1.1. Introduction

Birds are the major components of natural biological diversity. They are warm-blooded animals and have reptilian ancestry. Bird bodies are perfectly adapted for flying mode of life. They have highly developed eyesight and hearing power. They are unable to recognize perfect smell and taste. Birds are useful in various ways either directly or indirectly to mankind by controlling harmful insect pests and cleaning of the biological wastes. They act as pollinating agents and also used as food by man. Their guano is an excellent fertilizer. Avifauna are the good indicators of ecological status of any given habitat (Hosetti and Venkateshwarlu, 2001).

The entire surface of the earth is visited by the birds in view of their aerial flights and variable habitats in search of suitable breeding and feeding grounds. Crop fields, large waterbodies and wetlands which made them eminent to adjust to aquatic habitats. A large number of diverse species of birds depend on waterbodies (Wetland birds).

The feeding and nesting habitat of any species is multidimensional function and it may be divided into several components. The availability of micro and macro fauna as food and the vegetation for nesting activity, that gives species a measure of ecological isolation and enables more than one closely related species to live within a single niche.
Aquatic systems provide plenty of food and shelter for wetland housed and wetland dependent species of birds and also provide suitable habitat for the breeding of resident and migratory species. Their regular movements are governed by the seasons and availability of food. Weaver birds are one such typical group of resident or local migratory birds usually visit wetland vegetation to hang their retort nests during breeding seasons (Sharma, 1995).

Nature has created a number of living beings which are useful to the human race. Birds are one of them. Birds, those winged jewels, have attracted people since antiquity. Free to roam in the atmosphere, they represent the very spirit of wilderness to us. Observing birds has therefore been an enjoyable pastime. There are many things about birds that appeal to people. Among those are their beautiful coloured their plumage welcome springtime songs, their fascinating habits, their strange migrations and apparent freedom to come and go, and the fact that most of them are of economic value to man. It may be said without exaggeration that birds play a vital role in controlling pests and protecting our crops and forests. Biological methods of control of agricultural pests have assumed incalculable importance, as cheapest and probably one of the feasible natural methods. Hence, Michelet, the French writer, once said that, “Birds might live on this planet even if there were no men” they are an integral part of the whole web of life on this
planet. They are needed in the same way as that of soil, plants, animals and air as needed for the sustenance of man (Bilgrami, 1995).

Flight, intelligence, adaptability and sight are some of the attributes that add to the diversity in life of birds and in consequence there is complexity in their overall behavioral pattern (Agarwal et al., 1982). Birds can live in different habitat conditions and have been blessed with plumage cover and flying ability. These are evolved from the reptilian link which is still evidenced in the similarities in terms of scales on the legs of the birds and reptiles. According to Hooksley birds are nothing but highly evolved reptiles (Hosetti, 2002).

At the later development in ecological studies, ‘Ornithology’ gained much importance. It is now considered as a good tool for prediction of the health of an ecosystem. Birds are one of the best groups of biological indicators of environmental quality of any ecosystem. The council of environmental quality (USA) identified birds as the commonly used indicator of environmental degradation. Habitat loss or alteration in the habitat is one among the major cause for environmental changes threatening wildlife with extinction of many species. Most of the avifauna have specific habitat requirements and it varies from season to season, and many species exhibit morphological syndromes for specific habitats and microhabitats, especially on feet, leg, musculature, wing and shape of the bill. Thus, the conservation value of habitat could be addressed by the presence of
variety of avifauna in an area. Ali (1956) reported that the studies on the ecology as well as ethology of birds in different habitats in relation to avifauna would give valuable clue for forest management too.

The population measurements of a bird species or a group of species will help in an area, regarding information about the species and the quality of the environmental studies on avian community and breeding seasonality. These have been found to be effective tools in monitoring an ecosystem (Hosetti and Arvind Kumar, 2001). Avian ecologists have attempted to define bird communities in relation to density of plant communities where they occur. Primarily, vegetation determines the distribution and abundance of most terrestrial birds. Other factors, such as food availability, predators and parasites also play a vital role in determining the distribution and abundance (Vladimir and Karels, 1999).

1.1.1. Weaver birds

Different kinds of weaver birds are grouped together in Family Ploceidae, which include 720 species of weaverbirds distributed throughout the world (Hvrs, 1964). The weaver birds of world may be grouped into five sub-groups viz., i. Sparrows, ii. Whydahs, iii. True weavers, iv. Buffalo weavers and v. Wax bills.
The systematic position of weaver birds of India is as follows.

Kingdom : Animalia  
Phylum : Chordata  
Sub phylum : Vertebrata  
Sub division : Gnathostomata  
Super class : Tetrapoda  
Class : Aves  
Sub class : Neornithes  
Super order : Carinatae  
Order : Passeriformes  
Family : Ploceidae  
Sub family : Ploceinae  
Genus : Ploceus  
Species : Philippinus, benghalensis, manyar and megarhynchus

More than 117 species of true weaver birds are known to occur in the world. Most of them confined to Africa (Davis, 1973; Silbey and Monroe, 1990) and India possesses only four of them and they are mentioned below.

1  
*Ploceus philippinus* (L). Common baya / Indian baya  
2  
*Ploceus benghalensis* (L). Black throated weaver bird  
3  
*Ploceus manyar* (L). Streaked bird / Indian striated weaver bird  
4  
*Ploceus megarhynchus* (L). Finn’s baya
Weaver birds were chosen for intensive field study on account of the interesting facts revealed by the previous workers concerning their life history, and desirability of obtaining more detailed and statistical data about various aspects. The baya is a sparrow like bird that moves about the cultivated lands in small parties and flocks of 100-200 individuals during non-breeding season, but sometime, there may be an enormous concentration of several hundred individuals, coming from all directions and roost mostly in the paddy and sugarcane fields. Bayas are non-migratory species, observed throughout the year to reside in one place, however they also move in search of food across crop lands.

The nests of baya are easily located as they are large and conspicuous. In the study area, the most accessible nest colonies were around the paddy field, channels, and sloppy areas. Being a gregarious species, a flock can easily be located from a considerable distance. The species is sexually dimorphic during breeding season, and the sexes are then easily identifiable. An added advantage is that in the breeding season the adult males can be readily distinguished from young males in having breeding dress. The young male are without yellow crown and yellow colour on the chest and look like females. The yearling assume breeding plumage only during second year. Moreover, these young males live separately from the breeding colonies.

An additional reason for studying the breeding biology of the weaverbirds is on account of the damage they cause to cereal crops. Although the baya is not
such a serious agricultural pest, yet it causes considerable local damage particularly to jowar, paddy and sugarcane, the most important food crops in the area. It is therefore, important from the economic standpoint to obtain a proper idea of its population dynamics and ecology.

1.1.2. Details about Baya species

a. *Ploceus philippinus* L.

Field characters

Male

Breeding plumage yellow, crown yellow, rest of upper parts dark brown streaked with yellow chest. Below, throat and ear-coverts dark brown, breast yellow, belly cream-buff [Plate 1.1(1)]. Non-breeding plumage is similar to female but darker, more boldly streaked above, supercillium and breast more pale yellow rather than buff yellow.

Female

Distribution

Throughout India, Bangladesh, Pakistan and Sri Lanka. These are residents and local migrants. Three races are recognized based on size and details of colouration.

Habits

Flocks of considerable size, found in the paddy fields and other croplands. Occasionally these cause damages to ripening crops. Roosts in enormous numbers in reed-beds bordering tanks, etc. The seasonal and local movements are largely governed by paddy and cereal cultivation which provide both nesting and feeding sources. These birds are also found to feed on insects and wild grass seeds.

Call

A sparrow like chit-chit-chit more loudly during cool hours of the day. In breeding season males follow up these by a long drawn joyous chee-ee uttered in chorus, accompanied by flapping of wings while weaving their nests in a colony.

Nest

A swinging retort shaped structure with long vertical entrance tube, compactly woven by strips of paddy, bamboo, coconut, arecanut and rough-edged grasses, suspended in clusters from twigs usually over water. Blobs of mud collected when wet, are stuck inside the dome near the egg chamber, eggs 2 or 3 pure white. Male alone fabricates the nest and female alone incubates the eggs. Each male builds 3-4 nests in a season and female also pairs 3-4 times in a season.
b. *Ploceus benghalensis* L.

**Field characters**

The male in breeding plumage has brilliant golden yellow crown, white throat and a black band separating it from the fulvous-white under parts. During non-breeding season male and female possess crown with light browned in colour like rest of upper plumage, black pectoral band less developed. A prominent supercillium, a spot behind ear and narrow, moustachial streaks yellow. Flocks found around cultivated crops, reedy margins of tanks and extensive tall grass areas.

**Distribution**

Polygynous, colonial, on the whole similar to those common baya and streaked weavers. During courtship male bows low before visiting female, presenting golden crown at her. Flaps wings deliberately and sings softly tsi-tsisik-tsisik, tsik like chirp of cricket or subdued sound of uncoiled bicycle wheel.

**Nesting season** - June to November (Depends on start of monsoon season).

**Nest**

Similar to the streaked bayas, somewhat smaller and normally with short entrance tube. Built in reed-beds, sugarcane field and marsh with some of the growing needs incorporated into the dome as to support singly or in scattered groups of 4-5, sometimes large colonies. Eggs are 3-4, white indistinguishable from those of other two weavers.
c. *Ploceus manyar* L.

**Field characters**

Differs from the baya in having the breast fulvous, boldly streaked with black in both sexes and at all season. Crown of head in breeding males yellow, in females it is brown. Flocks in swampy tall reed-beds of *Ipomea aquatica*.

**Distribution**

India, Bangladesh, Pakistan, Sri Lanka etc.

**Habits**

Similar to the common baya’s except that it is more inclined to tall coarse grassland and swampy reedy tank margins. In addition to the normal chit-chit-chit, the breeding male has pretty song ti li lili, tililee-kititi lileekiti, etc., utter in courtship chase and in invitation to a female to an available nest.

**Nesting**

**Season**: February to September, varying with local monsoon conditions. Nests similar to baya’s but not so free for swinging. Usually smaller and short entrance tube. Attached directly to tips of several arching bulrush or grass blades or some emergent aquatic plants. The nest is smallest among the three species noticed in south India. Small in marshy reed-beds. Eggs 2-4 pure white.

d. *Ploceus megarhynchus* L.

**Field character**

Adult male in breeding plumage with head and nape bright yellow having brown ear-coverts. Back dark brown streaked. Rump yellow, below bright golden yellow. Female possesses head and nape pale canary or brown heavily
diffused yellow or fulvous white. First year breeding males similarly coloured. In non-breeding plumage, sexes alike and difficult to separate from common baya.

**Distribution**

Resident in the Kumaon terai and West Bengal. Constructs nests in marshes with extensive strands of *Imperata* and *Saccharum* grasses sparsely dotted with silk cotton trees. It is absent in south Indian states.

**Habits**

Gregarious at all time moving in flocks in the grassland.

**Food**

Rice and other grains. Nestlings feed on insects.

**Call**

Louder and harsher than that of the common baya. A high-pitched alarm note. Male song rendered as wit-t.t-trr wheeze whee. These sing in chorus.

**Nesting**

The nesting season is May to September. Nest built in colonies on tree tops 9 to 10 m above the ground level or in marshy reed beds. Unlike other weavers nest is supported, not suspended and made by coarse grass. Males have an elaborate wing beating display. Eggs 2-3 white, male is polygynous. Both sexes participate in feeding the young ones.
1.2. Review of Literature

The field of ornithology was established on scientific lines from the year 1861 onwards. In that year, Paleontologists discovered the Archaeopteryx, the first bird like fossil with reptilian features. For a long time, paleontologists viewed the Jurassic period as the period of feathered dinosaurs. Archaeopteryx as unquestionably the first bird to flap its wings in the sky. To scientists of that period, in particular to Charles Darwin, these findings of semi-reptilian birds represented the evolutionary links in the primitive reptiles to the class Aves. Gerhard Heilmann in 1925 published the book, ‘The Origin of Birds’. Later, Hugh Whistler published ‘Popular Handbook of Indian birds’ in 1928. In 1941, BNHS (Bombay National History Society) published ‘The Book of Indian Birds’ by Salim Ali.


Further investigation on the bird sanctuaries include those of Neginhal (1971) who discussed about the breeding, migration and present status of the bird sanctuaries in India. Trevor Prince and Nitin Jamdar (1991) reported on breeding biology of the yellow crowned leaf warbler; Raghunatha et al. (1992)
and Hosetti et al. (2001) carried out preliminary survey of Gudavi Bird Sanctuary and investigated the present status of avifauna.


The other contributors to the field of ornithology includes Khader (1995) on flora and fauna of Karnataka who pointed out the distribution of birds in deciduous forests.


Several short-term studies have been conducted on weaverbirds. Blyth described the weaverbirds nest and gave description of the habitats of the three Indian species, Ploceus philippinus, Ploceus manyar and Ploceus benghalensis. But the first detailed description of the nest of the common weaver bird Ploceus philippinus and a suggestion of the probable use of the transverse loop in the nest was given by Jerdon (1863).
Horne (1869) published the first photograph of a baya colony in the proceeding of the Zoological Society of London. Diwar (1909) published an original paper in the Journal of the Bombay natural history society (BNHS). He recorded some details of how the birds collect nesting material and observed that the cocks took the lion’s share in nest building. The scientific study regarding some of the aspects of the breeding biology of the baya weaverbird was furnished by Salim Ali (1931). He tried to solve some of the much-debated problems regarding the breeding habits.

The facts he brought to light are the common baya weaver is polygynous in habit, not in the ordinary sense but in a manner of its own. The male builds usually one nest at a time and as soon as the nest is occupied by a female, the male goes on to construct a second nest near by, which is again occupied by a second female in due course. Ali conclusively reported that, the male alone constructs a nest and the female alone incubate the eggs (Sharma, 1995).

To understand the building technique, and to test the intelligence of the weaver bird, experiments were carried out by mutilation of the nests such as cutting windows of various shapes and sizes in the fabric. After observing the method of repair in the different cases, it was confirmed that the male alone could repair the nests. The female was helpless under such situation (Sharma, 1995).

Crook (1960) studied the behavioural aspects of courtship of baya weaverbird. He further classified the breeding habitat and discussed the survival value of colony visited. Mathew (1976) described the feeding habits of baya, *Ploceus philippinus* with particular reference to paddy crop in Cuddapah district of Andhra Pradesh. Mukerjee and Saha (1974) gave a qualitative analysis of gut contents of *Ploceus Philippinus* in West Bengal and Orissa, In Jallundar (Punjab) about 98% of the diet of *Ploceus philippinus, Ploceus benghalensis* and *Ploceus manyar* was plant matter, the rest was animal matter. George (1974) observed adult *Ploceus philippinus* feeding on small frogs. Hamid et al. (1978) is of the opinion that the diet of adult weaver bird consisted mainly of paddy.

Dhindsa and Toor (1980) have opined that damage to paddy nurseries by weaver birds can be minimized by sowing the seeds treated with 0.5% methiocarb, a bird repellent. The nest building by a baya is so skilled and powerful that even heavy showers will not damage them (Pittie, 1996). Raghupathy and Davis (1984) have described nest parasites and nest users. Bayas are significant birds of Indian
ornithology known for their skill of constructing special type of nests. Hence these are also called as architects of avian world.

A typical completed nest of *Ploceus philippinus* is a bottle shaped structure can be divided into three parts, stalk, body and entrance tube (Ambedkar, 1964a,b; Crock, 1964a,b; Sharma, 1985; Davis, 1985; Jesse, 1897). The baya construct hanging nest on a variety of supporting trees and objects in various protected areas (Hosetti, 2003). Various aspects of the behavioural ecology of the common weaver bird *Ploceus philippinus* was studied (Dewar, 1909; Ali and Ambedkar, 1956, Jerdon, 1963; Ali and Ripley 1974; Mathew, 1976; Mukherjee and Saha, 1975; Ferguson and Siegfried, 1989; Sibley and Monroe, 1990; Meek and Barclay, 1996; Cundall and Greene, 2000).

It is observed that the baya birds always built their nests in colonies and the nests are hanged to tips of twigs (or) even to telephone and electric wire passing through sugar cane fields [Plate 1.1 (3)]. However, detailed information on the ecology and biology of this species is still lacking. Absolutely no attempts were made to study these birds in Karnataka. Therefore, the baya weaver is selected for the intensive field study. It is also an agricultural pest particularly to paddy crops, and hence it is important to study ecology and the population dynamics in the mid Western Ghat area of Karnataka State.
1.3. Study Area

*Ploceus philippinus* is a typical bird of open cultivated country partial to jowar and paddy crops. The foothill of Western Ghats of Shimoga, where the major study was carried out, is a typical suitable habitat of baya weaver birds.

The study area is located in the vicinity of foothills of Western Ghats, at a height of 1050 meters above the sea level. The study area is a part of malnad (Heavy rainfall receiving area) located in the mid Western Ghats of Karnataka range. The crops of the area include paddy, ragi, sugarcane, jowar and plantation crops. Paddy is grown twice annually and the area is rich in water sources (irrigated) and vegetation. Perhaps due to the availability of plenty of water, food source, protection and suitable habitat conditions, various members of Plocinae have inhabited this area. For the convenience, the study area was divided into three imaginary zones, considering B.R. Project as its center. The three zones spread in north (Zone-1 : Chikmagalur), north-east (Zone-II : Davangere) and south-west (Zone III : Shimoga) each about 60 km\(^2\) area (Maps 1 to 3).

**Topography**

The topography of the area is 13°42'00" North longitude and 75°38'20" East latitude.
Climate

The climate is warm tropical type and the region experiences light variation in agroclimatic conditions. The temperature fluctuates from 9°C to 42°C during the winter and summer months respectively. The climate of the area represents typical monsoons. They are as follows,

- **Spring**: February, March
- **Summer**: April, May, June
- **Autumn**: July, August, September and October
- **Winter**: November, December, and January

Shimoga area receives most of its rainfall from south-east monsoon and it prevails from the end of June to September or at times upto October end.

Temperature

The minimum temperature during January 2001 to July 2005 was 9°C in December 2002 and maximum temperature was 42.5°C in May 2002 (Table 1.1).

Rainfall

The rainfall was comparatively high during 2002 to 2005 than in the other consecutive years of the study. Though the number of rainy days was high in 2002 and 2004, the amount of rainfall received was low and both the years were observed as drought years. The month of maximum rainfall differed considerably. It was July in 2002, September in 2002, 2003, 2004 and 2005 respectively (Table 1.2).
Table 1.1. Mean, maximum and minimum temperature (°C) recorded during 2001 to 2005

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Table 1.2. Monthly average rainfall (in mm) during 2001 to 2005

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<td>March</td>
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<td>-</td>
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<tr>
<td>April</td>
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<td>25</td>
<td>138.4</td>
<td>20.2</td>
<td>59.2</td>
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<tr>
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<td>19.2</td>
<td>11.4</td>
<td>19.2</td>
<td>120</td>
<td></td>
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<tr>
<td>June</td>
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<td>97.4</td>
<td>87.6</td>
<td>100.4</td>
<td>71.2</td>
</tr>
<tr>
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<td>87.4</td>
<td>288.9</td>
<td>87.4</td>
<td>131</td>
<td>158</td>
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<tr>
<td>August</td>
<td>150.6</td>
<td>238.5</td>
<td>118.6</td>
<td>218.8</td>
<td>83.8</td>
</tr>
<tr>
<td>September</td>
<td>130</td>
<td>118.4</td>
<td>130.2</td>
<td>180.6</td>
<td>41.4</td>
</tr>
<tr>
<td>October</td>
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<td>112.8</td>
<td>39.8</td>
<td>48</td>
<td>346.2</td>
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<tr>
<td>November</td>
<td>18.8</td>
<td>12</td>
<td>13.8</td>
<td>32</td>
<td>0.8</td>
</tr>
<tr>
<td>December</td>
<td>-</td>
<td>1.6</td>
<td>-</td>
<td>1.2</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>533.1</td>
<td>906</td>
<td>635</td>
<td>862.6</td>
<td>824.6</td>
</tr>
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</table>

'-' indicates no rainfall
1.4. Methodology

Birds are perhaps the easiest of animals to enumerate. They are often brightly coloured, relatively easy to see, and highly vocal. They are also very popular to study, often give away their presence vocally and their calls and songs help to detect many species of birds. There’re, however, some potential pitfalls in birds song as a census tool.

In the present study, the fieldwork consisted of direct observation (direct count method) of birds in the open and hide situations (Colin et al., 1993). During field survey, the exact location of nesting activity of *Ploceus philippinus* and *Ploceus benghalensis* was detected by following their calls and songs. Some time also taken the help by farmers and localities to locate their nesting places. The nest built on tall plants and in remote places were observed from distance with binoculars.

**Routine visits**

The nest building behaviour of active pair of birds were studied by monitoring the nest from early morning and late evening for five to six consecutive days. Nidification activities such as the number of hours of labour for nest construction, the amount of nesting materials collected during the busy hours of nidification, average time spent in gathering nest materials for nest building,
average time taken to carry the nesting materials from its source to the nest, nest inspection and rearrangement activities by nest occupants were recorded to determine the role of both sexes in nesting activities.

All the colonies were visited early in the morning usually at about 7.00 a.m. to know the early movements of the birds from the selected colonies. The completed (selected) nests in such colonies were examined daily in order to study the weight of the fresh eggs, weight of young chicks, their growth rate and so on. Selected colonies were visited at every one hour interval from 6.30 a.m. to 6.30 p.m. for one week continuously to study the laying pattern.

This work was carried out during the peak period of egg laying. The nests were photographed and those, which remain beyond our reach, their sketch was made on the paper and utilized for the study. The orientation of hanging nests was also recorded in diverse types of habitats. Abnormal and partially built nests were collected at the end of the monsoon rain when the breeding activity of weaver birds came to end. All types of nests were collected after completion of breeding season with the help of a hookstick. The internal structure of the nests was examined by bisecting the nests at different planes with scissors (Plate 1.1 (4)). The host plants preferred by the weaver bird, *Ploceus philippinus* were also identified according to the Keys described by Gamble (1935) and Saldana (1995).
The data of nest population with respect to the plant species was subjected to statistical evaluation of percent frequency and density by following the procedure of Raunkair (1934).

During our surveys some samples of adults, sub adults and nestlings were collected, from the study area for their stomach contents analysis. Samples were collected one hour later in the morning and one hour earlier in the evening. Adults and sub-adults were collected while they were busy in feeding on ground. Nestling birds were collected from brooding chamber of nests. Live birds were killed by chloroform or benzene in air-tight polythene bags. Birds were dissected and opened for estimating gut-contents and analyzed by gravimetric method of Mukharjee (1969). This comprised crushing of contents in water, semi drying on blotting paper, exposing in air for about half an hour, weighing, finally fixing in 90% alcohol and transferring to 70% alcohol after 24 hours for laboratory analysis. The contents were separated out into inorganic and organic groups; the latter was further separated into vegetative and animal matters. Each item of food was weighed after drying in air for about 50 minutes. For determination of items, samples were compared with the items in field, from where the birds were captured. Identification of the gut contents was confirmed by specialists.
1.5. Scope of the Work

Weaver bird was chosen for intensive field study on account of the interesting facts revealed by the previous research’s concerning to its life history and the desirability of obtaining more detailed and statistical data about various aspects. The previous research work on the breeding biology of the baya weaverbird is traced back from 1931 to 1970. It is also an agricultural pest particularly to paddy and jowar crops and hence it is important to study ecology and the population dynamics of the species.

This thesis contains five sections. Section-I includes, introduction, review of literature, study area, methodology and scope. Section-II deals with the survey of weaver birds, ecology of *Ploceus philippinus*, sequential settlement by nesting male and female *Ploceus philippinus*, analysis of nest building of *Ploceus philippinus*, abnormal nesting and orientation of nests. In section-III, host plant selection, effect of drought on nesting activity, status of weaver birds in agriculture and nest associates and destructors were studied in detail. Section-IV provides summary and conclusion. Section-V contains references.
Map 1. Chickmagalur District (Zone-I)
Map 2. Davangere district (Zone-II)
Map 3. Shimoga district (Zone-III)
1. Male weaver bird, *Ploceus philippinus* with breeding plumage

2. Female weaver bird, *Ploceus philippinus* with breeding plumage

3. *Ploceus philippinus* constructs the nest on electric wire

4. L.S. of nest showing deposition of egg chamber with cotton hairs etc.