Chapter 1  General Introduction

1.1 Rationale

An understanding of ecology is important for conservation of a species and its habitat. The important ecological questions can be framed and answered with profound knowledge of the ecology of the species and environment in which it lives. The conservation of nature and natural resources today need to identify essential problems and scientific solution for them.

Katerniaghat Wildlife Sanctuary harbor several taxa of endangered species such as Indian rhinoceros (*Rhinoceros unicornis*), Indian tiger (*Panthera tigris*), Swamp deer (*Cervus duvaucelii*), Gangetic dolphin (*Planista gangeticus*), Gharial (*Gavialis gangeticus*), Swamp francolin (*Francolinus gularis*), Bengal florican (*Houbaropsis bengalensis*), White-rumped vulture (*Gyps bengalensis*) and probably Hispid hare (*Caprolagus hispidus*). The diversity of these endangered taxa in this fragile ecosystem intrigued me to take up a study in this area.

Galliformes are one of India's best known bird groups. The larger species, particularly the pheasants, are well known in India. The family Phasianidae is the largest and has the most varied congregation (Johnsgard 1986) and includes 38 genera, 155 species and 399 taxa distributed all over the world. Out of 51 species of world’s pheasants, 17 occur in India with inadequate ecological information (Fuller & Garson 2000). The Red Junglefowl is a tropical member of the pheasant family. Of all pheasants, the Red Junglefowl stands first in importance to mankind on the earth as all the forms of domestic chicken have originated from this species and this relation of economic utility to man assumes a position of great interest (Beebe 1931). The population of species is declining owing to habitat loss, its degradation and over-hunting for food almost all over its distributional range in India. The species’ range across India is now highly fragmented due to agricultural encroachment and other developmental activities (Kaul & Garson 1993).
A very scanty information is available regarding the population status of Red Junglefowl and also very less is known regarding patterns of habitat use by this species in India. Quantitative surveys of Red Junglefowl population would make a significant contribution towards determining its conservation strategy and help predict possible consequences of the ongoing habitat fragmentation.

It is believed that the genome of Red Junglefowl in India has got affected due to its hybridization with Domestic Chicken (*Gallus domesticus*). However, the level to which contamination of its genome has occurred is not known till date. This is one of the most serious threats to the species pertaining to its long-term survival. The major threat for this species at present is excessive hunting all over its distribution range irrespective of the protection status of forest habitat where it occurs. The quantitative data on this aspect is however, lacking.

The goal of the present study is to examine habitat-wise temporal patterns of distribution and abundance of Red Junglefowl in Katerniaghat Wildlife Sanctuary to plan a long-term conservation and management of the species. This study also examines habitat use by the species in the Sanctuary and discusses conservation implications of the species by using the data generated during the study.

### 1.2 Status, Taxonomy and Distribution

The IUCN Red Data List, 2012 categorized Red Junglefowl as Least Concern (LC) with an extent of its occurrence in about 5,100,000 km² area and it is included under Schedule IV of the Indian Wildlife (Protection) Act, 1972, due to its wider distribution in India. However, Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) has not listed this species in its Appendices. The classification of Red Junglefowl according to del Hoyo *et al.* (2014) is as follow:

- **Kingdom**: Animalia
- **Subkingdom**: Bilateria
- **Phylum**: Chordata
Subphylum  Vertebra
Class       Aves
Order       Galliformes
Family      Phasianidae
Subfamily   Phasianinae
Genus       Gallus
Species     gallus

There are four species of the genus *Gallus* in the order Galliformes, which occur in India, Sri Lanka, Southeast Asia and Indonesia. They are Red Junglefowl, *Gallus gallus*, Sri Lankan Junglefowl, *Gallus lafayettii*, Grey Junglefowl, *Gallus sonneratii* and Green Junglefowl, *Gallus varius*. Red Junglefowl has the maximum number of subspecies and varieties and it also has largest population among all these species.

Carl Linnaeus published his description of Red Junglefowl in the 10th edition of *Systema Naturae* in 1758, as many as five Red Junglefowl subspecies. These have subsequently been described by ornithologist from 1792 to 1928. On account of geographical variations, different nomenclatures of subspecies of the Red Junglefowl have been used by different authors. The Red Junglefowl sub-species are:

- *Gallus gallus bankiva* Temminck, 1813 - inhabits Sumatra, Java and Bali
- *Gallus gallus jabouillei* Delacour & Kinnear, 1928 - inhabits Malay Peninsula
- *Gallus gallus murghi* Robinson & Kloss, 1920 - inhabits India
- *Gallus gallus spadiceus* (Bonnaterre, 1792) - inhabits India and Myanmar
- *Gallus gallus gallus* (Linnaeus, 1758) - inhabits Indo-China, Thailand

The Red Junglefowl is widely distributed and its five subspecies are spread from the Indian subcontinent eastwards across Myanmar, South China, Indonesia to Java (Johnsgard 1986). In India, two sub-species occur, the type specimen, *Gallus gallus*
murghi and *Gallus gallus spadiceus* (Ali & Ripley 1983). While the former is found in the north and central part of India, extending eastwards to Orissa and West Bengal, the latter is confined to the north eastern parts of India (Fernades *et al.* 2007).

### 1.3 Physical characteristics

The Red Junglefowl shows very strong sexual dimorphism. Males have rufous-orange hackles, blackish-brown under parts, rufous wing panel, white tail-base, and long greenish-black, sickle-shaped tail. There is an eclipse plumage, after the summer moult, when the hackles are replaced by short, dark brown feathers, and the central tail feathers are lacking. Females have ‘shawl’ of elongated (edged golden-buff, black centered) feathers, rufous head, and naked reddish face. Immature males are much duller than adult males; hackles are less developed (with black centers); lack elongated central tail feathers. Male’s loud cock-a-doodle-doo is very similar to crowing domestic cockerel; both sexes make cackling and clucking notes (Grimmett *et al.* 2013).

### 1.4 Review of Literature

#### 1.4.1 Habitat

Red Junglefowl is a generalist species and is well adapted to a wide range of habitats such as forests, secondary thickets, woodlands and grasslands in which they wander in small groups of varying numbers of individuals. According to Delacour (1951), the Red Junglefowl (*Gallus gullus*) ranges from north, central and northeast India, extreme southern China, and Southeast Asia; mainly in Sumatra, Java, and Bali. It has been subsequently introduced in many other places also such as Hawaiian Islands, Kauai, Christmas Islands, Vanuatu and the Mariana Islands. Its distribution in the north is limited by the Himalayan Mountain Range (Collias & Collias 1967). Baker (1928) states that this race is not often found above 5000 feet (1524 m) elevation, and in general its range coincides with the Sal (*Shorea robusta*) forest.
Its occupancy of secondary forest habitat over most of its geographic range insures the species as common near villages in the forest, and in this sense such an occurrence can be considered a preadaptation to domestication (Collias & Collias 1967).

Subhani et al. (2010) reported that Red Junglefowl occupied densely vegetated, hilly areas between 350 m and 415 m elevations, especially areas with grassland followed by habitats with Zizyphus mauritiana and Lantana camara as dominant vegetation in Deva Vatala National Park, Azad Jammu and Kashmir, Pakistan. They also found that Red Junglefowl was less tolerant towards human presence and seem to have pushed back into densely vegetated areas of the park mainly to avoid disturbance by local hunters, shepherds and grass cutters. Javed and Rahmani (2000) have studied six habitat types used by Red Junglefowl in Dudhwa Nationa Park, Uttar Pradesh and found its preference for mixed forest and avoidance for teak forest.

In Malaysia, the sub-species of Red Junglefowl (Gallus gallus spadiceus) is widespread up to 1700 m above sea level mainly in drier parts of low land forest and often seen in clear fields, in oil palm, rubber, tea and timber plantations, bamboo groves and small woods near cultivation (Tweedie 1970, Davison 1985, Abdullah & Babjee 1982, Yatim 1992, Arshad & Zakaria 2011). Similarly, Johnson (1963) observed Red Junglefowl in bamboo forest interspersed with patches of small deciduous trees and shrubs in southern and central Thailand.

1.4.2 Population

Population sizes of vertebrate species have declined by 52 percent over the last 40 years between 1970 and 2010 due to overexploitation, habitat degradation, habitat loss and climate change (McLellan et al. 2014). The Red Junglefowl population size has also been affected by this global loss of vertebrate species population. Although, the global population size of Red Junglefowl has not been quantified, but the species is reported to be declining owing to habitat loss and degradation and over-hunting for food (del Hoyo et al. 1994). Some regional estimates have been made across its distributional range by various workers (Sathyakumar et al. 2012, Lalthanzara et al. 2014, Subhani et al. 2010) who also identified various threats to Red Junglefowl
population in their respective study sites. Subhhani et al. (2010) estimated 15.63 birds/km$^2$ as maximum population density in Deva Vatala National Park, Pakistan whereas Arshad (1999) has reported 84.22 birds/km$^2$ as maximum in old palm plantation and of 6.06 birds/km$^2$ as minimum density in rubber plantations in the state of Selangor, Malaysia.

1.4.3 Ranging pattern

The movement and ranging pattern of an animal is a complex relationship of its life history, behaviour, and response to the underlying habitat (Morales & Ellner 2002, Morris 2003, Schick et al. 2008, Kubiczek et al. 2014). Movement through space to acquire essential resource is the basis for long-term survival and reproduction of species. The animals move and use environmental spaces, have an impact on other organisms or resources and thus affect ecosystem processes (Van Bael et al. 2003, Böhm et al. 2011).

In spite of its wider distribution, very little information is available on the ranging pattern and resource selection of Red Junglefowl populations. But radio-telemetry studies have been carried out on Red Junglefowl only in Malaysia (Arshad & Zakaria 2011) and Thailand (Arsirapoj 2008). These studies have revealed important information on ranging pattern, movement and a better understanding of life history strategy in this bird. According to Beebe (1918-22), the home ranges of individual Red Junglefowls were of quite limited size; being sedentary birds they did not incline to wander. However, Arshad and Zakaria (2011) reported that the daily and monthly home range of a male was larger than that of female and also the total daily movement of male was larger in comparison to female. They also calculated the maximum home range size of male and female individuals that were 312.50 ha and 49.07 ha respectively and this variation was attributed to mating strategy of the species, habitat destruction and predator avoidance. No such study was conducted in India till date to asses ranging patterns and territory of Red Junglefowl using radio-telemetry or tagging and banding techniques. However, some attempts were made to accomplish this on Grey Junglefowl (Gallus sonneratii) by Kuttý (2014) using colour bands on two hens in Periyar Tiger Reserve, Thekkady, South India but the birds could not be
sighted after banding. Other pheasant species such as White-crested kalij (*Lophura leucomeleanos*), Satyr tragopan (*Tragopan satyra*), and Western tragopan (*Tragopan melanocephalus*) are well studied in India using radio-telemetry (Sharma 1990, Khaling 1999, Ramesh et al. 2008).

### 1.4.4 Food habits

Food is not always readily available in the forest and its availability fluctuates over space and time. This is an important limiting resource to birds (Scott 2012). The knowledge of feeding habits of birds is thus an important aspect of their effective management. Food habits of pheasants have revealed that they primarily feed on vegetative materials and also consume insects and other invertebrates (Ramesh et al. 1999). Although, India harbor seventeen species of pheasants but research on food habits of different species has not progressed well as compared to other countries (Arsirapoj 2008, Arshad & Zakaria 2000, Collias & Saichuae 1967, Pinthong 2009, Wanghongsa 2009).

Red Junglefowl comes out into the open on forest tracks, firelines, and fields at forest edges during early morning and late afternoon hours to feed (Sathyakumar & Sivakumar 2007). Similarly, Collias & Collias (1967) have observed Red Junglefowl scratching for food in the leaf litter for insects in summer. They have also observed that elephant, buffalo, and cattle dung, which may contain seeds and various insects, probably also provide some source of food to Red Junglefowl during the dry season when the forest floor is often burned in many places, and there is shortage of food in the forest. The Red Junglefowl like other pheasants is omnivorous and consumes a variety of items like grain, weed seeds, berries and other plant matter as well as numerous species of insects and invertebrates (del Hoyo et al. 1994).

Diet composition of Red Junglefowl in Thailand reveled that they mainly depend upon insects, which accounted for 65 - 68 % of their diet, followed by plants (26 - 27%) and mollusks (6 %) (Wanghongsa 2009). However, it is completely different from what has been reported for Red Junglefowl in Malaysia, where major food item of the Red Junglefowl was plant seeds (Arshad et al. 2000). Collias & Saichuae
(1967) and Arsirapoj (2008) reported that Red Junglefowl in Western Thailand were omnivores and can eat both seeds and vertebrates or invertebrates. One study on Red Junglefowl in Khao Ang Rue Nai Wildlife Sanctuary, Chachoengsao Province, in Eastern Thailand has concluded that its food habits may depend upon different food resources available in particular habitat (Krudthong et al. 2012). They have inferred that the Red Junglefowl has a diverse food choice and would likely choose the abundant high quality food items, such as invertebrates.

1.4.5 Breeding biology

In most species of pheasants, the breeding season is distinctly seasonal and it is typically associated with spring months in the temperate regions whereas with wet season in more tropical areas. The social group formed during the non-breeding season gradually gives way to the social organization of the species in the breeding season and egg laying is influenced by environmental factors such as photoperiod, and the duration of sunlight hours per day (Chauhan 2014).

According to Ali and Ripley (1983) the nesting season of the Red Junglefowl in India principally begins from March to May, thus coinciding with the dry season. Collias and Collias (1967) reported the main breeding season of the Red Junglefowl begins from April to June in north-central India in the Siwalik Hills just south of Dehradun. They also found that the Red Junglefowl appears to be polygynous and may be observed early in the breeding season in company of two or more females. However, Wanghongsa and Hayashi (2010) described the breeding season of Red Junglefowl in a Dry Evergreen Forest in Thailand from December to May and the non-breeding season from June to November. Different authors have reported clutch size variation in the Red Junglefowl in different areas. Bump and Bohl (1961) mentioned that the normal clutch size in Red Junglefowl for the first nest is five to seven eggs whereas renests usually have three to four. They reported sixteen nests observed in 1960, and in only three of them, the eggs were destroyed by a predator. The incubation period of the Red Junglefowl has been reported as twenty three days, based on experience with captive birds (Bump 1961). According to Johnsgard (1983) the incubation period of Red Junglefowl was 22 days. The study conducted on breeding biology of Red
Junglefowl by Arshad (1999) in the state of Selangor, Malaysia showed that one male was associated with a single female and rarely with two to four females. He also stated that the Red Junglefowl breeds throughout the year with a peak in December and the mean clutch size was 4.08 eggs. The clutch size of Red Junglefowl in Nepal has been recorded as the same as in the Southeast Asian Red Junglefowl (Nishida et al. 1990).

Birds select nest sites that maximize their reproductive success and provide protection against predation of eggs and nestlings. Safe nesting site also plays an important role for successful survival of chicks. The study on nest site characteristics of Red Jungelfowl in India is anecdotal. Collias and Collias (1967) have described a nest of a Red Junglefowl at the foot of a small rohini (Mallotus philipensis) tree in Dholkhand Rao, Saharanpur Forest Division, Uttar Pradesh. The nest consisted of a slight depression lined with just a few leaves and a couple of small feathers. It also contained two eggs visible against their background because of their uniform whitish coloration. Krudthong et al. (2012) identified nesting sites in Chachoengsao Province, Eastern Thailand and found that nests were located under tree stubs and surrounded by ground vegetation with an average height of 39.8 ± 7.1 cm above ground level, which Red Junglefowl likely uses as shelter. They also reported that nests were oval in shape and bedded with dry leaves. Similarly, nest site characteristics of Red Junglefowl in Datian National Nature Reserve of Hainan Province of China were studied by Yuan et al. (2009) and they recorded sixteen nests at the base of fasciculate grass or stunt bushes, ten of which (62.5%) were embedded in grass, one (6.25%) below bushes, and five (31.3%) were below grass and bushes.

1.4.6 Disease

Red Junglefowl is also vulnerable to a variety of highly contagious diseases which can reduce its populations. As mentioned by various workers, Domestic chickens forage in the peripheral areas of most of the protected areas in India. The species is also prone to different Domestic chicken diseases such as botulism, coccidiosis, owl typhoid, erysipelas, chicken cholera, avian tuberculosis, navel ill, crooked toes (young birds), Newcastle disease, eye infections and worms. Morris (1953) reported that the
Domestic chicken diseases known as ‘Ranikhet disease’ and ‘Chicken cholera’ are endemic in the reserve forests of the Kollegal and North Coimbatore divisions and in parts of the Mysore districts in India. He further confirmed that death of Junglefowls, Partridges, Quails, and Peafowls happens due to Domestic chicken diseases as these wild birds are often seen feeding with Domestic chicken and are bound to catch the latter’s diseases periodically. Bump and Bohl (1961) necropsied five Red Junglefowl and noted New Castle disease, coccidiosis, simple coryza and lice in them. Sathyakumar et al. (2012) recorded observations comprising forty nine minutes (n=10), where Red Junglefowl flocks were in close proximity of Domestic chicken. Domestic chicken may transmit their diseases to the wild birds. According to Kutty (2014), there were cases of Grey Junglefowl mortality in Periyar Tiger Reserve, Thekkady, South India in early 1990’s and the causes of death were unknown but possibility of disease that might have been transmitted by Domestic chicken may not be ruled out.

1.4.7 Threats

Habitat destruction and hunting pressure, either for food, sport or trade in local market, are the major threats to this species, particularly in areas near human habitation. Illegal hunting of Red Junglefowl is reported from protected areas and the surroundings and also from managed forests in the Indian subcontinent (Aiyadurai 2007). Similar kinds of threat have also been reported across its distribution range (Davison et al. 2008, Lim 1992). Internationally, the biggest threat to the Red Junglefowl is genetic hybridization since the species commonly mate with free-ranging Domestic chicken. Red Junglefowl is considered abundant both in captivity and in wild but today this bird is facing extinction in terms of genetic purity leading to an inference that there may not be any pure Red Junglefowl populations in the wild (Peterson & Brisbin 1998). Morejohn (1968) has attributed the loss of eclipse plumage, yellow legs of the Domestic chicken and presence of hen comb in the Red Junglefowl due to dilution of its genes. This genetic pollution is occurring at the edge of forests in bordering villages, where domesticated free ranging chicken are commonly kept. The origin and genetic purity of many Red Junglefowl populations throughout their native range remain unclear even today. Red Junglefowl is always
favoured as a bird for hunting and the species has been introduced into numerous localities and countries (Pyle & Pyle 2009). The species still remains widely distributed and is often considered as locally abundant.

1.5 Objectives

The aims of the present study on Red Junglefowl are:
1. To estimate population size of the Red Junglefowl in different habitats.
2. To study the habitat use pattern of Red Junglefowl.
3. To study nest site selection and preference of Red Junglefowl.
4. To develop prediction model for potential habitat of the Red Junglefowl using site characteristics in the study site.
5. To document the impacts of anthropogenic disturbance on Red Junglefowl.

1.6 Thesis organization

The thesis is structured into eight chapters

Chapter 1 gives introduction to the study and includes the background of this study and its significance. This chapter also describes the study species, the review of literature and the objectives of the study.

Chapter 2 gives descriptive account of the study area, mentioning its topography and vegetation, fauna and the human settlements present within the Sanctuary.

Chapter 3 deals with population size including encounter rates and density of Red Junglefowl in different seasons (post-monsoon, winter, pre-monsoon and summer). The encounter rates and densities are also given for different habitats of Katerniaghat Wildlife Sanctuary.

Chapter 4 describes the habitat use of Red Junglefowl in the study area, which includes habitat use vis-a-vis availability of different habitat types.

Chapter 5 covers nest site selection and preference of Red Junglefowl and prediction of suitable nesting habitat based on known nest locations.
Chapter 6 describes prediction model for suitable habitat of Red Junglefowl in Katerniaghat Wildlife Sanctuary.

Chapter 7 deals with assessment of anthropogenic pressures on Red Junglefowl population and habitat.

Chapter 8 discusses different issues related to conservation of Red Junglefowl in Katerniaghat Wildlife Sanctuary.