

# 1. INTRODUCTION

## 1.1 Background

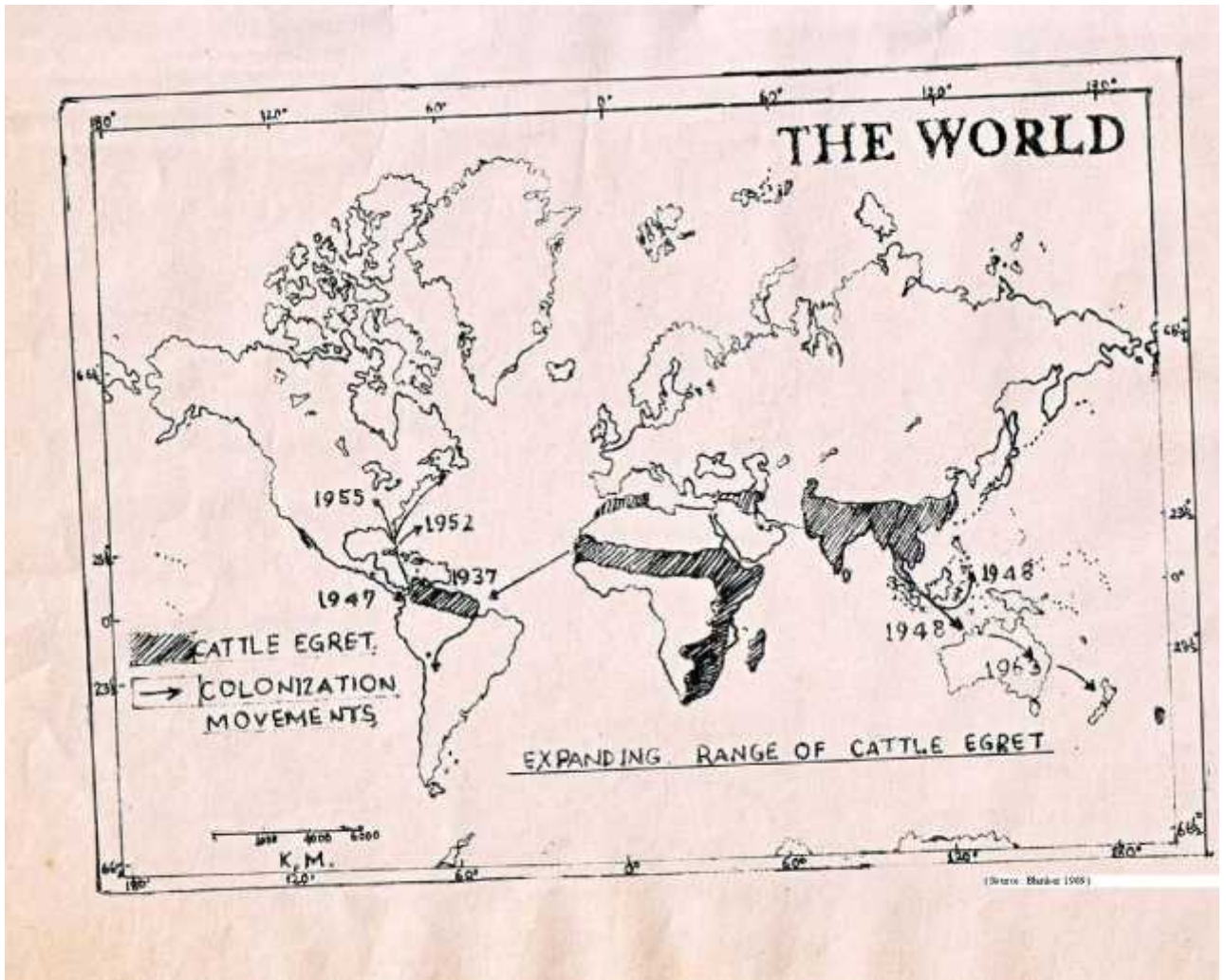
The egrets do not constitute a natural group and the name is applied loosely to many herons of the Tribe Ardeini (Grizmek 1972). The member of the genus *Bubulcus* as *Bubulcus ibis* is Cattle Egret.

The cattle egret is known as Gai-Bakulo, in Nepali as it is seen walking along with grazing cattle. All egrets are long legged, long necked, long billed birds with broad rounded wings and comparatively short tail (Ali 1964). Head is completely feathered but cannot use their long legs for swift running.

There is some difference in the taxonomy in the literature. Linnaeus named this bird as *Ardea ibis* Linn (1785), Boddaert (1783) named this bird as *Cancirina cirinabde* and Blenf & Cates named it as *Bubulcus cormandus* (Baker 1929). Fossils records of Egrets and Herons have been found dating from transitional period between the Eocene and Oligocene about 40 million years ago (Grizmek 1972).

The distribution of Cattle Egret is quite interesting and gives an excellent example of an animal extending its range naturally. With the increase in the number of cattle, the number of cattle egrets in the whole world increases from 695 million in 1939 to 800 million in 1953. For Africa alone, it increased form 80 million to 95 million. The number of its descendents evidently increased faster than the number of cattle or its food supply. So the cattle egrets were forced to enlarge its African range in all directions. Therefore, it is now only absent in true deserts and high mountains (Grizmek 1972).

With the increase in population even the gigantic African Continent become small, so about 44 years ago these birds crossed Atlantic and reached South Africa. For South America, they were first reported in 1937. They were able to occupy extensive area of Northern South America as well as Central and North America in only three decades). Wandering Northward through the west a small flock established in Florida in early 1950's and nested successfully on islets in Lake Okeechobee (Austin 1966).



Copyright: Subedi 1996

Cattle egrets are also reported from many parts of Canada, Trinidad, West Indies, Australia and New Zealand. In Australia, it reached naturally as well as it has been introduced artificially and both groups successfully bred (Grismek 1972). One of the major factors is its adaptability with such an ability of expanding its range. The Cattle egrets have not expanded surprising further in Europe (Grismek 1972). In Asia, it is found in Nepal, India, Pakistan, Srilanka, Bangladesh, Burma, Ceylon, Malaysia, Indonesia, Japan, China, Brunei, Philippines, Thailand, Maldives, Iran, Ceylon, and Philippines etc as resident migrants or on passage (Salim and Ripley 1968, Baker 1929). It is found as far as Southern Spain but much more commonly in Morocco, where it is seen in the field everywhere in the winter, generally in sizeable groups. They show a preference for walking among grazing cattles; often sitting on their backs in order to catch insects and larvae. They are often seen in ploughed and cultivated lands. It is understandable that this bird which is beneficial to cattle and man is not harmful so protected where ever possible.

*Bubulcus ibis cormandus* (Bonaparte) is the name of the race of cattle egret that is found in Nepal (Bhattarai 1889). The length of the bird i.e. from tips of the bill to the end the tail of about 50cm (20 inches) in average; though in comparison with other egrets it has shorter legs and bills (Fleming & Fleming 1976).

The cattle egrets are social, gregarious and very tame bird. The cattle egrets remain in flocks through out year, while other egrets remain solitary in no breeding season. It feeds on dry lands and usually feeds on insects, worms in grasslands and rarely seen to catch fishes (Subedi 1982).

These birds also accompany large wild animals such as elephants and wild buffaloes etc, warning them of approaching danger by taking flight (Donald & King 1974). Occasionally, it accompanies crocodiles, apparently picks leeches or other parasites of them, and some times feeds on small fishes, tadpoles and aquatic insects (Fletcher and Inglis 1936). They also consort freely with vultures at Slaughterhouses and animal carcass dump on outskirts of towns for the flies and maggots, these unsavory places provide (Ali & Ripley 1968).

It has a curious technique of fixing the insects with a stony stare, the neck being briggled from side to side for a brief moment or two (much as a cat will loosen up its

muscles before making rush) and then darting out its beak in a lightning job to seize the morsel, a technique used by some other egrets and herons (Subedi 1982).

Cattle egrets swallow their prey whole and digest almost completely (Subedi 1982). Their stuff depends upon the availability of food. Cattle egrets are beneficial as they feed mostly on insects those are harmful and injurious to crops and cattle (Fletcher and Inglis 1936).

Cattle egrets share their roosting trees with other egrets, herons, cormorants, crows, mynas etc to which they return evening flying a more or less disorderly rabble (U shaped) in the char, a heron style neck folded back (Ali 1964). The head haunched between the shoulders and legs tacked under tail projecting behind like a rudder (Ali & Ripley 1968, Fleming and Fleming 1976).

Breeding season mainly from March to August (Bhattarai 1998). The breeding time is influenced by arrival of monsoon season. With the alter of rainfall, the breeding period is also altered (Kumar 1991). The loss of egg and hatchlings are due to the attacks from crows (Mckilligan 1997), while the cases was not observed in Keshar Mahal (Bhattarai 1998).

Average clutch size is 3-5 eggs but some times up to 6 to or even 7 has been recorded with a average size of 44.1 x 33.6 mm which is broad ovals, very pale sea green, almost white or skin milk blue (Baker 1929). Average clutch size was 3.2 in 10 nests at Keshar Mahal. (Bhattarai 1989). At Keshar Mahal the success rate of incubation was 95.8% (Bhattarai 1989), while the rate was 94.4% in Paifang Island (Wen and Ru 1993). The mortality rate was 14.34% in Keshar Mahal (Bhattarai 1998), while it was 34% (Mckilligan 1987). It was finally concluded that the high mortality rate was due to the pathogenicity of ticks, starvation of nestling and predation of crows. Total number of nests counted in Keshar Mahal was 537 in 1995, 643 in 2001 and 597 in 2002 (King 2002).

## 1.2 Statement of the Problems

Among the birds found in Nepal Cattle Egret (*Bubulcus ibis*) is the commonest bird. Only few workers have studied on this species. Studies on Cattle Egret were conducted in Keshar Mahal by some researchers King (2002) and Bhattarai (1998). And study on feeding ecology of cattle egret is carried out by Subedi (1982). But intensive a study focusing on Cattle egret in Kathmandu valley was not conducted. A study on the distribution pattern and the species of tree preferred by the cattle egret for roosting and nesting is essential. The estimation of the population status and its distribution in the valley is the main work as it is the indicator species of urban area.

## 1.3. Objectives

The major objective of the study were to-

- Determine distribution pattern of cattle egrets in the valley.
- Determine population status of cattle egret in the valley.
- Identify the trees species preferred for roosting and nesting.

## 1.4 Rationale

The rationale of the present study has tried to determine the distribution pattern and population status of cattle egret in Kathmandu valley. This study is important for the identification of tree species preferred for roosting and nesting purpose.

Economically cattle egrets are very important, they directly benefits farmer feeding mainly on harmful pests. The beautiful birds feeding in the greed meadow provide high scenic value as well as they represent the indicator of good sanitary in urban environment.

Hence, the study provides boarder concepts regarding the environmental of Kathmandu valley. The research findings can be used for the conservation of the habitat of cattle egret. The study also provides reference for further research.

## **1.5 Limitation**

Since the study was carried out in the capital city of Nepal, although following were the limitation during the study.

- i. The political situation at that time was worse due to which the places like Sundarijal army camp and Keshar Mahal were considered as sensitive area where I was not allowed to visit the area frequently. Due to which the study on breeding success was not conducted.
- ii. Lack of sufficient study materials in the current topic.
- iii. Financial matter also limited the study.
- iv. Lack of sufficient equipment also limited the study.

## **2. STUDY AREA**

### **2.1 Physical Description**

Kathmandu valley is a flat bottom valley with deposit of lacustrine soil and covers an area of about 351km<sup>2</sup>. It is a circular valley with flat basin that lies in the mid hills. The valley is situated in between 27°22' - 28°50' E, and 85°10' –85°32' N. The minimum and maximum altitude is 1372m and 2831m. The valley is 30kilometers east to west and 20 kilometers north to south. The valley is surrounded by Phulchowki hill (2785 m) in the South –East, Shivapuri in the North, Champa Devi (2550) in the South West and Nagarjun (1989m) hill in the south. The valley has about 0.7 percentage of the total area of the country with an area of 1097 sq. km (HMG, Survey Department 1994)

### **2.2 Geology and Soil**

Kathmandu valley is a flat bottom valley, which can be divided into two major physiographic division- central plain valley floor and surrounding hills (Gurung 1992).

The central, more or less flat plain is nearly level or gently sloping toward the center. The altitude of the plain is lowest at Chovar which is about 1265m and reaches about 1400m in the north and 1500m in south of the valley. The valley floor is terraced by the work of rivers. These terraces are locally called Tars and plateau like with sharp escarpments along its sides (Gurung 1992).

The surrounding hills rise steeply on all sides. The hills are higher in the northern and southern side reaching an elevation of 2700 m above mean sea level. Hills along the western and eastern side have lower height of about 1700 m above mean sea level (Gurung 1992).

The soil at the valley is very fertile due to the deposition of alluvial soil washed away by the river. It has top soil, which is black and is very fertile. The soil of Kathmandu valley is matured soil with distinct layers and horizons (Gurung 1992).

### **2.3 Water bodies**

There are many water resources like river, lakes and ponds. The major river systems of Kathmandu valley are Bagmati, Bishnumati, Manohara, and Dhobikhola etc. All the main streams are perennial even if the discharge changes with the season, where

as many of the upstream tributaries flow only after sufficient amount of rainfall (Gurung 1992). The major lakes and ponds inside the valley are Taudaha, Indradaha, Nagdaha, Ranipokhari etc.

The river Bagmati is the only river leaving the valley. All the streams flow into Bagmati, which then leave the valley through Chovar George.

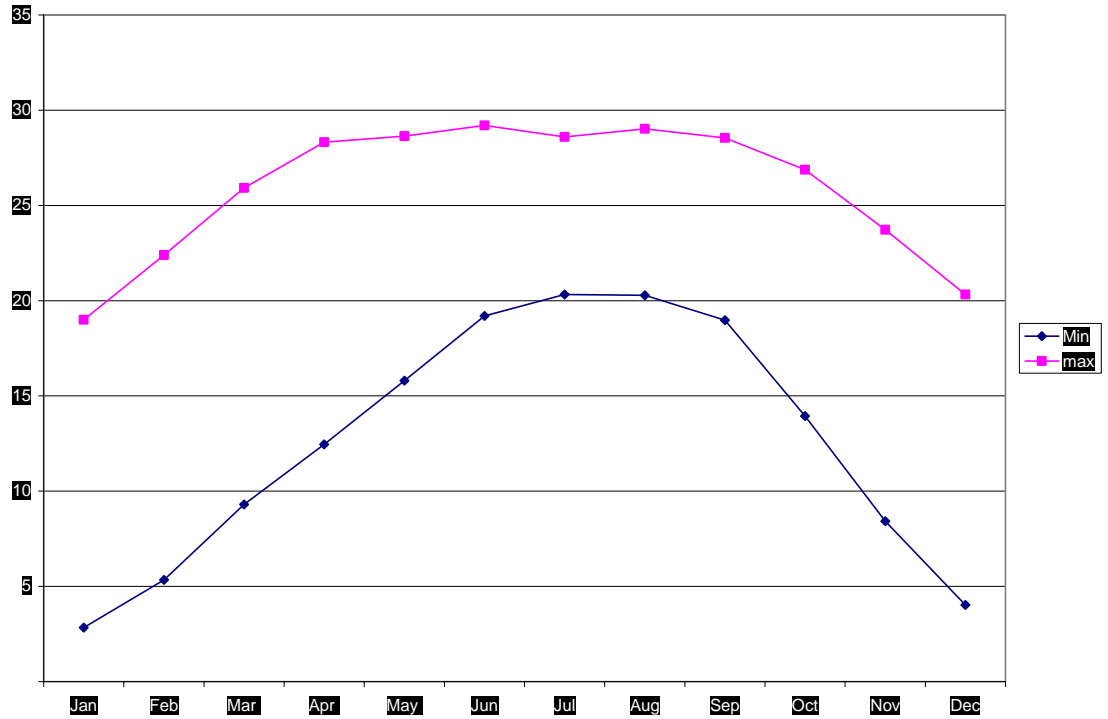
## **2.4Climate**

Kathmandu has sub tropical climate with high humidity all throughout the year in the three main seasons.

Towards mid May, pre-monsoon storms set in. Dark clouds amass in the afternoon with thunder, lightening, and high winds. If precipitation occurs, it comes in as late afternoon showers lasting perhaps only 15 to 20 minutes. As May changes into June the showers come with increasing frequency. Monsoon proper begins by the southeasterly winds sweeping up from the Bay of Bengal bring in heavy rains. From the annual total of some 1,500mm, more than 80% falls in these 3 months. Precipitation is not normally, continuous and often there are as many dry days as wet ones in any of the monsoon months.

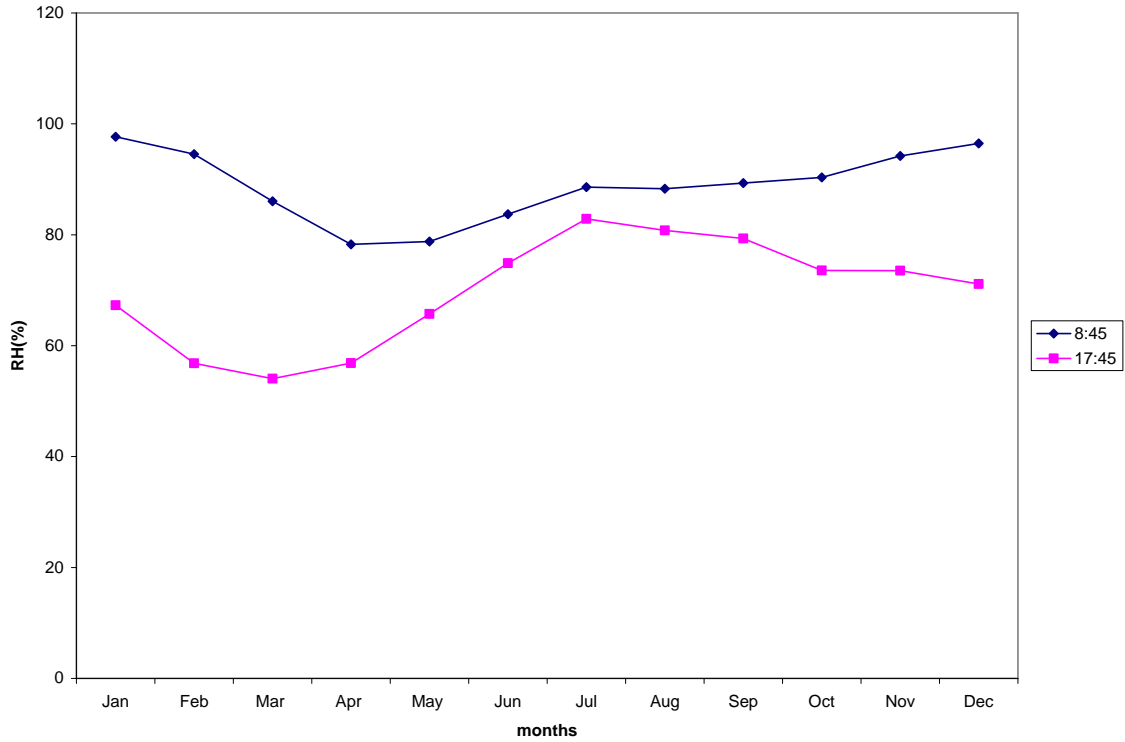
Winter begins in September and lasts until the end of February. The northern winds coming down from the mountains are cold. December and January, are the coldest months with temperature falling to freezing point especially after days of rain. From October, the relative humidity touches 100% in the morning and so dewfall is very heavy from late October through January nights. A heavy fog generally forms in the night and hangs low over the valley. On some days, it persists until 11:00 a.m. or even later. This makes early morning the coldest time of day and dampness causes the chill to be felt even more. During this cold period, the trees shed their leaves. In this season, Cattle Egrets are seen frequently along the riverside and cultivate fields for feeding, sun basking and preening (Bhattarai 1998).





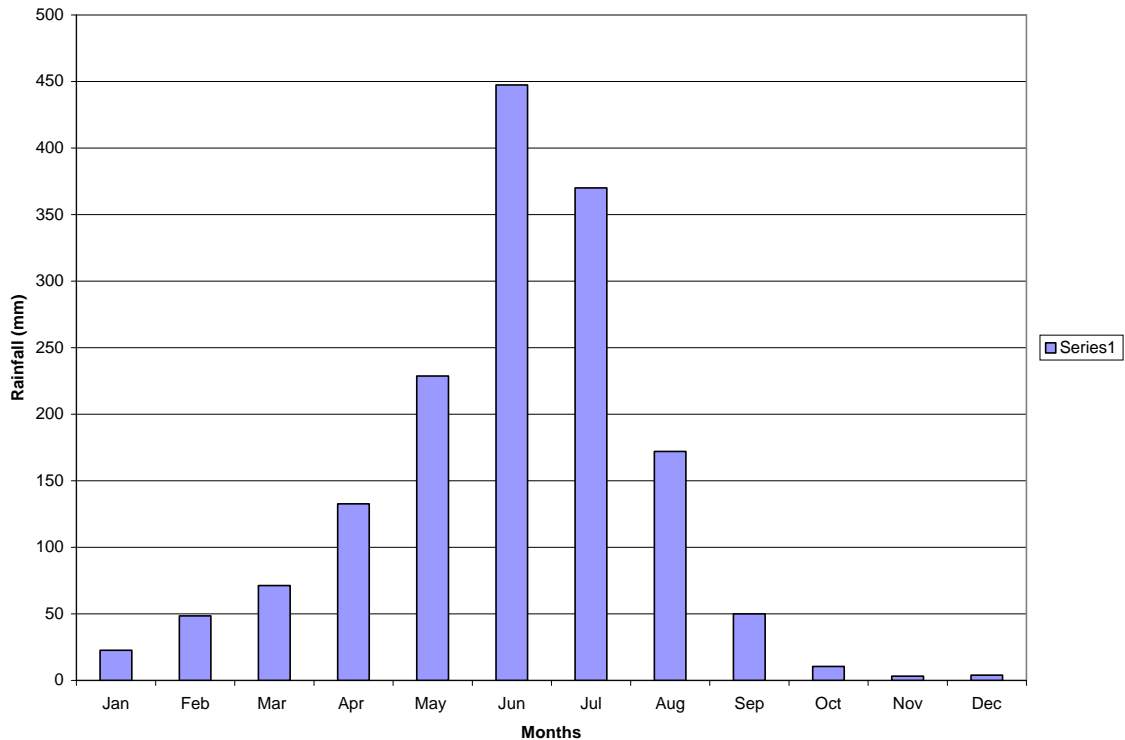
**Figure 1. Monthly mean Temperature (2001-2005) recorded at Kathmandu Airport, Kathmandu Valley**

December, January and February are very cold months and June and August are warm months. January is the coldest month with average 2.84°C, while June is the hottest with 29.2°C on mean average (Figure 1). 2001 is the hottest year and coldest year in comparison to others (Annex 1)



**Figure 2. Monthly mean Relative Humidity (2001-2005)**

The mean monthly relative humidity in the morning (8:45 hrs) ranges from 54.06% in March to the maximum of 82.86% in July while the mean monthly relative humidity in the evening (17:45) ranges from minimum of 78.26% in April and the maximum of 97.66 in January (Figure 2). RH was recorded maximum in 2002 and RH was recorded minimum in 2001. June, July and August are the most humid months. On comparison, March had minimum humidity and July had maximum humidity for five years 2001-2005 (Annex 2).



**Figure 3. Monthly Precipitation (2001-2005)**

June, July and August are rainy months. Precipitation rate is high in July while minimum in November and December (Figure 3). On comparison, 2002 received more precipitation, i.e. 1620.9 mm, and 2005 received the least, i.e. 1185.9 mm (Annex - 1).

## 2.5 Flora

The natural vegetation although not free from human disturbances is mainly concentrated on surrounding mountains and forested areas like Pashupati forest, Gokarna forest, Swyambhu hills, Hattiban etc (HMG 1986). The valley lies in the warm temperate zone and the surrounding mountains show the forest of upper temperate zone. *Schima-Castanopsis* forest occurs in the valley floor and the base of the surrounding mountains. In the middle of the mountain Oak Laurel forest, occurs and at the upper part, evergreen Oak forest is found (DFO 2004).

In the valley, following trees are found naturally- *Schima wallichii*-Chilaune, *Tona ciliata*-Tooni, *Quercus incana*-Banjh, *Castanopsis sp*-Katush, *Pinus roxburgii*-Sallo (DFO 2004).

Planted species in Kathmandu valley are as follows- *Pinus roxburghii*-Khote sallo, *Jakaranda mimosifolia* -Jakainda (Exotic), *Eucalyptus sp*-Masala (Exotic), *Populus sp* -Lahare peepal (Exotic), *Grevillia robusta* -Kangiyophul (Exotic), *Prunus cerasoides* –Painyu, *Curerssus sp* –Dhupi, *Cinnamomus camphora*-Kapoor (Exotic), *Callistemon viminalis* -Kalki phul (Exotic), *Celtis sp*-Khari, *Choerospondias auxillaris* -Lapsi *Melia azedarach*- Bakaino, *Fraxinus floribunda*-Lakuri, *Alnus nepalensis*-Uttis, *Pinus patula*-Sallo (DFO 2004).

## **2.6 Fauna**

Out of 15 species of endangered birds recorded in valley, 13 species of birds are recorded in National Red Data Book (BCN 1996). 1 threatened reptile species in Shivapuri National Park has been recorded (HMG 2003). Some of mammalian species recorded are *Canis aureus*-Jackal, *Vulpes vulpes*-Red Fox, *Macca mulatto*-Hanuman Langur, *Panthera paradus*-Leopard, *Felis chaus*-Jungle cat, *Pardofelis nebulosa*-Clouded leopard (DFO Ktm, 2004).

More than 500 species of birds are recorded from Kathmandu valley (BCN 1996). Some of endangered birds recorded are *Turdoides nepalensis* – Spiny babbler, *Falco severus* – Oriental Hobby, *Garrulax cerrulatus* – Grey sided laughing thrush, *Acgypius monachus* – Cinereous vulture, *Epiphelbia laidlawi* – Himalayan dragonfly is the endangered dragonfly found in Kathmandu valley (Bhattarai 2002).

## **3. METHODS**

### **3.1 Reconnaissance**

Reconnaissance survey was conducted during the period of January to February 2003. At the same time almost all places inside the valley was visited. The survey was done for nesting and roosting sites. Participatory Rural Appraisal (PRA) method was applied during the survey. During the period the study sites was visited frequently to confirm both nesting and roosting sites.

### **3.2 Equipments used**

Only the simple equipments were used during the survey. The equipments are binoculars (7x35 mm, Olympus), ordinary camera and zoom camera having 200mm zoom, measuring tape, GPS were used in the field.

### **3.3 Field surveys**

The survey was carried out from January 2003 to February 2004 and almost all the place was visited reachable by road. Distribution, status and habitat preference of Cattle Egret was determined by direct counting methods. For study purpose, Kathmandu Valley was divided into three blocks namely Kathmandu, Lalitpur and Bhaktapur. Nesting and roosting sites were mainly focused. The nest counting technique was used for the determination of population status. Number of nest in each tree was noted down in each location.

### **3.4 Distribution Pattern**

Distribution pattern of Cattle Egret in the Kathmandu Valley was determined based on night roosting and nesting sites. The actual location during the field visit was plotted in the map to show its distribution in the valley.

### **3.5 Roosting and Nesting**

The study is specially based on the nest counting and roost counting. The total number of Cattle Egret is calculated by multiplying the nest by 2.

### **3.6 Habitat preference**

The nesting and roosting tree species was identified. The number of each tree species as well as the diameter and crown cover of the tree was also measured. The radius of the crown cover was taken and using the formula  $A = r^2$ , the area of crown cover was calculated. To determine the circumference of the stem was taken at DBH and radius was

calculated by using formula  $C=2r$ . The basal area was calculated by using formula  $A=r^2$ . The data was used to estimate which tree species is preferred for nesting.

### 3.7 Questionary survey

Local people from the different places in the valley were questioned. For the population status of Cattle Egret and its distribution few general question were asked.

### 3.8 Data analysis

The collected data were categorized and tabulated to determine distribution, population status and habitat preference of Cattle Egret. To determine the relationship between variables, the following statistical tools are adopted.

#### 3.8.1 Variance to Mean Ratio ( $S^2/X$ )

Data on animal location such as number of individuals, recorded in each habitat type were used to determine distribution pattern. The distribution pattern of the Cattle Egret was determined by variance to mean ratio (Odum, 1971) which is because in Poission distribution, the variance ( $S^2$ ) is equal to the mean.

If  $S^2/X < 1$ , distribution is uniform

If  $S^2/X = 1$ , distribution is random

If  $S^2/X > 1$ , distribution is clumped

#### 3.8.2 Chi-Square test for goodness of fit ( $\chi^2$ )

A Chi square goodness of fit test was carried to determine whether the individuals of the Cattle Egret were distributed according to the availability of habitat types. The test was performed by setting the hypothesis that the Cattle Egret was uniformly distributed in all habitat types. The hypothesis was tested at 1% and 5% level of significance.

Under  $H_0$ , the test stastics is given by

$$\chi^2 = \frac{\sum (O - E)^2}{E} \sim (n - 1) \text{ df} \dots\dots\dots 1$$

Where, O = Observed frequency

E = Expected frequency

### **3.8.3 Spatial Analysis**

Spatial analysis of habitat characteristics, use and preference was done by using Geographic Information System Software Arc View 3.3.

## 4. RESULT

### 4.1 Distribution

#### Nesting

A total of five nesting sites, three in Bhaktapur and two in Kathmandu were recorded during this study in the valley (Table 1). All the nesting sites were recorded in planted tree species.

Table 1. Distribution of nesting sites

SN	Area	Latitude	Longitude	Altitude
1	Hanumanghat, Bhaktapur	27°40'3"E	85°25'48"N	1310m
2	Belukhel, Bhaktapur	27°40'4"E	85°25'46"N	1312m
3	Indrayanimandir, Bhaktapur	27°40'19"E	85°25'42"N	1307m
4	Keshar Mahal, Kathmandu	27°42'14E	85°19'3"N	1312m
5	Sundarijal, Kathmandu	27°45'10E	85°25'16"N	1367m

The distribution pattern in Kathmandu valley showed clumped pattern in nesting ( $S^2/\bar{X} = 403.58$ ). The variance to mean ratio was significantly greater than 1. ( $\chi^2_{cal} = 494.57$   $\chi^2_{tab} = 5.19$  and  $11.4$  at 1% and 5%).

#### Roosting

There were no specific day roosting sites found during the study as the bird roost anywhere nears the feeding ground. The day roosting depended on the food availability in the feeding ground. However, night roosting was in specific ground. Only three night roosting sites were found during the month October. Two locations were found in Kathmandu district while only one night was found in Lalitpur district. No night roosting sites was found in Bhaktapur district. In all sites *Populus sp* was used for night roosting by Cattle Egret (Table 2).



# Nesting & Roosting sites of *Bubulcus ibis* in Kathmandu Valley

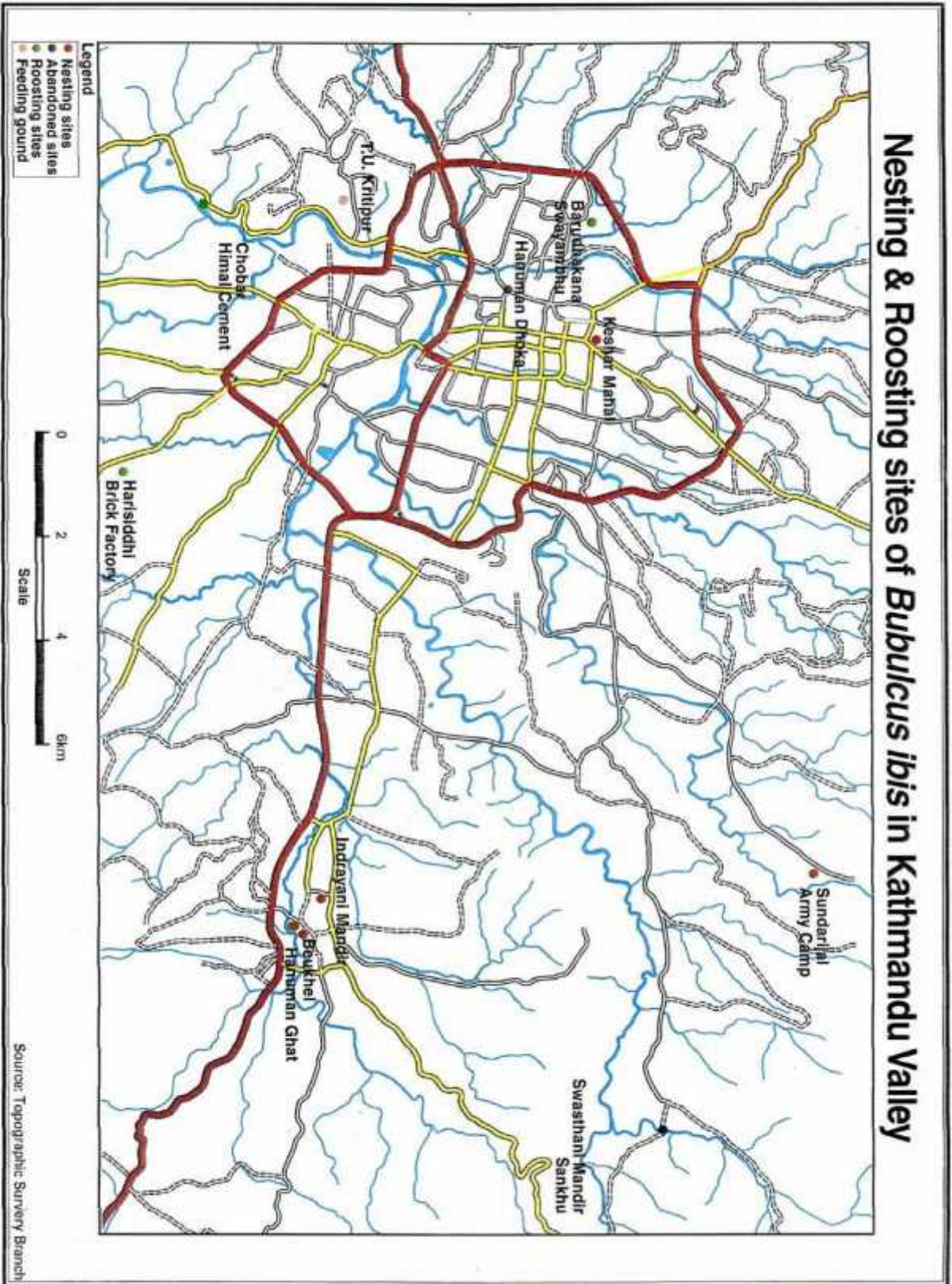


Table 2. The tree species preferred for night roosting at different location

S.N.	Location	Latitude	Longitude	Altitude	Botanical name
1	Chobhar, Kathmandu	27°39'19"	85°17'36"	1281m	<i>Populus sp</i>
2	Barudhkhana, Swyambhu, Kathmandu	27°42'54"	85°17'37"	1360m	<i>Schima wallachi</i> <i>Grevillia Robusta</i> <i>Populus sp</i>
3	Harisiddhi Brick Factory, Lalitpur	27°38'39"	85°20'41"	1316m	<i>Eucalyptus sp</i> <i>Grevillia Robusta</i> <i>Populus sp</i>

#### 4.2 Population status

##### Number of nest recorded according to district

Altogether 1284 nests were recorded in breeding season in the valley. Total number of Cattle Egret recorded was 2568 individuals. The highest number of nests recorded was in Kathmandu district, while there was not a nest recorded in Lalitpur district. (Table 3).

Table 3. Number of nest recorded in three districts.

S.N.	District	No of nest	No of matured egrets
1	Bhaktapur	454	908
2	Kathmandu	830	1660
3	Lalitpur	0	0
Total	3	1284	2568

### Number of nests recorded according to nesting sites

Altogether, 1248 breeding pairs were recorded in five different nesting sites in the valley. The maximum number of breeding pair was recorded in Sundarijal, Kathmandu district while minimum number of breeding pair was recorded in Belukhel, Bhaktapur district. (Table 4)

Table 4. Number of nests recorded in different nesting sites.

SN	Area	No of nest	No of Cattle Egret
1	Hanumanghat, Bhaktapur	220	440
2	Belukhel, Bhaktapur	53	106
3	Indrayanimandir, Bhaktapur	181	362
4	Keshar Mahal, Kathmandu	296	592
5	Sundarijal, Kathmandu	534	1068
	Total	1284	2568

Statically, there was significantly difference in the nesting pairs between different nesting sites, ( $X^2 = 494.57$ ,  $p < 0.5$ , at 4 d.f.), i.e. the number of nests was unevenly distributed in all five nesting sites.

### Breeding success of Cattle Egret in Hanumanghat

Table 5. Breeding success of *Bubulcus ibis* in Kosima tree at Hanumanghat.

No of nest	No of egg in each nest	No of hatchlings	Matured chicks	Hatching success (%)	Breeding success from egg to adult (%)	Chicks survived with respect to chicks hatched (%)
1	2	2	2	100	100	100
2	3	3	3	100	100	100
3	3	0	0	0	0	0
4	2	2	2	100	100	100
5	4	4	4	100	100	100
6	3	2	0	66.7	0	0
7	3	2	0	66.7	0	0
8	2	2	2	100	100	100
9	4	3	3	75	75	100
10	3	2	1	66.7	33.3	50
11	3	3	2	100	66.7	66.7
12	2	2	0	100	0	0
13	2	2	2	100	100	100
14	4	3	3	75	75	100
15	4	2	2	50	50	100
16	2	2	2	100	100	100
17	3	2	1	66.7	33.3	50
Total =17	x=49	y=38	z=29	-	-	-
Av	2.88 3	2.24 2	1.71 2	80.4	60.78	68.63

Out of 17 nests studied, a total 49 number of eggs were recorded with average clutch size 2.88 ( 3). A total 38 number of hatchlings were recorded with an average of 2.24 ( 2) in each nests. A total 29 matured chicks were recorded with 1.71( 2). On average 80.4% eggs hatched to chicks, 60.78% breeding success from eggs to adult and 68.63% of adults survived with respects to chicks hatched. Only 41% of the breeding pairs were able to breed 100% successfully. (Table no 5, Annex - II).

### **Comparison of number of nest in different section at Keshar Mahal in different year.**

Table 6. Comparison of number of nest in Keshar Mahal in different year.

Section/Year	2003	2004	2005	2006
Garden of Dreams	-	-	-	-
Garden of Dreams Extension Area	-	-	-	-
Ministry Garden	221	189	195	148
Along Driveway/Lazimpat way	75	84	74	63
Total	296	273	269	211

The total number of nests slightly increased from 1995 to 2001 and it gradually decreased onward. In 1995, Egret nest was found more in Dream of Garden section, which gradually decreases in 2001 & 2002. Finally, there were no nests found in this section. While there is fluctuation in number of nests in Ministry of Garden Section and along driveway/ Lazimpat way. During study, not a single nest was recorded from Garden of Dream and Garden of Dream Extension Area (Table 6 and Annex III).

### **4.3 Habitat preference**

#### **Nesting**

Both single tree and group of trees were found used for nesting to build nests. In both breeding sites, Belukhel and Indrayani Mandir only single tree was present. While in Hanumanghat only two trees was utilized for nesting. Remaining two nesting sites Keshar Mahal and Sundarijal were group of trees having maximum number of nest.

Sundarijal has the maximum number of nests while Belukhel has minimum number of nests. Based on number of nests, Sundarijal was the best habitat preferred and the Belukhel was least habitat preferred by Cattle Egret for nesting sites.

Based on number of trees *Grevillia robusta* was mostly the tree species preferred for nesting while *Lisea monoptela*, *Wendlandia puberula* and *Ficus religiosa* were the least preferred species among all tree species used for nesting. Based on number of nests, *Ficus benghalensis* was the most preferred tree while *Palmyra spp* was the least preferred species among the trees species utilized for nest building. (Table 7)

Table 7. Name and number of tree species preferred for building nests at different nesting sites.

S. N.	Scientific name	Common name	No of nest in each species					Total no of nest (y)	No of each trees species
			Hanumanghat	Belukhel	Indrayaniman dir	Keshar Mahal	Sundarijal		
1	<i>Magnolia grandiflora</i>	Rukh kamal	-	-	-	27	45	72	5
2	<i>Juniperus indica</i>	Dhupi	-	-	-	28	59	87	12
3	<i>Palmyra spp</i>	Khajuro	-	-	-	2	-	2	2
4	<i>Ribes glaciale</i>	Kimbu	-	-	-	11	-	11	3
5	<i>Grevillia robusta</i>	Silveraok	-	-	-	135	84	219	44
6	<i>Choerospondias auxillaris</i>	Lapsi	-	-	-	17	7	24	2
7	<i>Melia aredarach</i>	Bakaino	-	-	-	15	7	22	4
8	<i>Lisea monoptela</i>	Kutmero	-	-	-	14	8	22	1
9	<i>Actinodaphne sikkimensis</i>	Khapate	-	-	-	8	-	8	3
10	<i>Michelia deltsopa</i>	Champ	-	-	-	24	7	31	5
11	<i>Albizia julibrissin</i>	Sirish	-	-	-	15	10	25	3
12	<i>Mangifera indica</i>	Mango	-	-	-	-	123	123	6
13	<i>Cinnamomus camphora</i>	Kapoor	-	-	-	-	28	28	2
14	<i>Pius roxburghii</i>	Sallo	-	-	-	-	53	53	5
15	<i>Fraxinus floribunda</i>	Lakuri	-	-	-	-	6	6	2
16	<i>Viburnum nervosum</i>	Asarephul	-	-	-	-	42	42	10
17	<i>Schima wallichii</i>	Chilaune	-	-	-	-	51	51	3
18	<i>Wendlandia puberula</i>	Kainyu	-	-	-	-	4	4	1
19	<i>Ficus benghalensis</i>	Bar	220	-	181	-	-	401	3
20	<i>Populus religiosa</i>	Peepal	-	53	-	-	-	53	1
Total			220	53	181	296	454	1284	117
Average			11	2.65	9.05	14.8	22.7	64.2	5.85

### Total Crown Cover and size of Stem of individual species used for nesting

Table 8. Total crown cover, total and average basal area and average height of nests in each tree species.

S. N.	Name of the tree	Total Crown cover (m <sup>2</sup> )	Total Basal area (m <sup>2</sup> )	Average basal area (m <sup>2</sup> )	Average height of nest (m)
1	<i>Magnolia grandiflora</i>	100.05	0.19	0.04	5.33
2	<i>Juniperus indica</i>	26.97	0.17	0.02	4.17
3	<i>Palmyra spp</i>	9.10	0.12	0.06	7.41
4	<i>Ribes glaciale</i>	61.91	0.06	0.02	4.83
5	<i>Grevillia robusta</i>	425.14	9.03	0.21	
6	<i>Choerospondias auxillaris</i>	51.78	0.23	1.12	9.74
7	<i>Melia aredarach</i>	98.67	0.49	0.12	6.32
8	<i>Lisea monoptela</i>	5.31	0.15	0.15	6.36
9	<i>Actinodaphne sikkimensis</i>	22.05	0.13	0.04	5.54
10	<i>Michelia deltsopa</i>	103.92	0.46	0.09	6.07
11	<i>Albizia julibrissin</i>	112.35	0.26	0.09	5.98
12	<i>Mangifera indica</i>	100.60	0.99	0.17	7.31
13	<i>Cinnamomus camphora</i>	52.29	0.45	0.23	6.07
14	<i>Pilus roxburghii</i>	105.61	0.87	0.17	7.71
15	<i>Fraxinus floribunda</i>	6.10	0.11	0.06	4.79
16	<i>Viburnum nervosum</i>	56.18	1.21	0.12	6.37
17	<i>Schima wallichii</i>	39.73	0.77	0.26	7.48
18	<i>Wendlandia puberula</i>	4.52	0.08	0.08	6.48
19	<i>Ficus benghalensis</i>	535.59	12.76	4.25	10.45
20	<i>Populus religiosa</i>	47.76	1.06	1.06	7.64

Among the tree species used for the nesting, *Ficus benghalensis* had highest (535.9 m<sup>2</sup>) crown cover while *Fraxinus floribunda* had least (6.10 m<sup>2</sup>) crown cover. As regard on the basal area *Ficus benghalensis* had highest (12.76 m<sup>2</sup>) basal area and *Fraxinus floribunda* had least (0.11 m<sup>2</sup>) basal area. (Table 8 and Annex – V)



The data showed that the highest height of nest was found in *Ficus benghalensis* with an average height of 10 meters while the least height of nest was found in *Juniperus indica*, with average height of 4.17 meters. (Table 8 and Annex-V).

### **Roosting**

Survey on roosting was carried out during the month October 2003. On the arrival of cold season, some Cattle Egret migrates toward low land so the estimation of population becomes difficult. Therefore, the study was focused only on finding the trees species preferred for roosting.

### **Day Roosting**

Cattle Egret was found roosting in the trees planted in roadsides, in the bank of river in the field, even inside the compound of Tribhuvan University and in the shade of tree when it is hot at midday. It was found roosting everywhere in the tree near the feeding ground.

### **Tree species preferred for day roosting**

Total six places were surveyed for day roosting. It was found that the Cattle Egret prefer *Populus spp* the most (Table 9).

Table 9. The tree species preferred for Day roosting at different places at Kathmandu valley. (Note:- +ve represent presence & –ve represent absence).

S.N.	Tree species	T.U. Complex, Kirtipur, Ktm	On the way to Sankhu, Ktm	On the way to Sankhu, Ktm	International conference hall, Baneswor Baneswor, Ktm	On the way to Godawari, Lalitpur, Lalitpur	Arniko Highway, Bhaktapur
1	<i>Alnus nepalensis</i>	+	+	-	-	-	-
2	<i>Callistemon viminalis</i>	+	-	-	-	-	-
3	<i>Cinnamomus camphora</i>	+	-	-	-	-	-
4	<i>Curerssus sp</i>	+	-	-	-	-	-
5	<i>Eucalyptus sp</i>	+	+	-	-	+	-
6	<i>Fraxinus floribunda</i>	+	-	-	-	-	-
7	<i>Grevillia robusta</i>	+	+	-	+	+	+
8	<i>Milea aredarach</i>	-	-	-	-	-	+
9	<i>Pinus roxburgii</i>	+	-	-	-	-	-
10	<i>Ficus religiosa</i>	-	+	-	-	-	-
11	<i>Populous sp</i>	+	+	+	+	+	+
12	<i>Schima Wallachi</i>	-	+	-	-	-	-

## Night Roosting

### Roosting sites

Altogether three night roosting sites were found. Out of them, two nights roosting sites were in Kathmandu district (Himal Cement Factor, Chobhar- 576, Barudhkhana, Swyambhu- 397), one in Lalitpur district (Hari Siddhi Brick Factory- 484) while none was found in Bhaktapur district. (Table 10)

Table 10. Night roosting sites recorded at Kathmandu valley

S.N.	District	Location	Longitude	Latitude	Elevation	Total no of Cattle Egret
1	Kathmandu	Himal Cement Factory, Chobhar	27°39'19''	85°17'36''	1281m	576
2	Kathmandu	Barudhkhana, Swyambhu	27°42'54''	85°17'37''	1360m	397
3	Lalitpur	Harisiddhi Brick Factory	27°38'39''	85°20'41''	1316m	484
4	Bhaktapur	-----	----	-----	----	----
						1457

### Tree species preferred for night roosting

Only four species of trees was seen to be used for night roosting during the study. The tree species *Populus spp* was found the most preferred tree for the night roosting in all sites by Cattle Egrets (Table 11).

Table 11. The tree species preferred for night roosting at different location.

S. N.		Himal Cement Factory, Chobhar Kathmandu	Barudhkhana, Swyambhu, Kathmandu	Harisiddhi Brick Factory, Lalitpur
1	<i>Eucalyptus sp,</i>	-	-	+
2	<i>Grevillia robusta,</i>	+	+	+
3	<i>Populus sp,</i>	-	+	+
4	<i>Schima wallachi,</i>	-	+	-

## 5. DUSCUSSION

The distribution pattern of cattle egret in Kathmandu valley showed clumped pattern in nesting stage. Cattle Egret breed in the colony and can be easily observed in different sites of the Kathmandu Valley. Five nesting sites with 1284 nests were identified in Kathmandu Valley. Only one nesting sites Keshar Mahal was cited by the Bhattari (1989) and King (2002) while five nesting sites were observed in the valley during study period. The maximum number of nest were found in Sundarijal area (534), followed by Keshar Mahal Complex (296), Hanumanghat (220), Indrayani Mandir (181) and Belukhel (53). It was due to undisturbed area, feeding ground available nearby, secured places and large number of matured trees, which is comparatively low in Keshar Mahal, while two and one tree was found respectively. It was interesting that no single nests were found in Lalitpur district in comparison to Kathmandu district (830) and Bhaktapur district (454). This was due to relatively lower density of preferred mature tree species for nesting. Another reason may be the higher human intervention in Lalitpur district.

Study at Keshar Mahal complex showed that there were 547 nests in 1995, 643 nests in 2001 and 597 in 2002 (King 2002). Present study showed; 296 nests in 2003, 273 nests in 2004, 264 in 2005 and 211 in 2006. The data shows that distribution of nesting sites for cattle egret within the Keshar Mahal complex has changed dramatically due to the establishment of Garden of Dream Restaurant and the number of nests in the compound is decreasing. In 1995, the majority of nests were in the Garden of Dreams restaurant and aviary (King 2002). The activity within the Garden has compelled the egrets to shift to the more isolated area between the driveway to Lazimpat and wall that has mature trees suitable for nesting. However, during the study period not a single nest was seen in the Garden of Dreams and Garden of Dreams Extension Area. Maximum nests were seen in Ministry Garden during the study period from 2003 t 2006. This was due to the reason that few tree along driveway to Lazimpat and wall were dead and while other living trees had dead branches. This drastic decrease in number of nests was due to the presence of dry and dead matured trees. This had significantly decreased the habitat area used for nesting which has compelled the birds to shift to another places for nesting. The preferred habitat was found in the Sundarijal Area that has supported the nesting

sites for Cattle Egret as it had matured preferred trees and public were not allowed to go there for any purposes.

Baker (1929) has found 3-5 clutch size while Bhattarai (1989) has found 3.2 clutch sizes in Keshar Mahal in their studies. While present study shows that out of 17 nests studied, a total 49 number of eggs were recorded with average clutch size 2.88 (3). The hatching success at Keshar Mahal was 95.8% (Bhattarai 1989) while a rate was 94.4% in Pifang Island (Wen and Ru 1993). But the present study shows the success of hatching is 80.4%.

60.78% breeding success from eggs to adult and 68.63% of adults survived with respects to chicks hatched. Only 41% of the breeding pairs were able to breed 100% successfully. 85.66% of total breeding success was recorded at Keshar Mahal (Bhattarai 1989) while the current study shows success rate of 85.29%. In total, 2190 new individuals were added to the population of 1284 breeding pair, which amounts to 4758 individuals. Although the breeding success rate is high the number of cattle egret nest at Keshar Mahal was decreasing. Only 1457 individuals were counted after non breeding season due to the arrival of chilling cold in Kathmandu valley cattle egrets migrate to lower lands (Bhattarai 1989).

The maximum height of nest was found in *Ficus spp* with an average height of 10 meters while the minimum height of nest was found in *Juniperus indica*) with a average height of 4.17 meters. The nests at maximum and minimum height are vulnerable to thunder, storms, predation and human interference (Mckilligan 1997). Therefore, breeding success is low in nests at those heights.

However, the comparative study carried out at Keshar Mahal in different year showed that the numbers of nests were decreasing. This mean the population o f Cattle Egret is decreasing which do not coincide with the breeding success rate observed in Hanumanghat.

Both single and group of tree were found used for nesting to build nests. In both breeding sites, Belukhel and Indrayani Mandir only single tree was present. While in Hanumanghat only two trees were utilized for nesting. Group of trees were observed in Keshar Mahal and Sundarijal were group of trees, with one having maximum number of nest.

By number *Grevillia robusta* was mostly the tree species preferred for nesting while *Lisea monoptela*, *Wendlandia puberula*) and *Ficus religiosa* was the least preferred species among all tree species used for nesting. *Ficus benghalensis* was the most preferred tree species with maximum number of nest (401) while *Palmyra spp* was the least preferred species among the trees species utilized for nest building.

*Ficus benghalensis*) had highest 535.2 m<sup>2</sup> crown cover while *Fraxinus floribunda* had least 6.10 m<sup>2</sup> crown cover. *Ficus benghalensis* has highest 12.76 m<sup>2</sup> basal area and *Fraxinus floribunda* has least 0.11 m<sup>2</sup> basal area.

Cattle Egrets were found roosting in the trees planted in roadsides, in the bank of river in the field, even inside the compound of Tribhuvan University and in the shade of tree when it was hot at midday. It was found roosting everywhere in the tree near the feeding ground. The day roosting depended upon the availability of the food in their feeding grounds and the tree available near by.

It was found that the Cattle Egret prefer *Populus spp* the most for roosting purpose. Two night roosting sites were in Kathmandu district, one in Lalitpur district while none was found in Bhaktapur district.

## 6. CONCLUSION

The study concluded that the population status and distribution of cattle egret in Kathmandu valley were as follow.

The distribution pattern in Kathmandu valley showed clumped pattern in nesting stage.

It was found breeding in the same nesting sites at the same place unless the habitat is eventually disturbed.

Undisturbed area, feeding ground available nearby, secured places and large number of matured trees are required for nesting purpose.

Both group and solitary trees are used for nesting purpose and it should be matured trees.

Cattle egret can even nest in colony in an urban area but require quite undisturbed area for its nesting purpose. The breeding success rate was 85.29%, which is very high, which shows a good sign of adaptation of Cattle Egret with its environment.

The Cattle Egrets have shown their tolerance for urban growth, and have continued to successfully nest here. However, when the minimum requirements of shelter, food, water and a secure environment of raising young are no longer available, the egrets too will flee and migrate away.

The number of Cattle Egret nest in Keshar Mahal is decreasing year by year.

Height of cattle egret nest range from 4.17 meters *Juniperus indica* to 10 meters *Ficus benghalensis*.

By number trees *Grevillia robusta* was mostly the tree species preferred for nesting while *Lisea monoptela*, *Wendlandia puberula* and *Ficus religiosa* was the least preferred species.

*Ficus benghalensis* was the most trees species having maximum number of nest, while *Palmyra spp* was the least preferred species among the trees species.

The day roosting depends upon the availability of food in their feeding grounds and the tree available near by.

*Populus spp* was the most preferred tree species for roosting purpose.

Cattle egret prefers Kathmandu and Bhaktapur district for nesting while Kathmandu and Lalitpur for roosting in non-breeding season.

The distribution of Cattle Egret shows that for nesting purpose the – northern east part of valley for nesting purpose while southern west parts of the valley were used for roosting during cold season (after breeding season). While it was seen feeding everywhere in field, garden, lawn and riversides.



## 7. RECOMMENDATION

The information presented in this M. Sc Dissertation relates to the population status and distribution of cattle egret in Kathmandu valley based on nesting and roosting sites. The following are the recommendation; to protect the cattle egret and its nesting as well as roosting sites in the Kathmandu valley.

- i. As the cattle egret nest at the same place and same tree, all the nesting sites should be protected.
- ii. The most preferred tree species like *Ficus benghalensis* and *Grevillia robusta* should be planted in open places place of existing nesting trees if possible. Plantation of trees along roadside as well as within private resident compound should be encouraged. Green belt should be developed in the urban areas. Besides illegal cutting of trees should be stopped.
- iii. The study shows that the number of nests at Keshar Mahal is decreasing. This states that the environmental condition at the Keshar Mahal and its surrounding were getting worse due to which the number of cattle egret was also decreasing. So concerned bodies should make their efforts to preserve and improve the environmental conditions of the concerned area.
- iv. Regular monitoring of cattle egret should be done to know their status in the urban areas.
- v. Public awareness program
- vi. Education will facilitate local people's understanding their environment and wildlife. Massive formal and informal education program is recommended to conserve Cattle Egret & other wild species and their habitat. Inter-school debates or conservation education should be encouraged. Local people should be encouraged to keep their locality ecosystem green.

## 8. REFERENCE

- Ali, S. and Ripley, S. D. 1968. Handbook of the birds of India and Pakistan Oxford University Press, Bombay.
- Ali, S. 1964. The book of Indian Birds (7<sup>th</sup> Edition), Bombay Natural History Society.
- Austin, O. L. 1966. The birds of the world. Paul Hemlyn. London.
- Baker, E.C.S. 1929. The fauna of British India birds Vol. VI 2<sup>nd</sup> edition. Taylor and Francis. London.
- BCN 1998. Ibis bill, Journal of Himalayan ornithology. BCN
- BCN 1996. A list of birds recorded from Kathmandu valley. (Unpublished data from Bird Conservation Nepal.)
- Donald, S.F. and King, J.R. 1974. Avian Biology Vol. I Academic press New York and London.
- Bhattarai, A. R. 1989. Breeding biology of cattle egret, *Bubulcus ibis cormandus* a case study at Keshar Mahal, Kathmandu. M. Sc. dissertation submitted to central Department of Zoology, Institute of Science and Technology, T. U. Kirtipur.
- Bhattarai, L. 2002. A report on Invertebrates fauna of Godawari Area. Central Department of Zoology, T. U., Kirtipur.
- Bird Conservation Nepal 2002. Birds of Nepal. An official checklist.
- Encyclopedia of Animal world. 1972. Vol 7. Elsevier Int. Project.
- Fleming, R. L. Sr. and Fleming, R. Jr. 1976; Birds of Nepal with references to Kashmir and Sikkim.
- Fletcher, T.B. and English, T.M. 1936. Birds of an India Garden (2<sup>nd</sup> edition). Thacker spink and Co. Calcutta.
- Gopal, K. G. (1991). Effect of drought on the breeding activities of cattle egret, in a semi arid to arid region Geobios (Jodhpur) 18(1): 10-15 (Biol-abst.).

- Grizmek, H. C. 1972. Grizmek's Animal Life Encyclopedia Vol VII. Grizmek H. C. Bernherd. Rob & Comp.
- Gurung, D. (1992). Landform classification of Kathmandu Valley. A dissertation submitted to Central Department of Geology, Institute of Science and Technology, T. U. Kirtipur.
- HMG. 2004. Department of Forest, District forest Department Kathmandu, Hattisar Community forest Development programme an out look. DFO, Kathmandu.
- HMG. 2004 Department of Forest, District forest Department, Bhaktapur. Darpan. A community forest Development Programme. DFO, Ktm.
- HMG. 2004 Department of Forest, District forest Department, Lalitpur, Nepal A comparative report on monitoring and evaluation of community forest for the fiscal year 2002-2003. DFO, Ktm.
- HMG. 1986. Ministry of Forest and Soil Conservation. Flora of Kathmandu Valley.
- HMG. Ministry of Forest and Soil Conservation.
- King, W. 2002. A repeat survey of Cattle Egrets, *Bubulcus Ibis* at Keshar Mahal; Daphne Vol-II, Bulletin no-3, Sept 2002, BCN.
- Thailand.
- Mckilligan, N. 1987. Cause of nestling losses in cattle egret *Ardeola ibis* in Eastern Australia with special reference to the pathogenicity of the tick to nesting. Aust. J. Ecol. 12(1); 9-16 (Biol.abst.).
- Odum, E. P. 1971. Fundamental of Ecology. W. B. Saunders Company USA.
- Subedi P. K. 1982. Comparative study of feeding ecology of cattle egrets, *Bubulcus ibis cormandus*. (M. Sc. Dissertation submitted to Central Department of Zoology, Institute of Science and Technology, T.U. Kirtipur.)
- (Note: References ending with Biological abstract were not consulted in their original form but from the Biological abstracts)

## 9. ANNEXES

### ANNEX-I

**Meteorological data on temperature, relative humidity, precipitation for 2001-2005 recorded at Kathmandu Airport, Latitude 27°42", Longitude 85°22", Elevation 1336m (Source; Department of Hydrology and Meteorology, Government of Nepal).**

#### **a) Monthly mean Air Maximum Temperature (°C)**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	20.7	24.6	26.7	29.6	28.2	28.6	28.9	29.0	28.5	27.7	25.2	20.6
2002	19.0	22.7	25.3	27.1	27.3	29.3	28.6	29.0	28.1	26.7	23.8	19.8
2003	19.2	20.7	24.5	28.6	29.7	28.8	28.7	29.1	28.5	27.6	23.6	19.6
2004	18.2	22.0	27.3	27.7	28.6	28.8	27.7	29.0	28.1	26.0	22.7	20.6
2005	17.9	22.0	25.8	28.6	29.4	30.5	29.1	29.0	29.5	26.4	23.3	21.0

#### **b) Monthly mean Air Minimum Temperature (°C)**

	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
2001	2.1	4.8	7.4	11.2	16.4	19.2	20.1	19.9	18.5	14.3	8.5	3.7
2002	2.7	5.4	9.3	13.0	16.7	19.6	20.4	19.8	18.2	13.5	8.4	4.0
2003	2.0	5.4	9.0	13.3	14.5	19.1	20.3	20.5	19.4	14.8	9.3	4.4
2004	3.1	5.2	10.7	13.2	16.5	18.9	20.2	20.6	19.3	13.1	7.5	4.5
2005	4.3	5.9	10.1	11.6	14.9	19.2	20.6	20.6	19.5	14.0	8.4	3.5

**c) Monthly Relative Humidity (%) at time period 8:45 am and 17:45 pm**

	2001		2002		2003		2104		2005	
	8:45	17:45	8:45	17:45	8:45	17:45	8:45	17:45	8:45	17:45
Jan	99.2	61.1	99.7	57.5	98.0	73.4	96.5	75.8	94.9	68.2
Feb	96.5	48.8	96.7	49.6	95.6	68.8	92.7	62.4	91.2	54.5
Mar	85.8	42.4	91.9	54.2	86.5	63.0	82.5	56.3	83.8	54.4
Apr	76.9	45.2	84.7	59.8	78.7	60.0	79.3	65.7	71.7	53.6
May	83.1	69.9	83.9	69.6	74.2	60.9	78.8	70.0	74.0	59.1
Jun	84.5	78.2	86.2	72.8	84.2	77.9	86.9	80.5	76.7	65.0
Jul	89.2	82.1	91.2	79.7	86.7	82.5	91.2	89.3	84.7	80.7
Aug	90.9	78.9	90.7	80.7	86.8	82.8	85.9	79.9	87.3	81.6
Sep	91.3	78.3	91.7	75.1	89.0	83.7	88.6	81.1	86.0	78.5
Oct	92.5	67.2	90.6	74.8	91.1	76.2	89.7	73.5	87.9	76.1
Nov	96.3	65.6	95.3	76.6	93.6	79.5	94.1	70.9	91.7	75.0
Dec	99.1	62.4	97.0	78.0	96.3	78.4	95.8	69.0	94.1	67.8

**d) Monthly Precipitation (mm)**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	1.3	5.3	20.9	61.9	209.9	266.5	336.3	384.7	119.4	0.6	0.0	0.2
2001	6.8	15.7	8.4	34.6	179.9	250.4	498.8	460.3	145.5	20.5	0.0	0.0
2002	33.8	29.9	93.0	93.9	158.8	227.4	544.8	499.9	148.0	15.0	26.5	0.0
2003	19.5	68.4	85.9	38.0	37.7	222.3	591.5	347.0	293.4	17.7	0.0	18.6
2004	26.9	0.0	32.3	164.1	168.8	183.0	459.5	219.4	199.1	120.5	36.0	0.0
2005	5.1	17.0	50.1	34.8	40.6	222.9	253.5	309.3	126.5	126.1	0.0	0.0

## ANNEX II

The number of eggs/chicks recorded in Kosima tree at Hanumanghat, Bhaktapur district Kathmandu Valley.

No of nest	(Mar/Apr)	(Apr/May)	(May/Jun)	(Jun/Jul)	(Jul/Aug)	(Aug/Sep)
		Egg	Egg/Chick	Chick	Chick	Chick
1	Only nest were seen	2	2	2	2	2
2		3	3	3	3	3
3		3	0	0	0	
4		2	2	2	2	2
5		4	4	4	4	4
6		3	3	2	0	0
7		3	3	2	0	0
8		2	2	2	2	2
9		4	4	3	3	3
10		3	3	2	2	1
11		3	3	3	2	2
12		2	2	2	1	1
13		2	2	2	2	2
14		4	4	3	3	3
15		4	4	2	2	2
16		2	2	2	2	2
17		3	2	2	2	1
Total		49	45	38	31	29

### **ANNEX-III**

#### **Egrets nests in different section of Keshar Mahal produced by King (2002)**

Section/Year	1995	2001	2002	2003	2004	2005	2006
Garden of Dreams	368	220	35	-	-	-	-
Garden of Dreams Extension Area	-	-	54	-	-	-	-
Ministry Garden	179	194	144	221	189	195	148
Along Driveway/Lazimpat way	-	229	364	75	84	74	63
Total	547	643	597	296	273	269	211

## ANNEX IV

The name, number and crown cover of each trees in which the *Bubulcus ibis* nest found.

### Crown cover

S. N.	Name of the tree	No of trees	Radius( r) m	C= r <sup>2</sup>	Total (m <sup>2</sup> )
1	Rukh kamal	1	3.5	38.47	100.05
		2	3.4	36.30	
		3	1.5	7.07	
		4	1.6	8.04	
		5	1.8	10.17	
2	Dhupi	1	0.3	0.28	26.97
		2	0.6	1.13	
		3	0.8	2.01	
		4	0.7	1.54	
		5	0.7	1.54	
		6	0.5	0.79	
		7	0.9	2.54	
		8	1.2	4.52	
		9	1.1	3.79	
		10	0.7	1.54	
		11	1.3	5.31	
		12	0.8	2.01	
3	Khajuro	1	1.2	5.31	9.10
		2	1.1	3.79	
4	Kimbu	1	2.3	16.61	61.91
		2	2.2	15.12	
		3	3.1	30.18	
5	Silver oak	1	2.2	15.72	425.14
		2	2.3	16.61	
		3	2.4	18.09	
		4	2.5	19.63	



		5	1.5	7.07	
		6	1.4	6.15	
		7	1.9	11.34	
		8	1.8	10.17	
		9	1.4	6.15	
		10	1.5	7.07	
		11	1.3	5.31	
		12	0.7	1.54	
		13	2.3	16.61	
		14	1.1	3.79	
		15	0.7	1.54	
		16	0.9	2.54	
		17	1.7	9.08	
		18	2.3	16.61	
		19	1.5	7.07	
		20	2.2	15.12	
		21	3.4	36.30	
		22	1.6	8.04	
		23	1.5	7.07	
		24	1.8	10.17	
		25	1.0	3.14	
		26	2.0	12.56	
		27	1.7	9.08	
		28	1.5	7.07	
		29	1.3	5031	
		30	0.7	1.54	
		31	0.6	1.13	
		32	1.7	9.08	
		33	1.5	7.07	
		34	2.1	13.85	
		35	1.5	7.07	

		36	1.4	6.15	
		37	1.3	5.31	
		38	2.1	13.85	
		39	2.2	15.12	
		40	2.4	18.09	
		41	2.0	12.56	
		42	1.5	7.07	
		43	0.6	1.13	
		44	1.8	10.17	
6	Lapsi	1	2.5	19.63	51.78
		2	3.2	32.15	
7	Bakaino	1	3.1	30.18	98.67
		2	2.0	12.56	
		3	3.4	36.30	
		4	2.5	19.63	
8	Kutmero	1	1.3	5.31	5.31
9	Khapate	1	2.1	13.85	22.05
		2	1.5	7.07	
		3	0.6	1.13	
10	Champ	1	0.3	0.28	103.92
		2	1.9	11.34	
		3	3.5	38.47	
		4	3.3	34.20	
		5	2.5	19.63	
11	Sirish	1	3.2	32.15	112.35
		2	2.3	16.61	
		3	4.5	63.59	
12	Mango	1	3.4	36.30	100.60
		2	2.1	13.85	
		3	1.8	10.17	
		4	2.4	18.09	

		5	1.5	7.07	
		6	2.2	15.12	
13	Kapur	1	3.3	34.20	52.29
		2	2.4	18.09	
14	Sallo	1	2.7	22.89	105.61
		2	3.1	30.18	
		3	1.6	8.04	
		4	2.9	26.41	
		5	2.4	18.09	
15	Lakuri	1	0.5	0.79	6.10
		2	1.3	5.31	
16	Asarephul	1	201	13.85	56.18
		2	1.5	7.07	
		3	0.4	0.50	
		4	1.3	50.31	
		5	0.8	2.01	
		6	0.7	1.54	
		7	0.7	1.54	
		8	1.4	6.15	
		9	1.8	10.17	
		10	1.6	8.04	
17	Chilaune	1	2.4	18.09	39.73
		2	1.7	9.08	
		3	2.0	12.56	
18	Kainyu	1	1.2	4.52	4.52
19	Bar	1	9.2	265.77	535.59
		2	8.7	237.67	
		3	3.2	32.15	
20	Peepal	1	3.9	47.76	47.76
Total	20	117			1965.63

## ANNEX V

**The Basal area of each individual trees and the height of nest formed in each trees.**

S.N.	Tree		Stem					Height of nest ( m)			
	Name	No	C (m)	r (m)	a (m <sup>2</sup> )	Total (A)m <sup>2</sup>	Av	Min	Max	Mean	Average
1	Rukh kamal	1	0.84	0.13	0.06	0.19	0.04	4.05	7.35	5.70	5.33
		2	0.91	0.15	0.07			4.31	7.21	5.76	
		3	0.52	0.08	0.02			3.91	6.54	5.23	
		4	0.55	0.09	0.02			3.85	6.53	5.19	
		5	0.58	0.09	0.02			3.76	5.81	4.79	
2	Dhupi	1	0.43	0.07	0.02	0.17	0.02	3.51	5.06	4.29	4.17
		2	0.26	0.04	0.01			3.06	3.25	3.16	
		3	0.47	0.08	0.02			3.71	4.81	4.26	
		4	0.51	0.08	0.02			3.85	4.92	4.39	
		5	0.42	0.07	0.01			4.02	5.01	4.52	
		6	0.45	0.07	0.01			3.91	4.54	4.23	
		7	0.56	0.09	0.02			3.66	4.67	4.12	
		8	0.44	0.07	0.02			3.57	4.88	4.23	
		9	0.41	0.07	0.02			3.90	5.21	4.56	
		10	0.39	0.07	0.02			3.45	4.39	3.92	
3	Khajuro	1	0.86	1.14	0.06	0.12	0.06	7.45	7.45	7.45	7.41
		2	0.84	1.13	0.06			7.36	7.36	7.36	
4	Kimbu	1	0.53	0.01	0.02	0.06	0.02	4.01	6.95	5.48	4.83
		2	0.48	0.01	0.02			3.96	5.31	4.64	
		3	0.51	0.01	0.02			3.78	4.97	4.38	
5	Silver oak	1	2.32	0.37	0.43	9.03	0.21	7.58	12.43	10.01	
		2	2.12	0.34	0.36			8.86	13.01	10.94	
		3	2.22	0.35	0.39			9.05	12.86	10.96	
		4	2.35	0.37	0.44			8.54	13.45	11.00	
		5	1.96	0.31	0.31			8.67	13.36	11.02	

		6	1.85	0.30	0.27			6.55	9.58	8.07	
		7	1.44	0.23	0.17			5.35	7.58	6.47	
		8	0.95	0.15	0.07			4.35	6.89	5.62	
		9	1.21	0.19	0.12			5.05	8.95	7.00	
		10	2.01	0.32	0.32			5.75	11.73	8.74	
		11	1.87	.030	0.28			5.07	10.52	7.80	
		12	1.86	0.30	0.28			5.09	11.01	8.05	
		13	1.57	0.25	0.20			5.35	10.08	7.72	
		14	1.66	0.26	0.22			5.25	11.05	8.15	
		15	1.63	0.26	0.22			5.31	10.98	8.15	
		16	1.52	0.24	0.18			5.28	10.56	7.92	
		17	1.63	0.26	0.22			4.98	10.35	7.67	
		18	1.58	0.25	0.20			5.35	10.68	8.02	
		19	1.75	0.28	0.24			5.41	10.55	7.98	
		20	1.68	0.26	0.21			5.42	10.59	8.01	
		21	1.22	0.19	0.12			5.35	10.36	7.86	
		22	0.98	0.16	0.08			4.98	10.20	7.59	
		23	1.04	0.17	0.09			5.07	9.57	7.32	
		24	1.35	0.22	0.15			5.25	10.01	7.63	
		25	1.01	0.16	0.08			5.15	9.89	7.52	
		26	1.41	0.23	0.16			5.45	10.25	7.85	
		27	1.36	0.22	0.15			5.21	10.06	7.64	
		28	1.27	0.20	0.13			5.25	10.25	7.75	
		29	0.98	0.16	0.08			5.31	11.05	8.18	
		30	1.39	0.22	0.15			5.42	11.38	8.40	
		31	1.51	0.24	0.18			5.68	11.22	8.44	
		32	1.46	0.23	0.17			5.35	11.65	8.50	
		33	1.51	0.24	0.18			5.21	11.65	8.42	
		34	1.43	0.23	0.16			4.97	11.56	8.27	
		35	1.27	0.20	0.13			5.33	11.32	8.33	
		36	1.35	0.21	0.15			5.20	11.48	8.34	

		37	1.87	0.30	0.28			6.01	11.36	8.69	
		38	1.68	0.27	0.23			5.39	11.35	8.37	
		39	1.72	0.27	0.24			5.47	11.75	8.61	
		40	1.72	0.27	0.24			5.47	10.87	8.17	
		41	1.67	0.26	0.22			5.37	11.09	8.23	
		42	1.55	0.25	0.19			5.27	11.17	8.22	
		43	1.50	0.24	0.18			5.67	11.57	8.62	
		44	1.40	0.22	0.16			5.07	11.05	8.06	
6	Lapsi	1	1.15	0.18	0.11	0.23	1.12	4.21	5.61	4.91	9.74
		2	1.21	0.19	0.12			3.96	5.70	4.83	
7	Bakaino	1	1.31	0.21	0.14	0.49	0.12	4.52	7.11	5.82	6.32
		2	0.98	0.16	0.08			5.09	8.01	6.55	
		3	1.25	0.20	0.12			5.13	7.65	6.39	
		4	1.39	0.22	0.15			5.22	7.85	6.54	
8	Kutmero	1	1.35	0.22	0.15	0.15	0.15	4.85	7.86	6.36	6.36
9	Khabate	1	0.65	0.10	0.03	0.13	0.04	3.75	6.95	5.35	5.54
		2	0.75	0.11	0.05			4.03	7.02	5.53	
		3	0.82	0.13	0.05			4.15	7.35	5.75	
10	Champ	1	0.97	0.15	0.08	0.46	0.09	4.95	6.85	5.90	6.07
		2	1.05	0.17	0.09			5.06	7.05	6.06	
		3	1.15	0.18	0.11			5.15	6.95	6.05	
		4	0.89	0.14	0.06			5.25	6.88	6.07	
		5	1.25	0.20	0.12			5.35	7.25	6.30	
11	Sirish	1	0.65	0.10	0.03	0.26	0.09	4.96	6.31	5.64	5.98
		2	1.21	0.19	0.12			4.85	6.25	6.55	
		3	1.15	0.18	0.11			5.06	6.42	5.74	
12	Mango	1	1.45	0.23	0.17	0.99	0.17	3.59	10.59	7.05	7.31
		2	1.36	0.22	0.15			3.68	11.06	7.37	
		3	1.38	0.22	0.15			3.72	11.25	7.49	
		4	1.42	0.23	0.16			3.73	10.78	7.26	
		5	1.44	0.23	0.17			3.69	10.86	7.28	

		6	1.53	0.24	0.19			3.70	11.15	7.43	
13	Kapoor	1	1.58	0.25	0.20	0.45	0.23	4.56	7.09	5.83	6.07
		2	1.76	0.28	0.25			5.06	7.55	6.31	
14	Sallo	1	0.73	0.12	0.04	0.87	0.17	4.35	10.57	7.46	7.71
		2	0.85	0.14	0.06			4.54	11.07	7.81	
		3	1.57	0.25	0.20			4.35	11.10	7.73	
		4	1.83	0.29	0.27			4.25	11.25	7.75	
		5	1.94	0.31	0.30			4.37	11.29	7.83	
15	Lakuri	1	0.85	0.14	0.06	0.11	0.06	3.86	5.96	4.91	4.79
		2	0.79	0.13	0.05			3.21	6.13	4.67	
16	Ashare phul	1	1.52	0.24	0.18	1.21	0.12	3.96	7.95	5.96	6.37
		2	0.89	0.14	0.06			4.25	8.42	6.34	
		3	0.95	0.15	0.07			4.21	8.47	6.34	
		4	1.25	0.20	0.12			4.31	8.51	6.41	
		5	1.35	0.22	0.15			4.26	8.43	6.35	
		6	1.21	0.19	0.12			4.46	8.52	6.49	
		7	1.10	0.18	0.10			4.57	8.62	6.60	
		8	1.33	0.21	0.14			4.53	8.60	6.57	
		9	1.27	0.20	0.13			4.35	8.40	6.38	
		10	1.33	0.21	0.14			4.27	8.21	6.24	
17	Chilaune	1	1.98	0.32	0.31	0.77	0.26	4.37	10.51	7.44	7.48
		2	1.58	0.25	0.20			4.56	10.22	7.39	
		3	1.82	0.29	0.26			4.22	11.02	7.62	
18	Kainyu	1	0.97	0.16	0.08	0.08	0.08	4.39	8.56	6.48	6.48
19	Bar	1	5.72	0.96	2.61	12.76	4.25	5.34	16.65	10.96	10.45
		2	1.75	0.12	0.05			3.18	6.01	4.60	
		3	11.26	1.79	10.10			8.82	22.68	15.75	
20	Peepal	1	3.65	0.58	1.06	1.06	1.06	4.85	10.43	7.64	7.64
Total	20	117				13.76	Av= 0.12				

**ANNEX-VI**

**Questionnaire Survey on Cattle Egret**

(For interviewing local residents on nesting and roosting sites of Cattle Egret in Kathmandu Valley)

Cattle Egret roosting and nesting sites survey questions.

The question was given to find out what people know about Cattle Egret. You don not have to answer the question if you are not willing to do so. Answering the question will take five minutes only. You can skip any question you like saying “skip” or stop answering anything at anytime you choose. If you have any questions, you can ask me now or after you finish answering question. Do you have any question for me right now about the survey?

**Would you like to participate in the survey? (If yes, proceed to ties # 1.)**

- 1. Name of interview Date:
- 2. Name of the place
- 3. Respondent gender: Age Occupation:

**Cattle Egret sighting and status**

- 1. Have u seen Cattle Egret?
- 2. Where have u seen?
- 3. Have u seen it roosting or nesting in the tree near by your places?  
(If respondent, answer ‘no’)
- 4. Can you show the place or tell the name of place?
- 5. What is the name of tree species?
- 6. Do you see them seasonally or year round?
- 7. For how many years you are seeing the bird roosting or nesting.
- 8. What do people have opinion about Cattle Egret?
- 9. Do you have to say any thing about the Cattle Egret that I have not asked?



**Interviewer comments- Do not read aloud**

10. How do you rank the informant's reliability? Circle one.

0

1

2

3

4

Very unreliable

Very reliable

Comments and other observation: Use the back of the page to add any comments of observation you may have done.