Chapter 2

Ecological Setting

2.1. Background

The state of Jammu and Kashmir is situated at a strategic location and is important for bio-geographic, historical and economic reasons. It is at the confluence point of different bio-geographical realms. The state possesses three distinct bio-geographic zones viz., Trans Himalaya (1A), North-west Himalaya (2A) and Semi-arid Plains (4A) (Rodgers & Panwar, 1988). Ecologically this region is of huge importance due to its diverse habitats, which harbour many primitive as well as newly evolved taxa. The State has three distinct regions comprising of Kashmir Valley, Jammu division and Ladakh.

Our study site is located in Kashmir Valley. Kashmir means a desiccated land (from Sanskrit, Ka = water, shimeera = desiccate). According to Kalhana (mid-12th century; http://hinduism.about.com/od/history/a/Kashmir-Paradise-Lost.htm), the writer of one of the best histories of Kashmir, Kasmir was formerly a vast lake. And this lake got drained in the form of Jhelum River by cutting through hills of Pirpanjal near Baramulla (http://en.wikipedia.org/wiki/History_of_Kashmir).

The Kazinag National Park falls under the Kathai Forests within the Baramulla Block. Compartments of the Kathai range, some of which were already a game reserve of the erstwhile Maharaja of Jammu and Kashmir were declared into three protected areas, namely the Lachipora Wildlife Sanctuary, the Limber Wildlife Sanctuary and the Naganari Conservation Reserve in 1987, providing, for the first time in the area, protected refuge for wildlife (Kaul et al., 2014).

The main thrust of the conservation activities of the game reserve under the Maharaja focused around the protection of game by deploying game guards and improvement of habitat by providing adequate water and food during crunch times.
Kaul et al., 2014). Lacchipora Wildlife Sanctuary continued to be with the territorial forest division until 2008 when it was finally transferred to the Department of Wildlife Protection, Jammu and Kashmir and was not managed by the Department of Wildlife Protection. However, Limber was with Wildlife Department and the last management plan was by Baba (2005) for 2006–2010. The three protected areas were merged and upgraded as the Kajinag National Park in 2009.

2.1.1. Location and geography

Kashmir valley lies in the lap of Himalayas with Pirpanjal covering the south to western end and the Greater Himalayas running from the east to north-west (Figure 2.1). Kashmir is located in the North-West Himalayan Biogeographic zone (2A) (Rodgers and Panwar 1988). This study was conducted in Kajinag National Park (NP), situated in the Kajinag Range (34°10'0"N, 74°2'0"E) in northwestern Himalayas, on the north bank of Jhelum River in Baramulla (Figure 2.1). Kajinag occupies the north bank of the River Jhelum in Buniyar close to the international border with Pakistan on the northwestern side and Shamshabari Range (Langate Forest Division area of Kupwara District) to its north.

2.1.2. Geology and soils

This area has been grouped into the Buniyar Group containing Arenite/Quartzite with bands of Gypsum and sulphides. The Buniyar group except for the lowermost limestone areas includes low grade meta segments ranging from phyllites to slates. The Buniyar group is overlain by the Pirpanjal Volcanic Group. This group is characterised by various volcanic flows. The flows are andesitic in composition though basic flows are not uncommon (Zadoo, 1980). The important minerals found in the area are Gypsum, Graphite and Limestone.
2.1.3. Climate and water resources

The pattern of climate in the Himalayas is determined by the summer and winter monsoon system of Asia (Mani, 1981). However, the extra tropical western system (Western Disturbances), which moves in winter over the north of the sub-continent from west to east also play a role. Precipitation is mainly in the form of snow during winter and rains during early spring (March). The climate of the area may be described as Sub-Mediterranean to typically Temperate with higher degrees of variation in precipitation and dryness. Dryness is mainly during June and September to November. The Buniyar region is characterised by severe to moderate cold temperature in winters and moderate temperature in summer. The average annual rainfall is 100.95 mm per year (Anonymous 2013). The maximum temperature in the region goes upto 30°C during summers and the minimum temperature goes below freezing point upto -5°C. In higher elevations, the minimum temperatures can go to -15°C. In the higher regions of the area snow accumulation can reach up to 2 m. The climate of Kajinag National Park (KNP) may be described as sub-Mediterranean to typically temperate. Precipitation is mainly in the form of snow in winter with rains in March with occasional showers during July. Four distinct seasons can be classified during a year, viz., winter (December–February) with very low temperatures and snow covering most of the area, spring (March–May) when temperatures begin to rise and sprouts appears at lower elevations first and gradually move to upper elevations, summer (June–August) when temperatures rise further and the area contains abundant forage and receives some monsoon showers (residual) and autumn (September–November) when senescence sets in plant.

The altitudinal range of Kajinag is between 1,800 m to 4,300 m but our study area was confined approximately between 2,000 m and 4,000 m. The study area is interspersed with rocky cliffs more or less uniformly along the altitude (Figure 2.2). The narrow belt along streams is flatter and is bounded by extensive but steep slopes. Part
of the alpine meadows is rolling but most of the alpine and subalpine areas have steep slopes.

As mentioned above, KNP was one of the important Game Reserves of the Kashmir Maharaja, about 60 years ago. The core area was demarcated with cemented stone pillars, the ruins of which are still found. Interestingly, this core area actually represents the wildlife potential area (Personal Observation). The core area was very stringently protected during those times (interviews with locals) and thus was perhaps less disturbed by migratory livestock and other forms of resource dependence from locals. After independence, however, more migratory herders started using the reserve until the outbreak of insurgency in the early 1990s, when the area was almost abandoned by all except few of the local herders. The area of KNP is about 150 sq km and that of Hirpora WLS is about 340 sq km.
**Figure 2.1** Map shows the part of Pirpanjal and Kajinag Ranges. The Kajinag NP and the Hirpora WLS are marked by red boundary.
Figure 2.2  The distribution of cliffs in Kajinag: a) This was prepared by direct plotting of cliffs on a Survey of India Topographic Sheet and gives an idea of interspersion of cliffs in the landscape of Kajiang, b) this map of cliffs was modelled by showing the steep slopes (>55°) as cliffs.
### Table 2.1
Percentage of terrain type in each of the vegetation types.

<table>
<thead>
<tr>
<th>Terrain type</th>
<th>Alpine-subalpine</th>
<th>Mixed forest</th>
<th>Dense conifer</th>
<th>Forest blank</th>
<th>Subalpine forest</th>
<th>Temperate grassland</th>
<th>Woodland</th>
<th>Open conifer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth</td>
<td>26</td>
<td>47</td>
<td>74</td>
<td>64</td>
<td>28</td>
<td>71</td>
<td>62</td>
<td>20</td>
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<tr>
<td>Bouldary</td>
<td>49</td>
<td>42</td>
<td>17</td>
<td>27</td>
<td>44</td>
<td>18</td>
<td>21</td>
<td>30</td>
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<tr>
<td>Rugged</td>
<td>25</td>
<td>11</td>
<td>9</td>
<td>9</td>
<td>27</td>
<td>11</td>
<td>16</td>
<td>50</td>
</tr>
</tbody>
</table>

2.2. Biodiversity

2.2.1. Flora

Kazinag area is unique in that it has predominantly typical flora of the Kashmir temperate type (Zadoo, 1980). Vegetation in Kajinag is dominated by coniferous forests with deodar *Cedrus deodara* at lower altitudes, fir *Abies pindrow* and spruce *Picea smithiana* at middle to upper elevations and kail *Pinus wallichiana* is distributed along much of the elevational gradient, except the alpine-subalpine areas (Table 2.2). The broad-leaf forests are dominated by birch *Betula utilis*, which occur primarily in the subalpine forests. The other broad-leaf forests include breath (*Prunus cornuta*), maple (*Acer caesium*), which occur in middle elevations and the horse chestnut (*Aesculus indica*) stands that are distributed in lower elevations mainly close to streams. Wild walnut (*Juglans* spp.) is scarce and occurs in the lower elevations. There are grasslands at lower elevations mainly along the western and eastern aspects that I have classified as temperate grasslands.

Plant community structure and composition defines vegetation types or habitat types of an area. Therefore, assessing plant community structure will also help in
understanding the habitat use and distribution of associate ungulate community. I identified about 200 species of plants, which include 150 forb species, 20 monocot species, 20 species of shrubs and 15 species of trees.

2.2.2. Results from cluster analysis for vegetation types

Field methods

The vegetation of Kajinag was stratified into different physiognomic classes based on the reconnaissance survey and the experience after spending few years in the area. These classes include temperate grasslands, temperate scrub, conifer forests, broad-leaved forest, alpine meadows and alpine scrub. About 201 random points were generated on the study area map. These points were searched on the ground with GPS and other landmarks. Circular plots were laid at these random points in order to record the vegetation structure and the species composition in the stratified classes. For assessing herb and shrub cover and composition, 3 m circular plots were laid and percentage cover of all the shrubs and herbs was recorded for all the species. In order to make the estimation more precise, each circular plot was divided into 4 parts and the cover of all herb and grass recorded. Shrubs were counted and the height of dominant shrubs, herbs and monocots was recorded. Trees were counted species wise in the 10 m circular plots and their cover was visually estimated. The unidentified plants were given codes and local names and later identified by the plant taxonomist. For each plot, environmental and other relevant variables were recorded. These variables include elevation, slope, aspect, and distance from cliff, tree cover and livestock grazing. Each plot was marked on the topo-sheet map and the coordinates were also recorded. Grazing/browsing signs were also recorded to assess the palatability of a species. The palatability of different species was also confirmed from the grazers, local experts.

Analysis

We used PCORD software to perform cluster analysis. Vegetation maps were generated using softwares such as Erdas and ArcGIS.
I described different vegetation types, identified by cluster analysis. These vegetation types are:

(i) **Alpine Subalpine**: This vegetation type is at the highest altitude above 3,200 m and is dominated by alpine meadows and alpine scrub. The platable cover is moderate (60-68%). This vegetation type is treeless but has high ground cover (about 70%), dominated by forbs (49%) with a fair amount of monocots (20%) (Table 2.3). The shrub cover is relatively low at c. 11%. The monocots are dominated by *Juncus* spp., *Carex obscura*, *Dactylis glomerata* and *Phalaris* spp. Forbs are dominated by *Tanacetum longifolium*, *Pedicularis pyramidata*, *Potentilla argyrophylla*, *Geranium collinum*, *Jurinea dolomiae*, *Rumex nepalensis*, *Rheum australe*, *Hackelia uncinata*, *Polygonatum* spp., and the shrub layer is dominated by *Juniperus squamata*, *Rosa webbiana*, *Salix flabellaris*, *Lonicera spinosa* and *Lonicera myrtillus*. This vegetation type has relatively moderate diversity. This vegetation type consists of large meadows, interspersed with rocky cliffs.

(ii) **Sub-alpine Forest**: This vegetation type also occurs above 3,100 m and is a transient zone between the lower forested area and the alpine meadows higher up. It thus consists of scrub, trees and meadows. this vegetation type has high palatable colour (70-90%). Tree cover varies from 5-50%, and the main tree species include birch *Betula utilis*, fir *Abies pindrow*, and kail *Pinus wallichiana*. The relatively high ground cover (70%) is dominated by forbs (50%) with some monocot cover (20%). Dominant palatable herbs include *Polygonatum*, *Geranium collinum*, *Jurinia dolomiae*, *Rumex nepalensis*, *Rheum* spp., *Hackelia uncinata*, *Pedicularis pyramidata*, *Potentilla argyrophylla*, *Euphorbia wallichii*, *Artemisia dubia*, *Tanacetum longifolium*, grasses *Juncus* spp., *Carex obscura*, *Dactylis glomerata* and *Phalaris speciosus*. The shrub cover is high (22%) in this vegetation type and the dominant shrubs include *Spiraea canescens*, *Rosa webbiana*, *Salix flabellaris*, *Lonicera spinosa*, *Lonicera myrtillus* and *Juniperus squamata*. This vegetation type has the highest diversity. Sub-alpine vegetation type is dominated by rocky and broken terrain.
Because of the higher altitude, the above two vegetation types have delayed growth, meaning in peak summer when vegetation in lower elevations has become coarse and less nutritious, the ground forage (forbs and grasses) in these areas are at a younger and more nutritious phenologic stage. This is the reason the herders prefer to use these pastures in peak summer (interviews with herders), and temperate wild ungulates also show migration to higher altitudes Schaller, 1977; Mysterud et al., 2001). However, the senescence first starts from the higher altitudes and progresses to lower altitudes. So in autumn, the quality of forage reduces in alpine areas. These higher altitudes also get covered by snow during winter and are buried under deeper snow for most of the winter and early part of spring.

(iii) Mixed Forest: This vegetation type is occurs below 3,200 m and consists of a mix of conifer and broad-leaf trees. The tree cover varies from 10-50%. At middle elevations, the maple, horse chestnut *Aesculus indica*, breath *Prunus cornuta* and birch are the dominant broadleaf trees and the kail, fir are the dominant conifers. At lower elevations horse chestnut is the dominant broadleaf and kail and deodar *Cedrus deodara* are the dominant conifers. The ground cover is dominated by forbs (50%) with a fair percentage of monocots (20%) (Table 2.3). This vegetation type possesses rich, palatable plant community and thus high palatable cover (75-90%). Dominant forbs include *Filipendula vestita*, *Trillidium govanianum*, *Hackelia ucinata*, *Viola odorata*, *Leontopodium alpinum*, *Lepyrodiclis holosteoides* species and dominant monocots include *Poa alpinum*, *Pteridium aquilinum*, *Phalaris*, *Carex obscura*, *Dactylis glomerata*. The dominant shrubs include *Lonicera myrtillus Viburnum cotinifolium*, *Rosa*, *Sorbus cuspidata*. This vegetation type has moderate diversity. The terrain is gentle along the lower elevations where this vegetation type dominates the riverine areas. But at higher elevations it is along steeper slopes and bouldary terrain.

(iv) Forest Blank: This vegetation type occurs between 2,700 and 3,200 and is characterised by openings in the forest patches. Like Temperate grassland, it has less or
no tree cover (0-5%) and edges are marked by trees. It is dominated by forbs (69%) and the monocot cover is less (17%) and has high palatable cover (78-81%) Dominant forbs are Artemisia dubia, Polygonatum spp., Fragaria, Ligularia fischeri, potentilla argyrophilla, Rumex nepalensis and the dominant monocots include Carex, Phalaris speciosus. Shrub cover is relatively low (10%) and is dominated by Rosa, Indigofera heterantha, Spiraea canescens. This vegetation type consists of open areas and the edges surrounded by trees. The terrain is generally smooth but steep slope.
Alpine-subalpine (above 3200 m, occurs along all aspects. This is in summer)

Subalpine forest (above 3200 m, mainly on northern and eastern aspects. This is in early autumn)

Plates: Vegetation Types of the study area Kajinag NP, Jammu and Kashmir.
Mixed forest (2400 m to 3199 m; rarely occur along southern aspects. This is in early autumn)

Forest blank (mainly along southern aspects from 2700 m to 3199 m. This is in summer)
Plates: Vegetation Types of the study area Kajinag NP, Jammu and Kashmir.

Woodland (mainly on southern aspects above 2700 m and below 3199 m. This is early autumn)

Dense conifer (mainly found on northern aspects and gentle slopes. this in summer)

Plates: Vegetation Types of the study area Kajinag NP, Jammu and Kashmir.
(v) Open Conifer: This vegetation type also occurs below 3,200 m and consists of pure, relatively open (6-20%) conifer stands. This type is relatively less rich in palatable cover (62-73%) and the terrain is usually rugged. The ground cover is dominated by forbs (41%) and a fair amount of monocots (27%). The dominant monocots include *Phalaris speciosus*, and the dominant forbs include *Fragaria, Viola odorata, Polygonatum amplexi, Artemisia dubia, Geranium collinum, Rumex nepalensis, Aconogonum alpinum*. The fern species *Pteridium aquilinum* is also found in this vegetation type. The shrubs cover is relatively low (11%) and includes *Indigofera heterantha, Viburnum grandiflorum, Rosa*. This vegetation type mainly occurs at rugged terrain with cliffs and steep terrain. It is moderately diverse.

(vi) Woodland: This vegetation type also occurs below 3,200 m, and is purely conifer with tree cover between 20-40%. It consists of conifer trees with deodar and kail at lower elevations and fir, spruce and kail at higher elevations. The ground cover is more or less equally constituted of monocots (31%) and forb cover (37%) (Table 2.3) and the palatable forage cover is moderate (63-72%). The dominant forbs include *Artemisia dubia, Polygonatum spp., Aconogonum alpinum, Fragaria, Geranium collinum, Picris hieracioides* and the dominant monocots include *Phalaris speciosus, Dactylis glomerata* and the dominant fern is *Pteridium aquilinum*. The shrub cover is around 9% and the dominant shrubs include *Indigofera heterantha, Rosa webbiana, Rubus hoffmeisterianus, Rabdosia rugosa, Spiraea canescens*. This vegetation type is also moderately diverse and occurs mainly along bouldery and broken terrain.

(vii) Dense conifer: This is a pure conifer forest occurring below 3,200 m with relatively dense tree cover (41-80%) but low palatable cover (50-63%). At lower elevations, the dominant trees are the deodar and kail and at higher it fir, spruce and kail. This vegetation type occurs mostly in less steep areas. The ground cover is dominated by forbs (41%) and monocot cover is low (16%). The dominant forbs include *Fragaria, Viola odorata, trul, Polygonatum spp., Hackelia uncinata, Swertia, Valeriana hardwickii, Artemisia*
dubia, Cortusa malthiolii Euphorbia wallichii, Sonchus and the dominant monocots include Phalaris speciosus. The shrub cover is moderate (13%), and the dominant shrubs include Viburnum grandiflorum, Rosa, Berberis angulosa, Lonicera myrtillus, Skimmia anquetilia. The diversity in this vegetation type is high. This vegetation type occurs along less steep slopes with smooth terrain.

(viii) Temperate Grassland: This vegetation type is at the lowest altitude, occurring below 2,600 m. These are open grassy slopes (c. 90% cover) with deodar or kail at the edges (0-10%). The percentage of forb (45%) and grass cover (45%) is equal (Table 2.3), with a rich palatable cover (80-92%). The dominant forbs include Polygonatum spp., Aconogonum alpinum, Fragaria, Saussurea albescens, Tanacetum longifolium, Artemisia dubia, Hackelia uncinata, Heracleum candicans, Polygonatum verticillatum, Scabiosa speciosa and the dominant grasses include Crysopogon spp., Phalaris speciosus, Dactylis glomerata. The shrub cover is sparse (6%) and the dominant shrubs are Indigofera heterantha, Rosa, Lonicera myrtillus, Rabdosia rugosa. This vegetation type is mostly managed by locals who prevent livestock grazing here and harvest the abundant ground forage at the end of growing season to stall feed their livestock during winters. They are important habitats especially for goral during spring and winter. This vegetation type is less diverse. The terrain is smooth, steep with occasional cliffs.
Open conifer  (mainly grow around southern aspect and steep slopes between 2700 m to 3199 m. this in summer)

Temperate grassland (occur mainly along western and eastern slopes below 2700 m)

Plates: Vegetation Types of the study area Kajinag NP, Jammu and Kashmir.
Table 2.2. Cluster analysis based on tree layer, classified vegetation of Kajinag into 6 classes. The numbers under each tree species represent the total number of that tree species present in a particular vegetation types. The dominant tree species will determine the vegetation type.

<table>
<thead>
<tr>
<th>Group</th>
<th>Vegetation types</th>
<th>Birch</th>
<th>Prunus</th>
<th>Deodar</th>
<th>Fir</th>
<th>Horse-chestnut</th>
<th>Kail</th>
<th>Maple</th>
<th>Spruce</th>
<th>Walnut</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Broad leaf (lower)</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>23</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Deodar-spruce</td>
<td>0</td>
<td>0</td>
<td>39</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Mix conifer</td>
<td>1</td>
<td>5</td>
<td>13</td>
<td>41</td>
<td>7</td>
<td>306</td>
<td>0</td>
<td>71</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Birch</td>
<td>135</td>
<td>0</td>
<td>0</td>
<td>22</td>
<td>0</td>
<td>37</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Broad leaf (mid)</td>
<td>5</td>
<td>59</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>37</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>6</td>
<td>Fir-spruce</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>131</td>
<td>0</td>
<td>22</td>
<td>1</td>
<td>16</td>
<td>0</td>
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</tbody>
</table>
Table 2.3. The mean percentage of ground cover (grass and forb) and shrub cover in different vegetation types of Kajinag. These are means of visual estimates of % cover in each plot. The plots were circular with 3 m radius.

<table>
<thead>
<tr>
<th>Vegetation Type (N)</th>
<th>Grass cover (%)</th>
<th>Forb cover (%)</th>
<th>Shrub cover (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpine-subalpine (53)</td>
<td>20</td>
<td>49</td>
<td>11</td>
</tr>
<tr>
<td>Subalpine forest (18)</td>
<td>21</td>
<td>57</td>
<td>22</td>
</tr>
<tr>
<td>Mixed forest (36)</td>
<td>23</td>
<td>57</td>
<td>11</td>
</tr>
<tr>
<td>Forest blank (11)</td>
<td>18</td>
<td>53</td>
<td>10</td>
</tr>
<tr>
<td>Woodland forest (23)</td>
<td>31</td>
<td>37</td>
<td>9</td>
</tr>
<tr>
<td>Dense conifer (23)</td>
<td>16</td>
<td>41</td>
<td>13</td>
</tr>
<tr>
<td>Open conifer (20)</td>
<td>28</td>
<td>41</td>
<td>11</td>
</tr>
<tr>
<td>Temperate grassland (17)</td>
<td>45</td>
<td>45</td>
<td>6</td>
</tr>
</tbody>
</table>
Figure 2.3. Vegetation map shows broad vegetation types in Kajinag and can be related to the vegetation types described in the text above. In this map, the Alpine vegetation corresponds to Alpine-sualpine vegetation type. Mixed woodland corresponds to Subalpine Forest vegetation type at higher elevations (above 3200 m) and to Mixed Forest vegetation type at lower elevations (below 3200 m). Mixed Forest corresponds to Subalpine Forest vegetation type at higher elevations (above 3200 m) and to Mixed Forest vegetation type at lower elevations (below 3200 m). Forest corresponds to Dense Conifer. Grassland corresponds to Temperate grassland at lower elevations (below 2600 m) and to Open Conifer and Forest Blank vegetation type at higher elevations (2601 to 3199 m).
2.2.3. Fauna

The fauna of Jammu and Kashmir is unique and diverse due to its geographical location, allowing for influences of the Tibetan elements mixed with those of the Himalayan and the peninsular Indian elements (Kaul, 2002). However, Kajinag is located in the western part of the state, the Jhelum river gorge allowing for elements from the outer Himalaya access to the valley. Thus this area sees faunal species such as the goral *Nemorhaedus goral* and the recently sighted wild boar *Sus scrofa*. The important large herbivores in Kajinag include markhor *Capra falconeri*, Kashmir musk deer *Moschus cupereus*, goral and wild boar. Markhor is an endangered species and needs immediate conservation intervention as illegal hunting, poorly-planned developmental activities, habitat fragmentation and livestock grazing has led to its precipitous decline (Ranjitsinh *et al.*, 2005; Bhatnagar *et al.*, 2009; Ahmad *et al.*, 2011). Currently, only about 350 individuals are left in a small part of its erstwhile distribution range in India (Ranjitsinh *et al.*, 2005; Bhatnagar *et al.*, 2009). Kashmir musk deer is endangered and poaching and livestock grazing are the main threats. Large carnivores include Himalayan brown bear *Ursus arctos*, Himalayan black bear *Ursus thibetanus*, common leopard *Panthera pardus* and the small carnivores include Yellow-throated marten *Martes flavigula*, leopard cat *Prionailurus bengalensis* and Himalayan Weasel *Mustela sibrica*. Himalayan grey langur *Semnopithecus ajax* and rhesus macaque *Macaca mulatta* are the two primate species found here. The KNP is one of global strongholds for the threatened western tragopan, *Tragopan melanocephalus* and cheer *Catreus wallichii*, which is found only in a few sites in the state (Kaul and Ahmad 2007). The other two pheasants which are common in Kajinag include monal *Lophophorus impejanus* and koklas *Pucrasia macrolopha*. Among the important birds of prey, golden eagle *Aquila chrysaetos* is found in Kajiang besides 10 other raptors species. The bearded vulture *Gypaetus barbatus* and snow cock *Tetraogallus himalayensis*, and snow partridge *Lerwa lerwa* are other important avian species found in Kajinag. Other important bird species
include Kashmir red breasted flycatcher *Ficedula subrubra*, European roller *Coracias garrulus* and Tytler’s leaf warbler *Phylloscopus tytleri*.

**Human society**

The human population of Jammu and Kashmir has risen to 1.25 crores with 56 person/sq.km (www.census2011.co.in). Kashmir valley has a population of 70 lakhs with a density of 341 person/sq.km. Of twelve Scheduled Tribes, Gujjars is the most populous tribe having a population of 763, 806, thus forming 69.1% of the total ST population in Jammu and Kashmir (www.census2011.co.in). Bot is the second major tribe having a population of 96, 698 (8.7%) followed by Bakarwal (60,724) which is 5.5% (www.census2011.co.in).

Gujjars have the highest concentration in Poonch and Rajauri districts, followed by Anantnag, Udhampur and Doda districts. They show short distance migrations generally and are resident in Jammu as well as in Kashmir. However, small populations cross the Pirpanjal during summer. Bakkarwals are stretched in all the three regions, Kashmir, Jammu and Ladakh due to their long distance migrations. Their origin is in Jammu and are mainly from Poonch, Rajourie and Udhampur districts. In summer they mostly move to Kashmir and to few places in Kargil. In Kashmir, they mainly use the pastures in Anantnag, Baramulla, Kupwara, Bandipora, Shopian, Budam, Kulgam and Ganderbal.

**2.3.1. Local population (Pahadis, Gujjars, Kashmiris)**

In Kajinag, as in most other wilderness areas of India, local people are important part of the system with relatively long history of dependency on the resources available in the park. There are about ten villages located in the lower valleys of Kajinag. The local population is dominated by agro-pastoralists belonging to three ethnic groups Gujjars, Pahadis and Kashmiris. Maize is the main crop and rice is cultivated only in a few
villages. Due to the cold weather as well as the soil and topography, crops are grown only in summer in most of the surrounding villages. Rearing livestock is the major source of income in most of the villages. However, walnuts also form a considerable proportion of income and many locals also get good earning from *Morchilla*, a mushroom species, found in Kajinag (Bhatnagar *et al.*, 2007). The resident communities of Kajinag have been extracting resources from the Park for a long time in the form of fuel wood, timber, fodder, vegetables, *gucchi* or morels *Morchella* spp. and medicinal plants. They use relatively lower areas in the forests with gentler slopes because of cattle and buffaloes being the main livestock. Women generally go to forest in the morning to collect fuel wood most of the year except winter. Almost every family has the right to cut grass from the temperate grassland vegetation type in autumn and keep it for the stall feeding in winter.

One more group is of ‘Pohol’ (*shepherd*) who are Kashmiris. Most of the villages have a few families of *Pohol* who take livestock of locals (who do not go to *bahaks*) to summer pastures. In Kajinag we have *Pohol* from other areas (Rafiabad) and only few from Kajinag. Apart from these permanent settlers, the area receives many families of migratory people called *Bakkarwals* who come to graze their livestock (sheep and goats) during summer.

The main ethnic groups and the migratory communities are described briefly below:

**Gujjars:** These are one of the most important communities living adjacent to forests in Kashmir and Jammu region. They are an agro-pastoral community who rear buffaloes and grow maize, beans and potato. But their main income is from livestock and therefore they move to pastures in adjacent forests called *bahaks* during summer along with all their livestock and family and come down only in autumn. Buffaloes provide them milk, and they use and trade milk, butter and ghee, while maize is consumed by the families. The rights on pastures are of a Mohalla or a dynasty who usually go to
bahaks and build small huts together to form small hamlets called dokes, which is economical and secure. These dokes are made of coniferous trees with huge logs supporting the roof. They extract fuel wood to cook their food and for lighting in their huts. The buffaloes are being replaced by cattle, which are easier to rear. Some of the gujjars also keep sheep but sheep are send with the Shepherd or Bakkarwal if more than ten in a family. Gujjars usually use flatter areas where cattle and buffaloes can graze easily. Since they live near the forests and at higher altitudes than other communities in Kashmir, they use traditional bukharis that burns the local fuel wood and heats up the room during cold winters.

In Jammu, many of the gujjars from Poonch and Rajourie move to the southern slopes of Pirpanjal and many families cross the Pirpanjal to use the northern slopes (Ahmad et al., 2011). Gujjars who cross Pirpanjal keep a decent number of sheep (Ahmad et al., 2011). In winter they use warmer areas in Poonch and Rajourie unlike Kashmiri Gujjars.

Pahadis: As the name suggests, this community lives in the mountains. Just like gujjars, they also live near forests and are dependent on forest for fuel wood and fodder. They are agro-pastoralists who rear cattle and sheep and grow maize. But their main income is from livestock as they have little land for maize like the Gujjars. All of them move to summer pastures in the nearby Kajinag, where they have dokes and many families of a Mohalla stay together and graze their livestock together. They also use bukharis to fight the cold in winter. They are now purchasing horses to transport ration to higher posts.

Kashmiris: In Kashmir, the relatively flatter areas (valley) are dominated by this community. But in many places such as Kajinag, they share resources with gujjars. Kashmiris rear cattle and sheep but are slowly reducing the number of livestock. Most of the Kashmiris in Kajinag used to go to bahaks but their number has reduced tremendously. Since most of the Kashmiri families do not move to summer pastures now, the women folk take their cattle to the forest from the morning to late-afternoon
and come back along with some fuel wood while men go for earning from labour. Kashmiris have slightly higher land holdings and in parts of Kajinag, those who own apple orchards, have completely abandoned their dokes.

Pohol (Shepherds): They are professional herders who rear the livestock of others for cash and kind in return. In Kajinag there were few local shepherds who take livestock of locals to middle and subalpine areas. A few of the non-local shepherds but Kashmiris come from beyond the Kajinag ridge (Rafiabad) and use the alpine areas in Kajinag for about two months. They come with large number of sheep (>1000 sheep with each) from Rafiabad. They totally stopped during insurgency but have resumed in the last few year.

2.3.2. Bakkarwals

Bakkarwals are the nomadic pastoralists who come from Jammu region especially from Poonch and Rajourie districts across the Pirpanjal. They have been traditionally taking their livestock in the alpine and subalpine pastures of Kashmir during summer (Rao, 2002). As the name suggests they mainly rear goats. They come with entire families and the ration, camping gear on the horses and dogs to guard their livestock, through different routes, depending on which area they are coming and where in Kashmir they have to go. They have generally their traditional areas designated where they take their livestock every year (Pers. Comm., Rao, 2002)

The migratory Bakkarwals in Kajinag mainly come from District Rajourie, who cross the Pirpanjal and travel about 200 km to reach Kajinag during summer (interviews with bakkarwals). They mainly rear goats, which is their only source of their income. However, the well-off Bakkarwals also own agriculture land and grow maize and wheat in Poonch and Rajourie (Personal observation). Bakkarwals started using Kajinag area since the late 1940s after the closure of the border with Pakistan and some of them only after 1961’s war between India and Pakistan, when the Gurez area was closed for them (Interviews with the Bakkarwals). The Kajinag Bakkarwals initially reared only their goats
and the sheep of some local people from Kajinag. But now they take the sheep from several villages from outside Kajinag and rear them in the Kajinag to earn extra income. The number of livestock that they get from others was most of the time greater than their own stock. *Bakkarwals* therefore bring the largest numbers of livestock in Kajinag and use most of the areas including steep slopes, left by locals. They arrive in early summer (first week of June) when they use lower elevations and move to higher elevations during the peak summer. They begin to come down in early September and leave during the mid-September or end of September. They sell some of the livestock to butchers and other businessmen before they leave. This is also the best time to sell their animals as the animals are healthy with fat coatings after the grazing in subalpine and alpine areas for 3–4 months. During insurgency some of the pastures were closed for the *Bakkarwals* but now they are opened again.

Kajinag thus receives huge number of livestock during summer. Over 15,000 sheep and goats belonging to the nomadic *Bakkarwal* herders and shepherds arrive to graze in the pastures (interviews with herdsmen) while it was approximately 5,000 a decade back. These graziers are accompanied with their dogs to guard the livestock creating huge disturbance. Therefore, during summer, markhor and other two wild ungulates (musk deer and goral), the population of which estimate to about 400 individuals, have to share the resources with about 15,000 livestock. As mentioned Bakkarwals with families and also rear the livestock of others. They have a base camp where the whole family stays (including children, elders) and then they have grazing camps where only 2-3 members stay with livestock. They extract fuel wood and some of them build huts whereas others live in tents.

2.3.3. **Security forces**

Kajinag NP is situated along LoC and due to insurgency activities, the area has been under heavy security cover for last two decades. Therefore, security forces are important stakeholders and can affect any decisions for the conservation and
management of the park. The security forces include mainly the army and the units usually change after 3 years but may continue for five years. Like gujjars and bakkarwals they also occupy some of the higher areas in summer. They have been extracting fuel wood to cook and warm their rooms and timber to build bunkers. Some of the units also cut trees especially wild walnut for making furniture.

2.4. Socioeconomic transformations
The population of Baramulla District has shown an increase of about 20% in last decade (www.census2011.co.in ). However it has decreased as compared to the 1990’s when it increased to about 30% (www.census2011.co.in). During insurgency, many of the locals left the practice of going to dokes/summer pastures. The new generation tried to get into other professions which included govt jobs, daily wagers to nearby towns, act as porters to or use horses to transport the rations to higher army posts. The opportunities through government schemes such as Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) has also helped people in these areas. In few areas where people own apple orchards, they focussed more on this cash crop. However, certain people maintained higher livestock to earn livelihood.

2.5. Threats to biodiversity
The medicinal plants had been extracted on contract until the Kajinag was notified three decades back (Pers. Comm). At some point of time, timber was also extracted from Kajinag (Zadoo, 1980 in Kaul et al., 2014). The locals have been using the resources for longer time than the migratory people. It mainly included fuel wood and fodder. However, there was hunting of wild animals by the locals and to some extent by migratory people before the area was notified as PA (Pers. Comm.). The huge number of livestock is still a threat to the wild herbivores in Kajinag.

Hirpora Wildlife Sanctuary
Hirpora Wildlife Sanctuary is situated in Shopian district of Kashmir, in the Pir Panjal range of the Western Himalayas and covering an area of 340 Km$^2$ (Figure 1.1). It is located between latitude 33° 29’ to 33° 41’ N and longitude 74° 30’E to 74° 43’E and covers an altitudinal range of 2557m to 4745m. The Sanctuary is situated in Shopian district of Jammu and Kashmir, about 70 km south of Srinagar city and 12 km from the district headquarter (Shopian). Hirpora Wildlife Sanctuary got its name from the village Hirpora, a small village that lies on the northeastern outskirts of the protected area.

The trail that is passess thorugh this area has been a traditional route for travelers coming to the Kashmir valley from the plains of India and finds mention in Kalahan’s *Rajtarangini* (11 century AD). It was called the salt road because traders used to enter the valley with salt. This is the same route which was later developed by the Mughals and known as the Mughal Road but was Kaccha trail till recently. The same route has been followed by many migratory bakkarwals and gujjar herders to enter into the valley of Kashmir to graze their livestock in alpine and sublpine pastures during summer This road has however recently ( 5 years back) been constructed and rebuilt into a motorable highway connecting the Kashmir valley with Rajouri and Poonch in the Jammu province.

Hirpora Wildlife Sanctuary is an important habitat for the Markhor, *Capra falconeri falconeri*, in Jammu and Kashmir and indeed in the country, the main population of markhor is distributed mostly across the Pir Panjal and the Kazinag mountain ranges. The Hirpora is contiguus with smaller markhor populations in Kalamund-Tatakut and Khara gali areas of the Pirpanjal Range which makes it strategically more important. The other important fauna that occur in the Wildlife Sanctuary include Himalayan musk deer, Himalayan brown bear, Himalayan black bear, Tibetan Wolf, Himalayan snow cock, Himalayan griffon, bearded vulture.
The area experiences huge grazing pressures during summer season from the domestic sheep, goats and buffaloes owned by nomadic Gujjar and Bakarwal (Ahmad et al., 2011). Being enroute to the valley, the huge number of passing herders also make it as stop over while to and fro migration to valley and back.

Hirpora Wildlife Sanctuary has a mountainous topography with slopes of moderate to steep gradient broken by rocky cliffs. The main river draining the Hirpora catchment is called Rambiara, the sources of which are the twin lakes of Chandansar and Nandansar. Other tributaries that join the Rambir nalla before it hits the valley include Rupri nalla originating from Bhagsar. Other nallas joining the Rambiara include Khushikidar nar, Zaz nar. These nallas are perennial due to high snowfall and presence of several high altitude lakes in the Sanctuary.

The Hirpora Wildlife Sanctuary is predominantly a high altitude area with a majority of the habitat falling within the alpine zone. The subalpine zone is dominated by Juniper (Juniperus communis) with Rosa spp. and Salix spp. The subalpine forest is dominated by birch (Betula utilis). The temperate zone is dominated by moderate to dense coniferous vegetation dominated by kail pine (Pinus wallichiana) and associated with fir and spruce (Picea smithiana).

There are no permanent settlements within the sanctuary but few villages are situated in the adjacent areas. These villages have limited dependence on the sanctuary and its resources. However there are huge settlements of migratory herders inside the sanctuary during summer. These herders with unlimited flocks of sheep and goat graze inside their livestock inside the sanctuary. The migratory herders in subalpine and alpine areas use Junipers for fuel wood. The graziers whose camps are close to the conifer forests use pine and fir.
The recently constructed Mughal Road has fragmented the sanctuary into two parts. The road has also resulted in the destruction of important habitats and disturbance through soil erosion and unregulated traffic.

**Disease outbreaks**

The domestic livestock harbour many of the same parasites and diseases that attack deer and may even introduce other ailments to which the deer are not normally exposed (Whitehead, 1950). Johne's disease affected some sheep in 1977 and a captive Hangul in Dachigam National Park died of the this disease in Dachigam breeding farm (Kurt, 1978). The domestic livestock propobably pose a threat of infection to the wild fauna, especially the markhor, which being a wild goat may be more susciptible. However there have been no incidence of diseases reported so far but there is a need to investigate.
2.6. References


