1.1 RATIONALE

India, being one of the 12 “Megadiversity” nation of the world, is home to approximately 45000 plant species including 15000 flowering plants, 5000 species of algae, 1600 species of lichen, 20000 species of fungi, 2700 species of bryophytes and 600 species of pteridophytes. It also has about 75000 species of animals including 50000 species of insects, 4000 species of mollusc, 2000 species of fish, 140 species of amphibians, 420 species of reptiles, 1200 species of birds and 410 species of mammals (Anonymous 1994). The great diversity of life forms, evolved as a consequence of tremendous variation in climatic conditions and topography, is distributed in a variety of habitat types ranging from tropical thorn forest in west to mangroves and rainforest in east and north east; temperate forest and alpine grasslands in Himalaya in north to moist and dry tropical forests in southern India. Ruthless exploitation of forest for revenue generation, large scale clearance of forest for agriculture and human settlements, industrial development accompanied with rampant poaching and hunting in past have taken a heavy toll of India’s forest cover and its wildlife wealth.

The destruction of natural forest has led to severe reduction, fragmentation and degradation of forest cover. As a consequence, a large number of plant and animal species, communities and unique vegetation/habitat types have been subjected to drastic decline in abundance, distribution and coverage. This loss is reflected in a number of faunal and floral species being regarded as either extinct or near extinct, highly endangered, threatened and
vulnerable. The problem of tiger conservation in India explains as well as symbolises the crisis which the country is facing in general conservation of its biodiversity wealth as a consequence of past destruction of natural resources. Numbering around 40000 at the turn of last century, its entire population is currently estimated to be between 3000 to 4000. The habitat of tiger has drastically shrunk and is highly fragmented with individual populations averaging around 30 to 50. Even these individual populations are under tremendous poaching and biotic pressures. Like tigers, many other majestic large herbivores (elephant, rhino, wild buffalo etc.) have followed the same trail of decline in abundance and reduced distribution with very limited options for management and conservation.

The process of destruction of natural resources, although widespread, has not been uniform spatially across different bio-geographic zones of India and within each zone. The Himalaya, which covers 6.4% of area in India, constitute a significant unit for conservation of biodiversity. It harbours a great diversity of faunal and floral species distributed in a variety of topography types and climatic conditions. The Himalaya is divisible in four provinces namely north-west Himalaya, west Himalaya, central Himalaya and east Himalaya (Rodgers et al. 2000). The destruction of forest resources in Himalaya has been alarmingly high during last three centuries as compared to other bio-geographic zones. Before India’s independence, British as well as local kings exploited forest resources indiscriminately for revenue generation. Within Himalaya also, the destruction of
forest has been more in west Himalaya as compared to other three biogeographical provinces. The negative consequences of forest destruction in west Himalaya are well known. These included frequent flooding in plains, excessive siltation of rivers and dams in plains due to increased soil erosion in water catchment areas, severe hardships to local people who depended on forest resources a great deal for their daily sustenance and general loss and impoverishment of biodiversity. The hardships to local village communities have been so severe that these have given rise to very powerful people’s movements (e.g. Chipko movement in Garhwal division) against continued exploitation of already depleted forest resources.

The Kumaon division in west Himalaya, which covers an area of 21032 km², has also not escaped the trail of destruction. Once extensively covered with moist temperate oak forest with abundant wildlife, the landscape in Kumaon today is dominated by either the chir-pine forest or terrace fields, human settlements, barren lands and fragmented oak forest. The British cleared large areas of oak and deodar forests for revenue generation. Cleared areas were planted with chir-pine (*Pinus roxburghii*) which is fire resistant and ruderal in nature. Simultaneously the local people cleared forest for agriculture and also exploited the remaining forested areas for their timber, fuelwood, fodder, grazing and food requirements. This led to large scale fragmentation and degradation of oak and deodar forests resulting in endangered status of middle-altitude oak forest (Singh and Singh 1986). The wildlife populations also declined in
abundance. Rampant poaching and illegal hunting also added to negative impact of habitat loss and degradation on the abundance of wildlife. Although no precise estimates are available as to how abundant the general wildlife was, the descriptions provided by hunter turned naturalist—the legendary Jim Corbett (1989) indicate widespread distribution and high abundance of large predators such as tiger (*Panthera tigris*), leopard (*Panthera pardus*), Himalayan black bear (*Selenarctos thibetanus*) and their respective prey species such as goral (*Nemorhaedus goral*), barking deer (*Muntiacus muntjak*), sambar (*Cervus unicolor*) and serow (*Capricornis sumatraensis*). The tiger has already become locally extinct from much of the lower and middle ranges in Kumaon and leopard and black bear survive in relict and fragmented population with extremely low abundance. The prey species also survive in fragmented landscape and are under tremendous poaching pressure from local people.

The fragmentation of habitat and its subsequent degradation is known to have negative consequences for animal populations inhabiting them. One immediate direct impact is the fragmentation of larger animal and plant populations (Gilpin and Soule 1986). Once divided into smaller units the animal and plant populations face greater risk of local extinction either due to deterministic events (catastrophes, fires, heavy snow etc.) or due to stochastic events (e.g. random variation in birth or death rate of a population). Smaller populations also have the risk of heavy inbreeding in the long run if these populations are completely isolated and become smaller and smaller due to their
continued poaching. Inbreeding leads to loss of genetic variability of a population and have less viability of survival due to loss of general fitness, reduced disease resistance and greater demographic stochasticity. Thus wildlife populations in fragmented environment pose serious challenge for managers in terms of their management for long term conservation. Such populations require continuous monitoring and heavy research input on various aspects of their ecology. Going by the magnitude of destruction of oak forest in Kumaon which led to large scale fragmentation of animal and plant populations, the task of wildlife conservation is enormous. Majority of oak forested areas are small with high levels of isolations. These patches harbour relatively small wildlife populations and patches are under heavy biotic pressures from the local people. Conservation of wildlife resources in Kumaon may thus require some prioritisation of areas in terms of their overall viability and their value in terms of the biodiversity these contain.

Although India has made significant progress in conserving its biodiversity values through establishment of protected areas, lack of conservation planning has resulted in uneven distribution of protected areas in different bio-geographic zones and within different provinces. There are currently 566 protected areas in India spread over an area of 153000 km² or 4.66% of country’s geographical area (Rodgers et al. 2000). As already stated not only the distribution of protected areas is uneven, many of the established protected areas may have very little viability in the long term due to high dependence of local people and also for not protecting the entire range of biodiversity of a region. This is precisely
the case with protected areas in Kumaon Himalaya. Currently there are two wildlife sanctuaries in Kumaon Himalaya. These are Binsar Wildlife Sanctuary and Askot Wildlife Sanctuary covering approximately 45 and 600 km\(^2\) of areas respectively. Both sanctuaries have very high level of human dependencies with little documentation of biodiversity values.

In order to conserve biodiversity of a region through establishment of protected areas, it is essential that the current status and spatial distribution of elements of biodiversity is known which should be taken into consideration for conservation planning. Also threats to elements be known so that mitigation measures may be taken prior and after the establishment of protected areas. A review of available information on plant and animal communities in oak forest of Kumaon showed lack of information on animal communities (e.g. avian, mammalian etc.) as well as spatial distribution of extant oak patches and threats faced by these. Therefore prior to any conservation planning it was essential that studies be conducted to map the extant oak patches and data on status of elements of biodiversity are collected.

Large mammals by virtue of their larger body size and home ranges are, relatively speaking, more prone to decline as a consequences of fragmentation and degradation of their habitat as compared to other smaller animals such as birds or insects. They are also hunted for a variety of reasons. Therefore their abundance in a patch may be used as an indicator of general wellbeing of entire range of biodiversity. Ungulates species, which sustain large predators as well as
play vital role in vegetation dynamics were thus selected for the present investigation. Though the majestic tiger has vanished from much of Kumaon, the extant oak patches still harbour populations of leopard and black bear, which are partly being sustained by the ungulate community. The ungulate community which is comprised of barking deer, sambar, goral on lower and middle altitudes and Himalayan tahr, serow and musk deer on higher altitudes are some of the least studied species of Indian region and therefore the present investigation was not only needed for conservation planning but also to fill the gaps in our understanding on aspects of ecology of these species.

1.2 OBJECTIVES

The following were the objectives of this study:

1. To investigate the status, distribution and abundance of ungulates in extent oak forest patches of Kumaon Himalaya.

2. To investigate the seasonal abundance and habitat utilisation pattern of goral and barking deer in oak/pine ecosystems.

3. To investigate the feeding ecology of goral and barking deer in oak/pine forest ecosystems.

4. To quantify the threats to conservation of ungulates in oak forest ecosystem in the Kumaon Himalaya.

5. To prepare a conservation strategy for the ungulate community in Kumaon Himalaya.
1.3 DURATION OF THESIS
The field work for this study was started in January 1996 in the Binsar Wildlife Sanctuary and continued till December 1998. The general survey for assessment of status of ungulates was carried out in pre-monsoon 1997. A total of 36 months were spent in data collection in field. A total of 36 months were spent in data summarisation, analysis and thesis writing.

1.4 ORGANISATION OF THESIS
There are a total of eight chapters in this thesis. The chapters 3, 4, 5, 6, 7 and 8 have four section each: introduction, methodology, results and discussion. The detail of each chapter is as follows:

Chapter 1 deals with rationale of undertaking the present investigation.

Chapter 2 provides the details of extensive and intensive study areas.

Chapter 3 deals with vegetation studies carried out in whole of Kumaon Himalaya. Attempts have been made to develop understanding of general gradients in vegetation of Kumaon which has relevance to understanding distribution pattern of ungulate species in Kumaon.

Chapter 4 provides data on status, abundance and factors governing distribution of all major ungulate species found in Kumaon Himalaya.

Chapter 5 deals with the seasonal abundance and population structure of barking deer and goral in Binsar Wildlife Sanctuary.

Chapter 6 provides analysis of seasonal habitat utilisation pattern of barking deer and goral in Binsar Wildlife Sanctuary.
Chapter 7 deals with feeding ecology of barking deer and goral. Data were also collected on the nutritional status of ground cover vegetation in two different habitat in different seasons.

Chapter 8 deals with the assessment of threats in Kumaon Himalaya with special reference to Binsar Wildlife sanctuary. Data were collected on fire, fuel wood, fodder and extraction of timber and non timber forest products.

Chapter 9 deals with strategy for conservation of ungulate communities in Kumaon landscape.

1.5 LITERATURE REVIEW

However very little documentation exists about the animal communities especially mammals and birds which constitute significant component of overall biodiversity of Kumaon. Hudson (1930) documented 124 bird species in Nainital and Briggs (1931) documented 83 bird species in Ranikhet forest. Tak (1995) documented 127, 94 and 82 species of birds in Nainital, Almora and Pithoragarh districts in Kumaon. It is recently that Hussain et al. (1997), Aisha and Khan (1999), Tehmina et al. (1997) and Aisha and Khan (2000) have studied aspects of avian communities at different locations of Kumaon. Orus (1998) and Orus et al. (1998) have studied general aspects of biodiversity conservation in Binsar Wildlife Sanctuary and status and distribution of ungulates in Kumaon Himalaya.