasionally to 2000 m.

Family CORVIDAE : Crows, Magpies, Jays.

33. **Nucifraga caryocatactes hemispila** Vigors, Himalayan Nutcracker.

Salim Ali and Ripley (1972), H. B. No. 1043, vol. 5 : 233.

Baker (1922), FBI No. 46 (part), vol. 1 : 66.

Distribution : Distributed between 2000 to 3300 m., occasionally straggling lower or higher.

34. **Pyrhocorax graculus digitatus** Hemprich & Ehrenberg, Himalayan Yellowbilled or Alpine Cough.

Salim Ali and Ripley (1972), H.B. No. 1045, vol. 5 : 236.

Baker (1922), FBI No. 49, vol. 1 : 70.

Distribution : Normally between 2700 and 5000 m.

35. **Pyrrhocorax pyrrhocorax centralis** Stresemann,
West Himalayan Redbilled Cough.

Salim Ali and Ripley (1972), H.B. No. 1046, vol. 5 : 239.

Baker (1922), FBI No. 48 (part), vol. 1 : 68.

Distribution : Found between c. 2400 and 3500 m.

36. **Corvus macrorhynchos intermedius** Adams,
Himalayan Jungle Crow.

Salim Ali and Ripley (1972), H.B. No. 1054, vol. 5 : 252.

Baker (1922), FBI No. 7, vol. 1 : 28.

Distribution : Found between 1800 and 4500 m.

Family CAMPEPHAGIDAE

37. **Pericrocotus ethologus favillaceus** Bangs & Phillips,
West Himalayan Longtailed Minivet.

Salim Ali and Ripley (1971), H.B. No. 1085, vol. 6 : 32.

Baker (1924), FBI No. 738, vol. 2 : 323.

Distribution : Normally between 1200 and 3400 m, optimum zone 1800-2400 m.

Family MUSCICAPIDAE : Babblers, Laughing,
Thrushes and Flycatchers.

38. **Garrulax variegatus similis** (Hume),
Western Variegated Laughing Thrush.

Salim Ali and Ripley (1972), H.B. No. 1289, vol. 7 : 22.

Baker (1922), FBI No. 163, vol. 1 : 174.

Distribution : Usually between 1800 and 3300 m.

39. **Garrulax lineatus lineatus** (Vigors),
Simla Streaked Laughing Thrush.

Salim Ali and Ripley (1972), H.B. No. 1314, vol. 7 : 46.

Baker (1922), FBI No. 172, vol. 1 : 180.

Distribution : Normally between 1200 and 3000 m.

40. **Garrulax erythrocephalus erythrocephalus** (Vigors),
Redheaded Laughing Thrush.

Salim Ali and Ripley (1972), H.B. No. 1324, vol. 7 : 57.

Baker (1922), FBI No. 148 (part), vol. 1 : 163.

Distribution : Normally between 1800 and 3300 m.

41. **Muscicapa leucomelanura leucomelanura** (Hodgson),
Western Slaty Blue Flycatcher.

Salim Ali and Ripley (1972), H.B. No. 1423, vol. 7 : 170.

Baker (1922), FBI No. 645, vol. 2 : 219.

Distribution : Normally between 1800 and 3300 m.

42. **Muscicapa sundara whistleri** (Ticehurst),
Western Rufousbellied Niltava.

Salim Ali and Ripley (1972), H.B. No. 1431, vol. 7 : 180.

Baker (1924), FBI No. 684 (part), vol. 1 : 259.

Distribution : Normally between 1600 and 2700 m.

43. **Rhipidura hypoxantha** Blyth,
Yellowbellied Fantail Flycatcher.

Salim Ali and Ripley (1972), H.B. No. 1450, vol. 7 : 206.

Baker (1924), FBI No. 699, vol. 2 : 275.

Distribution : Normally between 1800 and 3600 m.

44. **Phylloscopus proregulus simlaensis** Ticehurst,
Western Pallas's Leaf Warbler.

Salim Ali and Ali (1973), H.B. No. 1594, vol. 8 : 158.

Baker (1924), FBI No. 868, vol. 2 : 467

Distribution : Normally between 2200 and 3300 m.

45. **Regulus regulus himalayensis** Bonaparte,
Himalayan Goldcrest.

Salim Ali and Ripley (1973), H.B. No. 1629, vol. 8 : 197.

Baker (1924), FBI No. 944 (part), vol. 2 : 539.

Distribution : Normally from c. 2500 m. upto c. 3500 m.

46. **Erithacus pectoralis pectoralis** (Gould),
West Himalayan Rubythroat.

Salim Ali and Ripley (1973), H.B. No. 1647, vol. 8 : 221.

Baker (1924), FBI No. 543, 2 : 92.

Distribution : Normally between 2700 and 4500 m.

47. **Erithacus cyanurus pallidior** (Baker),
Kashmir Redflanked Bush Robin.

Salim Ali and Ripley (1973), H.B. No. 1654, vol. 8 : 230.

Baker (1924), FBI No. 550, vol. 2 : 101.

Distribution : Normally between 2700 and 3600 m.

48. **Phoenicurus caeruleocephalus** (Vigors),
Blueheaded Redstart.

Salim Ali and Ripley (1973), H.B. No. 1670, vol. 8 : 251.

Baker (1924), FBI No. 553, vol. 2 : 104.

Distribution : Usually between 2400 and 3900 m.

49. **Phoenicurus ochruros rufiventris** (Vieillot),
Eastern Black Redstart.

Salim Ali and Ripley (1973), H.B. No. 1672, vol. 8 : 255.

Baker (1924), FBI No. 532, vol. 2 : 77.

Distribution : Normally between 3300 and 5200 m.

50. **Phoenicurus frontails** (Vigors),
Bluefronted Redstart.

Salim Ali and Ripley (1973), H.B. No. 1675, vol. 8 : 258.

Baker (1924), FBI No. 526, vol. 2 : 266.

Distribution : Normally between 3000 and 5300 m.

51. **Rhyacornis fuliginosus fuliginosus** (Vigors),
Plumbeous Redstart.

Salim Ali and Ripley (1973), H.B. No. 1679, vol. 8 : 266.

Baker (1924), FBI No. 535, vol. 2 : 81.

Distribution : Mostly between 1200 and 4300 m.

52. **Hodgsonius phoenicuroides phoenicuroides** Gray,
Hodgson's Shortwing or Whitebellied Redstart.

Salim Ali and Ripley (1973), H.B. No. 1680, vol. 8 : 269.

Baker (1924), FBI No. 491, vol. 2 : 21.

Distribution : Normally between 2400 m and 4400 m.

53. **Enicurus scouleri scouleri** Vigors,
Little Forktail.

Salim Ali and Ripley (1973), H.B. No. 1684, vol. 9 : 7.

Baker (1924), FBI No. 525, vol. 2 : 65.

Distribution : Chiefly between 1800 and 3300 m.

54. **Saxicola torquata prezevalskii** (Pleske),
Tibetan Collared Bush Chat.

Salim Ali and Ripley (1973), H.B. No. 1696, vol. 9 : 27.

Baker (1927), FBI No. 496, vol. 2 : 30.

Distribution : Seen upto 2500 m.

55. **Saxicola ferrea** Gray,
Dark-grey Bush Chat.

Salim Ali and Ripley (1973), H.B. No. 1705, vol. 9 : 37.

Baker (1924), FBI No. 502, vol. 2 : 36.

Distribution : Mostly between 1500 and 3300 m.

56. **Chaimerronis leucocephalus** (Vigors),
Whitecapped Redstar or River Chat.

Salim Ali and Ripley (1973), H.B. No. 1716, vol. 9 : 57.

Baker (1924), FBI No. 543, vol. 2 : 79.

Distribution : Mostly from 1800 m to 5300 m.

57. **Myiophonus caeruleus temminckii** (Vigors),
Himalayan Whistling Thrush.

Salim Ali and Ripley (1973), H.B. No. 1729, vol. 9 : 79.

Baker (1924), FBI No. 614, vol. 2 : 180.

Distribution : Normally between 1000 and 4200 m.

58. **Zoothera wardii** (Blyth),
Pied Ground Thrush.

Salim Ali and Ripley (1973), H.B. No. 1731, vol. 9 : 83.

Baker (1924), FBI No. 584, vol. 2 : 145.

Distribution : Usually between 1200 and 2400 m.

59. **Zoothera mollissima whiteheadi** (Baker),
Western Plainbacked Mountain Thrush.

Salim Ali and Ripley (1973), H.B. No. 1738, vol. 9 : 92.

Baker (1924), FBI Nos. 600 and 601, vol. 2 : 163,164.

Distribution : Mostly between 2700 and 4000 m.

60. **Turdus albocinctus** Royle,
Whitecollared Blackbird.

Salim Ali and Ripley (1973), H.B. No. 1749, vol. 9 : 110.

Baker (1924), FBI No. 570, vol. 2 : 129.

Distribution : Normally between 2100 and 4000 m.

61. **Turdus rubrocanus rubrocanus** G. R. Gray,
Western Greyheaded Thrush.

Salim Ali and Ripley (1973), H.B. No. 1758, vol. 9 : 122.

Baker (1924), FBI No. 572, vol 2 : 132.

Distribution : Usually between 2100 and 3000 m.

Family TROGLODYTIDAE : Wrens

62. **Troglodytes troglodytes nipalensis** Blyth,
Nepal Wren.

Salim Ali and Ripley (1973), H.B. No. 1771, vol. 9 : 133.

Baker (1922), FBI No. 458, vol. 1 : 445.

Distribution : Mostly between 2700 m and 5000 m.

Family CINCLIDAE : Dippers.

63. **Cinclus pallasii tenuirostris** Bonaparte,
West Himalayan Brown Dipper.

Salim Ali and Ripley (1973), H.B. No. 1775, vol. 9 : 142.

Baker (1924), FBI No. 479, vol. 2 : 4.

Distribution : Mostly upto 4000 m.

Family PRUNELLIDAE : Accentors

64. **Prunella collaris whymperi** (Baker),
Garhwal Alpine Accentor.

Salim Ali and Ripley (1973), H.B. No. 1778, vol. 9 : 146.

Baker (1924), FBI No. 620 (part), vol. 2 : 188.

Distribution : Normally between 3600 and 4500 m.

65. **Prunella strophinata jerdoni** (Brooks),
Western Rufousbreasted Accentor.

Salim Ali and Ripley (1973), H.B. No. 1782, vol. 9 : 152.

Baker (1924), FBI No. 629, vol. 2 : 197.

Distribution : Usually between 2700 and 4000 m.

Family PARIDAE : Tits or Titmice.

66. **Parus major nipalensis** Hodgson,
Nepal Grey Tit.

Salim Ali and Ripley (1973), H.B. No. 1793, vol. 9 : 168.

Baker (1922), FBI Nos. 51, 54, 55 (part), vol. 1 : 74, 77.

Distribution : Mostly in the foothills upto c. 1800 m.

67. **Parus monticolus monticolus** Vigors,
Greenbacked Tit.

Salim Ali and Ripley (1973), H.B. No. 1799, vol. 9 : 174.

Baker (1922), FBI No. 59, vol. 1 : 80.

Distribution : Mostly upto 3600 m.

68. **Parus melanolophus** Vigors,
Crested Black Tit.

Salim Ali and Ripley (1973), H.B. No. 1802, vol. 9 : 178.

Baker (1922), FBI No. 63, vol. 1 : 83.

Distribution : Usually from 2000 m. to 3500.

69. **Parus rubidiventris rufonuchalis** Blyth,
Simla Black Tit.

Salim Ali and Ripley (1973), H.B. No. 1804, vol. 9 : 180.

Baker (1922), FBI No. 66, vol. 1 : 85.

Distribution : Mostly between 2700 and 3600 m.

70. **Parus dichrous kangrae** (Whistler),
Western Brown Crested Tit.

Salim Ali and Ripley (1973), H.B. No. 1807, vol. 9 : 184.

Baker (1922), FBI No. 68 (part) vol. 1 : 87.

Distribution : Normally between 2400 and 3300 m.

71. **Aegithalos concinnus iredalei** (Baker),
Western Redheaded Tit.

Salim Ali and Ripley (1973), H.B. No. 1818, vol. 9 : 200.

Baker (1973), FBI No. 7 (part), vol. 1 : 93.

Distribution : Mostly upto 2400 m.

Family SITTIDAE : Nuthatches

72. **Sitta leucopsis leucopsis** Gould,
Western Whitechecked Nuthatch.

Salim Ali and Ripley (1973), H.B. No. 1832, vol. 9 : 217.

Baker (1922), FBI No. 117, vol. 1 : 130.

Distribution : Normally from 2100 m. to 3000 m.

73. **Tichodroma muraria nepalensis** Bonaparte,
Wall Creeper.

Salim Ali and Ripley (1973), H.B. No. 1839, vol. 9 : 226.
Baker (1922), FBI No. 457, vol. 1 : 441.
Distribution : Mostly above 3300 m, upto 6400 m.

Family CARTHIDAE : Tree Creeper.

74. **Certhia familiaris hodgsoni** Brooks,
Kashmir Tree Creeper.

Salim Ali and Ripley (1973), H.B. No. 1842, vol. 1 : 232.
Baker (1922), FBI No. 450, vol. 1 : 434.
Distribution : Normally upto c. 3000 m.

75. **Certhia himalayana himalayana** Vigors,
Himalayan Tree Creepers.

Salim Ali and Ripley (1973), H.B. No. 1847, vol. 9 : 237.
Baker (1922), FBI No. 444 (part) vol. 1 : 430.
Distribution : Mostly between 1500 and 3600 m.

Family FRINGILLIDAE : Finches.

76. **Mycerobas affinis** (Blyth),
Allied Grosbeak.

Salim Ali and Ripley (1974), H.B. No. 1983, vol. 10 : 126.
Baker (1926), FBI No. 1040, vol. 3 : 103.
Distribution : Mostly between 3000 and 4000 m.

77. **Carpodacus rhodochrous** (Vigors),
Pinkbrowed Rosefinch.

Salim Ali and Ripley (1974), H.B. No. 2017, vol. 10 : 171.
Baker (1926), FBI No. 1062, vol. 3 : 129.
Distribution : Usually between 2800 and 4600 m.

78. **Pyrrhula erythrocephala** Vigors,
Redheaded Bullfinch.

Salim Ali and Ripley (1974), H.B. No. 2039, vol. 10 : 210.
Baker (1926), FBI No. 1044, vol. 3 : 110.
Distribution : Mostly between 3400 and 4300 m.

79. **Pyrrhula aurantiaca** Gould,
Orange Bullfinch.

Salim Ali and Ripley (1974), H.B. No. 2040, vol. 10 : 202.

Baker (1926), FBI No. 1043, vol. 3 : 109.

Distribution : Normally between c. 2700 and 3300 m.

Family EMBERIZIDAE : Buntings

80. **Emberiza leucocephala leucocephala** S. G. Gmelin,
Pine Bunting.

Salim Ali and Ripley (1974), H.B. No. 2042, vol. 10 : 206.

Baker (1926), FBI No. 1123, vol. 3 : 202.

Distribution : Normally upto c. 2700 m.

Note : Subspecies after earlier records from the adjoining areas.