1. INTRODUCTION

1.1 Small Mammals

Small mammals represent a heterogeneous group as they include species in the orders of rodentia and insectivora. The species in this group share biological and ecological features related to their small size (Bhattarai 2012). Small mammals do not exist as a zoological group. The term is generally considered to apply to any non-flying adult mammal weighing less than a koilogram. Though there are few ungulates including small deer, i.e. water chevrotian (*Hyemoschus aquaticus*) and mouse deer (*Tragulus* spp.) which are smaller than some of the larger rodents and quite a lot of the Mustelids (e.g. ferrets, weasels) are diminutive. In practice, the term is generally restricted to rodents, marsupials, insectivores and elephant shrews (Barnett and Dutton 1995). Small or large mammals do not constitute strict taxonomic entities. The International Biological Programme (IBP) working group has divided the class mammalia into three groups on the basis of their adult living weight (i.e., large, medium and small).Those species of small mammals whose adult live weight ranges from less than two grams (e.g., the shrews, chiroptera, squirrels, logomorphs) to five kilograms (Bourliere 1975, Meritt 2010). Small cats and small carnivore are also included as small mammals in this study as the mammals upto ten kilogram are considered as small mammals (SMCRF 2012). According to Oxford Advanced Learners dictionary of current English (1974), Fox (canidae) is also included in small wildlife although the live weight of fox is larger than five kilogram.

1.2 Characteristics

Most species of small mammals are nocturnal or crepuscular in habit. They can forage more easily without being readily located by any aerial predators. Many species of small mammals depend on cover for their life requisites. Rodent and leporidae are mostly dependent on vegetation for all life requirements, whereas the insectivores use vegetation only for cover or shelter (Adhikari 2001). Population of some species can readily adapt to the microhabitat conditions commonly found within the leaf litter of forest, under the grass cover of Savannah, tall grasslands or below the deep snow layer of the high Himalayas, for example, Himalayan

Weasel (*Mustella sibrica).* Many of the species build up temporary or permanent shelter where they can take refuge (e.g. bush rat) when life becomes impossible outside (Adhikari 2001). Small mammals are often the indicators of ecosystem health (Jnawali et al. 2011). Small mammals are disturbance intolerant and can be good bio-monitor of environmental contaminants (Sheffield and Robertees 2001). Biodiversity of small mammals have been used as an indicator of disturbance in a natural ecosystem due to their quick response to environmental change (Avenant 2000).

Because of small body size, small mammals have easy concealment from predators hunting by sight, easy access to number of food sources like fresh leaves, fallen seeds, nuts, invertebrates in litter layers, buds in the lower grass layer; arthropods on tree trunks and branches. Some of the small mammals feed on fruits as well (Bourliere 1975). Many of the small mammals are solitary in nature, small in body size and occupy habitats with thick vegetation. Such cryptic nature of these animals made it difficult to study them, as a result, we know little about them (Kumara and Singh 2007).

Small mammal's size has also its drawbacks too. The most obvious is high energy cost of homeothermy. Small mammals are unable to change their physical and biological environments because of high metabolic rate, highly sensitive to changing temperature and ground cover (Southern 1973). They also form an important prey base for medium sized carnivores and raptors (Emonons 1987, Golley et al. 1975, Hayward and Phillipson 1979).

1.3 Abundance and Distribution

Distribution and abundance information is important not only for improving understanding of the biology of the species but also for assessing its conservation status and guiding conservations actions and decisions (Wang et al. 2007). Volant and non-Volant small mammals constitute almost 73% of the world's mammalian diversity with just the non-Volant small mammals contributing a little over 52.5% (Amori and Gippoliti 2000; Wilson and Reeder 2005). Small mammals make up half of all mammalian species in Nepal with 102 species (Baral and Shah 2008). Among the assessed species, 48% is considered data deficient. With 43% least concern and 9% considered threatened, this is one of the least threatened group but also the least known of mammal group (Jnawali et al. 2011). Species belonging to small mammals are terrestrial and

widespread in distribution, found almost everywhere in the world from sea level. e.g., Common shrew (*Sorex araneus*) to the high Himalayan pastures at an altitude of 5000 m. e.g., Himalayan marmot (*Marmota himalayana*). The distribution and abundance of small mammals depend upon topography, altitude, vegetation and ground cover from sea level, lowland to high Himalayan pastures (Adhikari 2001). The abundance and distribution organisms are identified as a key issue in ecology. The study of abundance and distribution of animals in relation to different ecological component that govern them such as habitat features and anthropogenic disturbances help to know about the relative significance of these components in driving animal occupancy patterns and abundance (Burnham et al. 1980).

Table1. Abundance of Small Mammals in Nepal.

Name of the Species	**Number of Species**
Pika and Hare	10
Squirrels and Marmots	13
Hamsters, Voles, Gerbils, Rats and Mice	35
Porcupines	2
Pangolins	2
Civets	4
Small Cats	2
Mongoose	3
Foxes and Spotted Linsang	3
Otters	3
Martens	3
Weasels and Red Panda	5
Moles and Shrews	16
Deer	1
Total	102

Source: Baral and Shah, 2008

Besides these, 53 species of bats have been identified so far (Acharya et al.2010). About 60% of mammals of Nepal belong to small mammals (SMCRF 2011).

1.4 Objectives

The main objective of the study was to investigate the occurrence, abundance and distribution of small mammals in different habitats of Chitwan National Park. The specific objectives were to:

- Examine occurrence and abundance of small mammalian species in riverine and sal forests.
- Evaluate the distribution pattern of small mammals
- Assess habitats of small mammals.

1.5 Rationale of the study

Small mammals are neglected for research and conservation in Nepal and very few reports and articles on small mammals have been published here (Dahal et al. 2011, Joshi 1995). Detail information on small mammals is not available even for Chitwan National Park, which is one of the most studied parks in Nepal. Small mammals were not focused until PPBio project was initiated in 2008 (Hero et al. 2011). Therefore, most of small mammals are data deficient. Thus, a baseline data of small mammals particularly focusing on occurrence, abundance and distribution in different habitats of the park are needed to develop an effective conservation plan and research programs.

2. LITERATURE REVIEW

Gray (1846, 1863) published a checklist on Nepalese mammals based on Hodgson's collections housed in British Museum. Scully (1887) reported 19 species of bats collected from Kathmandu valley. Thomas and Hinton (1922) reported on series of collections of mammals from the Mt. Everest region which consisted of 52 specimens belonging to 10 species. Among them, two species and one sub species were described as new. Hinton (1922) listed a collection of rats, which included 3 species and 4 sub species from the Kathmandu valley and nearby surrounding. He provided a detailed report on house rats based on earlier collections. Hinton and Fry (1923) published a checklist on the Nepalese mammals which contained 81 genera and 119 species. They listed a collection of 304 specimens consisting of 34 genera and 44 species. Thomas (1924) described a new field mouse *Apodemus gurkha (Apodemus flavicollis gurkha)* from the western part of the country. Fry (1925) reported on large collection of mammals from districts of Kathmandu valley. Lindsay (1929) described a new flying squirrel, Sciuropterus gorkhali (*Petaurista elegans gorkali).* Bishwas and Khajuria (1955) collected a small number of mammals from the Solukhumbu region of Eastern Nepal of which two species and two subspecies were described for the first time. A later list of mammals of Eastern Nepal was provided by Bishwas and Khajuria (1957). Ellerman and Morrison –Scott (1966) in their account of the mammals of the Palearctic Region and Indian Subcontinent included 71 genera and 106 species for Nepal. They recorded two species of Ochotona *(O. royeli and O. macrotis)* from Nepal. Weigel (1969) reported on the investigations of the Nepal Himalaya Expedition, 1968, which studied insectivores and rodents of Eastern Nepal. Three hundred twenty five mammal representing 10 genera and 14 species were obtained. One new species and a sub species were described and four new locality records were listed. The first comprehensive study of mammals was done by Hodgson and Gray from 1830 to 1850 (Abe 1971). Marten and Niethammer (1972) reported the first collection of *Apodemus sylvaticus wardi* in Nepal.

The study of small mammals started in Nepal with the report of three insectivores (*Crocidura attenuate* Milne Edwards, 1872, *Suncus stoliczkanus* Anderson, 1877, and *S.entruscus pygmaetoides*) during 1966 to August 1970 (Mitchell and Punzo 1975). They recorded nine species of small mammals along the forest edge bordering cultivated fields of Banke District in

the western Tarai of Nepal. The Indochinese shrew was first reported in Nepal by Mitchell and Punzo (1975), from midland forest and fields at 2440 m. Bhatta and Shrestha (1977) studied on fundamental ecology of mammals and their habitats of Shuklaphanta in the mid western tarai of Nepal and recommended further study on small mammals and vertebrates. Abe (1982) conducted a faunal survey on small mammals in central Nepal and suggested altitudinal segregation between sympatric Soriculus in Nepal. Abe (1982) recorded 32 different species of small mammals from central Nepal in 1968. Genus Soriculus is one of the Asiatic Soricine shrew genera and four Soriculus shrews have been reported inhabiting central Nepal (Kazuyuki et al. 2001). A hispid hare (*Caprolagus hispidus*) was reported in Sukhibar area of Chitwan National Park in central Nepal in 1984 (Oliver 1985). As this species has not been previously reported from the park and had not been reliably recorded anywhere in Nepal for more than thirty years, different researchers have thought of its recent extinction (Oliver 1985). Bell (1986) studied the biology and conservation problems of hispid hare in Shuklaphanta Wildlife Reserve from January to March in 1986. The research indicated that the hispid hares confine to patches of unburned tall grassland along streams, during winter season when grass cutting and burning is over. Common Soft-fured Rat (*Millardia meltada)* and Little Indian Field Mouse (*Mus booduga*) were confirmed to the Tarai region. Eastern House Mouse (*Mus musculus),* Himalayan Shrew (*Soriculus nigrescens*), Chestnut White-bellied Rat (*Rattus fulvescens)*, Hodgson's White-bellied Rat (*Rattus niniventer)* were only found only in the hilly region of Nepal and altitudinal range of Fawn-coloured Mouse (*Mus cervicolor*) was found to be wide (Newton et al. 1990). The other species of rodents and shrews have been recorded from Nepal many times and these records do not fall out of the altitudinal limits previously reported (Abe 1971, 1977, 1982; Mitchell and Punzo 1975).

The ecology and behavior of common palm civet was studied using radio telemetry in the Chitwan National Park (Joshi 1995). He reported five species of civets from there. These included Small Indian Civet (*Viverricula indica),* Large Indian Civet *(Viverra zibetha),* Masked Palm Civet (*Paguma larvata),* Asian Palm Civet (*Paradoxurus hermaphrodites)* and Spotted Lingsang (*Prionodon pardicolor*). Knowledge on small mammals present in an area and the role they play in ecosystem function is necessary for effective management (Brown 1996). Few studies on habitat preferences of small mammals have been carried out in Nepal (Peet et

al.1997). Similarly, Adhikari (2001) did a comprehensive study of small mammal diversity of the western Tarai.

Nembang (2003) studied about status and distribution of small mammals in Shuklaphanta Wildlife Reserve in relation to habitat features. His study recorded 12 species of small mammals. Among those 12 species, eight species were of the order rodentia, two species of order insectivora, one each of the order carnivora and order lagomorpha. In 512 trap nights, 76 individuals of 9 species were captured. The species richness of small mammals was documented high. The abundance and distribution of small mammals were correlated with percentage cover of ground vegetation and monocotyledon and average maximum height of dominant grass species. The distribution pattern was found patchy and random. Molur and Singh (2009) conducted a research for the identification of diversity and changes in non-volant small mammal composition in the Western Ghats of Karnataka. Altogether 412 individuals belonging to 14 species of non-volant small mammals were trapped. *Rattus wroughtoni* was the most commonly caught. His study indicated that Asian House shrew as commonest and widely distributed in India, Nepal, Pakistan, Bhutan, Bangladesh and Srilanka (Molur et al.2005). Similarly Dahal et al. (2011) conducted a month long survey of small mammals in Chitwan National Park and recorded 12 species. They recorded only two species of Muridae and one species of Scuridae during their survey. Small Indian Civet was trapped most of the time during the survey and House Rat was the second most trapped small mammal. Through camera trapping and semi structured questionnaire survey method, Pandey and Kaspal (2011) did the survey of small mammals to know their distribution and diversity in Koshi Tappu Wildlife Reserve. They recorded five species of small mammals belonging to five genera and four families. The recorded species were jungle cat, fishing cat, Indian hare, Small Indian Civet and Indian Crested Porcupine.

3. STUDY AREA

3.1 Location and Physiography

The study was conducted in Sauraha sector of Chitwan National Park (CNP). It lies in the Southern central lowlands or inner Tarai region in Chitwan, Nawalparasi, Parsa and Makwanpur district of Nepal (27°16.56'- 27°42.14' N latitudes and 83°50.23'-84°46.25' E longitudes) (CNP 2013) between the Siwalik outer range and the Mahabharat range. The park covers 932 km^2 of subtropical lowland with an altitude ranging from 150 to 815m (DNPWC 2012). Different characteristic features of the park comprise of Someshwor hills, Churia hills, ox-bow lakes and alluvial flood plain of the Rapti, Reu and Narayani river (Bhuju et al. 2007). At least 20 large ox-bow lakes lie in CNP (BPP 1995a). Besides, it has created a unique ecosystem with the combination of tall grassland, riverine forest and sal forest. It was designated as a world heritage site in November 1984. In 1996, an area of 750 Km^2 surrounding the Park was declared as a buffer zone which consists of forests and private lands (DNPWC 2012). The Park is one of the largest remaining natural lowland forests in the outer hills of Himalaya. Chitwan is located in a river valley basin or dun, along the flood plains of the Rapti, Reu and Narayani rivers. The Rapti and Reu river flow through the park and finally join the Narayani River. CNP was declared the first National Park in 1973, following an approval of the late King Mahendra in December 1970. The Narayani River marks the western boundary and Rapti river marks the northern boundary of the Park.and by Reu river and a forest road to the south and Parsa Wildlife Reserve as the eastern boundary of the Park (Figure 1).

3.2 Climate

The climate of CNP is subtropical monsoon with relatively high humidity. The park has a range of climatic seasons each offering a unique experience. From March to June, temperatures reach as high as 43^0C.October through February with average temperature of 25^0 C offers an enjoyable climate. Winter temperature falls almost to freezing point from March to June. (DNPWC 2012). The minimum relative humidity was 89% (April-January) and highest was 98% (Nov-mid

February) and becomes average between spring and summer. The monsoon season starts sometimes from late June and lasts until September. Annual precipitation averages 230 cm, 90% of which occurs during May-September.

3.3 Biodiversity

3.3.1 Flora

The flood plain of the Rapti, Narayani and Reu rivers composed of a dynamic interspersion of riverine forests, tall grasses and broad, sandy riverbanks. There is high chance of vegetational interspersion in the alluvial region of the park which may account for the high density and diversity of animals (Smith 1984). The Park is rich in flora where 919 species of flora had been estimated including endangered species such as the Tree fern (*Cyathea spinosa*), Cycas (*Cycas pectinata*), Screw pine (*Pandanus nepalensis*), and several other orchids. The Park consists of three basic vegetation; sal forest (70%), riverine forest (7%) and grassland (20%) while the remaining (3%) is primarily the open river bank (BPP 1995b).

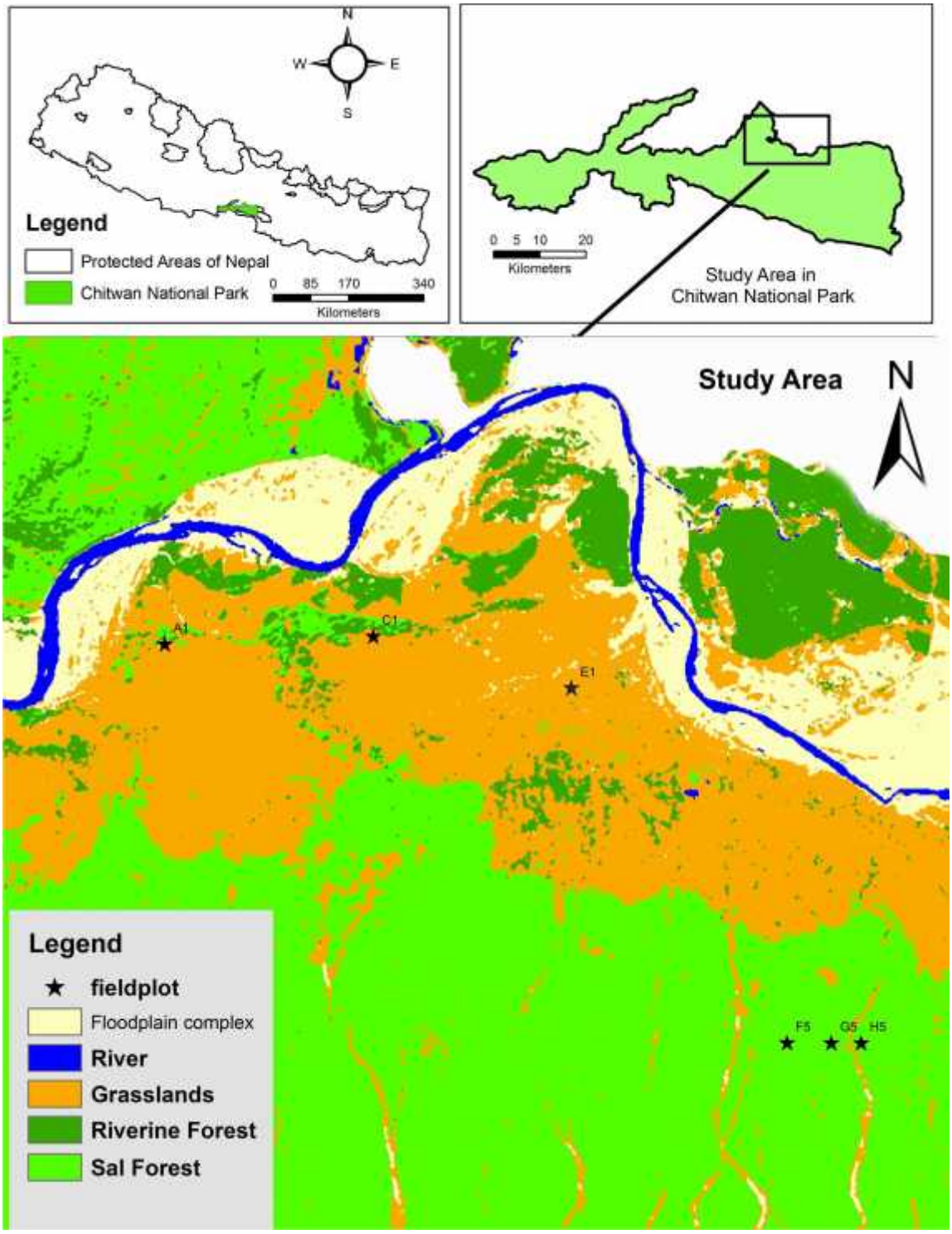
Sal forest: Sal (*Shorea robusta*) is supported by upland area of the park which attains the heights of 20-25m. In the Sal forest shrub layer is usually absent giving the appearance of open woodland. But in some areas, beneath the Sal forest some grasses like *Narenga porphyrocoma* and *Thyrsia zea* grows above the height of one meter. In the absence of dense understory, Palms grows on the upper and drier ridges of the Churia and Someswor hills (DNPWC 2012). Plots F5, G5 and H5 were of sal forest (Figure 1).

Riverine forest: Riverine forest is found along the lakes, streams and rivers in the park. Khair (*Acacia catechu*) and Sisso (*Dalbergia sisso*) are the most dominant species found in the bank of Rapti and Narayani rivers. There is usually a dense shrub understory of Rudilo (*Pogostemon benghalensis)* with a variety of shade-tolerant herbs and grasses. *Saccharum* species is the most dominant grass along the forest-flood plain interface. The riverine forest can be further divided into six diverse types as Khair-Sissoo Forest, Tropical Evergreen Forest, Simal-Velar Forest, Litsea-Bombax Forest, Machilus Forest and Eugenia Woodland (DNPWC 2012). Plots A1, C1 and E1 were of riverine forest (Figure 1).

Grassland: A complex and varied assemblage of grasses are found in the Park. It covers 11.5% of the total park area (Thapa 2011). Most abundant grass species are *Saccharum spp, Imperata spp, Themada spp* etc.

3.3.2 Fauna

CNP harbors 68 species of mammals (CNP 2013), 55 species of herpeto fauna, over 525 birds (DNPWC 2012). The large mammals in CNP include Rhino (*Rhinoceros unicornis*), Tiger (*Panthera tigris*), Elephant (*Elephas maximus*), Leopard (*P. pardus*) and four species of deer (*Axis axis, A. porcinus, Cervus unicolor* and *Muntiacus* muntjak), gaur bison *(Bos gaurus),* sloth bear (*Melursus ursinus),* Monkeys (*Semnopithecus hector, Macaca mulatta*). Small mammals in CNP include the order rodentia (family: *Rattus rattus, Mus booduga etc),* Family: felidae (*Felis chaus, Prionailurus viverrinus),* Family: Viverridae (*Paguma larvata, Viverra zibetha, Vivericula indica),* Family: Herpestidae (*Herpestes edwardsi, Herpestes javanicus),* different species of order chiroptera. The park is especially renowned for its protection of one horned rhinoceros (*Rhinoceros unicornis* Linnaeus, 1758), the Royal Bengal tiger and gharial crocodile (*Gavialis gangeticus* Gmelin, 1789). Likewise, Maskey frog (*Tomopterna maskeyi*) is the species endemic to the park (DNPWC 2012). Similarly Black-necked stork (*Ephippiorhynchus asiaticus*), Lesser-Adjutant (*Leptoptilos javanicus*), Grey-headed Fish Eagle (*Ichthyophaga ichthyaetus*) and the Brahmini duck (*Tadorna ferruginea*) are the bird species symbolic to the park (Bhuju et al. 2007).



Map Source: Thapa(2011)

Figure1. Study Area showing Plots.

4. MATERIALS AND METHODS

4.1 Research Design

This research has followed the techniques of Long-term Ecological Research (LTER), PPBio (Program for Planned Biodiversity and Ecosystem Research) Australasia project initiated from 2008 in Nepal (Hero et al. 2011)**.** PPBio is a universal meso-scale, multidisciplinary program designed for undertaking cost-effective and efficient ecological research and data collection. This study was conducted in three plots of riverine and three plots of sal forest within the 250 m long transect 10/10 m left and right breadth from the midline having the area of 0.5 ha.

Each plot was a strip (250m long by 20m wide) that follows topographic contours. The width of plot was up to 20m wide either side of the plot midline. The midline includes a 2m wide buffer strip (1m on either side of the midline) designed to concentrate impacts within to concentrate impacts within this zone and minimize trampling within the study plot.

4.2 Small Mammals Sampling

The quantitative data on small mammals were collected by Elliot trapping, pitfall trapping and camera trapping method. All these traps were set to capture animals three nights per season in each plot. In addition to above mentioned methods, direct observation method was also used.

4.2.1 Elliot Trapping

Twenty-five baited Medium Elliot traps (9cm×10cm×33cm) were used per plot. They were placed 10m from the plot midline on the left and right hand side of the midline. Elliot traps were placed 20m apart. The twelve pairs of Elliot traps were set parallel to left and right hand side of the midline from 20m mark to 240m mark. The 13^{th} trap was set on the midline at the 250m as shown in figure 2. Seventy five Elliot traps were deployed in each plot for a season. Altogether 900 Elliot trap nights was done during this study. Traps were baited with a universal bait mixture of peanut butter and rolled oats and are set for three consecutive nights. Traps were checked and rebaited each morning. All captures were identified in the field where possible and

measurements taken (weight, head-body length, tail length, hind foot length, ear length). Each animal was also uniquely marked by clipping a unique combination of toenails before being released at the point of capture (Hero et al. 2011). Colorful flag tapes were marked on the branches of tree at the trap station to locate the Elliot traps.

Small mammals are very sensitive to temperature, particularly vulnerable to trap death because of their high metabolic rate. Therefore, enough food and bedding of dry leaves were provided in the trap. Traps were placed on the ground under the bushes or cover in order to protect trapped animals cold and sun light effects. Traps were cleaned and baits were replenished after every capture.

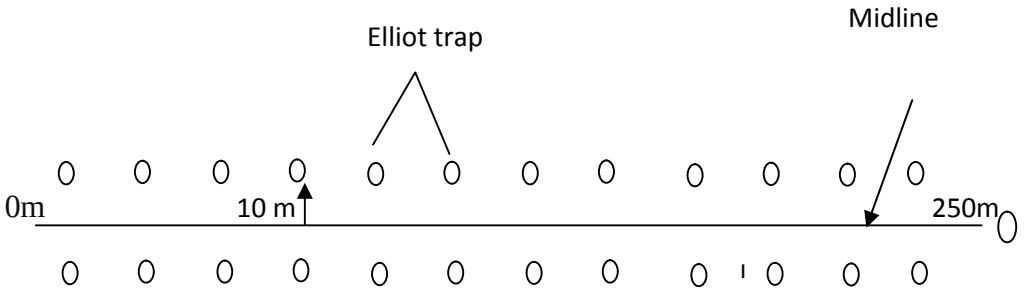


Figure 2. Positioning of Elliot Traps in 250 m transect (Hero et al. 2011).

4.2.2 Pit Fall Trapping

Small terrestrial mammals were sampled in three pitfall trap at each plot. Each pitfall trap consisted of two 25 L plastic buckets which were buried into the ground such that the bucket opening was flushed with ground surface. They were located at either end of a 5m plastic drift fence measuring at least 40cm in height. The base of the drift fence was buried so that no animals were able to cross under the fence. Pitfall arrays were established 5m left of the midline at the 62.5, 125 and 187.5 m marks as shown in figure below (Figure 3). Each plot was deployed with 3 pitfall traps per season. Altogether 108 pitfall trap nights was done for the study. All captured animals were measured; marked, essential information was noted released every day (Hero et al.2011).

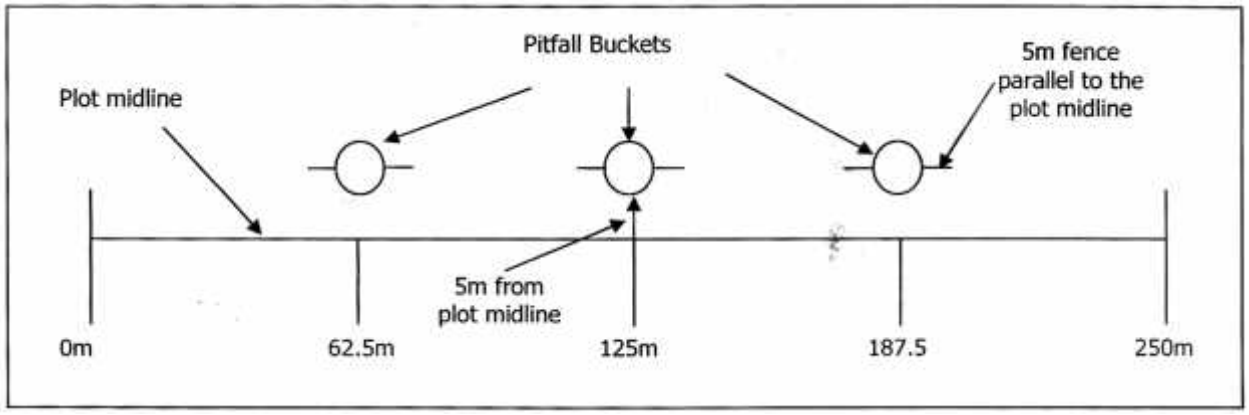


Figure 3. Positioning of Pitfall Trap in 250m transect (Hero et al.2011).

4.2.3 Camera Trapping

Reconyx RM45 was deployed to take the picture in every 10 seconds when any objects crossed the beam. Alkaline battery "C" were used. It was a wide area of sensitivity to detect the presence of animals. Two motion sensor cameras were set per plot and placed at the 50m and 200m marks along the plot midline. Seventy two trap nights was done for the study. Two to three-day stale chicken carcass was wired to the base of a tree or sapling between 1.5 and 2m away from, and in direct line of sight of the camera trap which was itself secured to the base of a tree no more than 0.5m above the ground in order to provide a clear and detailed image of the target small mammal. The chicken baits were replaced as necessary (Hero et al. 2011). The traps used to be monitored and checked on every morning 08.30-10.30 A.M in 2011 and 09.30-12.00 PM in 2012.

4.2.4 Direct observation

Direct observation of small mammals was recorded when encountered during the stay within the study site, during checking and setting of traps, while walking on the trails and a list was prepared.

4.3 Study on captured animal

The plot number; head and body length; weight; tail length; age; sex; ear length; reproductive condition (pregnant or lactating female, sexual dimorphism) were recorded. The body weight was measured using Pesola balance; the head and body length, tail length was measured using appropriate ordinary scale and ear length was measured using Vernier calliper. Sexing criteria (except shrew species) was based on the distance between anus and the vagina. The distance between anus and vagina is shorter in female than the distance between anus and penis in Males. All the captured animals were identified up to species level based on the morphological characters using standard literatures (Jnawali et al. 2011, Baral and Shah 2008, Menon 2009, Prater 1971). Then, each captured animal was individually marked by fur clipping and released immediately at the same place from where they were captured. Marking was done by fur clipping (Gurnell and Flowerdew 1990). This is a reliable method for short term experiments as the mark remains visible for few days and has no adverse effect to the animal

4.4 Data Analysis

4.4.1 Occurrence and abundance of small mammals

Occurrence of species was measured as the total number of species recorded in the plot. The study of distribution and abundance of organism is recognized as an important issue in ecology (Burnham et al. 1980). The study of abundance and distribution of animals in relation to ecological factors like habitat features and anthropogenic disturbances helps in understanding the relative importance of these factors in determining occupancy patterns of animals. Species abundance was analyzed by dividing total number of each species per number of plot in which it occurred (Krebs 1985). Similarly, distribution pattern of small mammals was analyzed by calculating the variance-mean ratio ($S^2 / \overline{X}$) as,

If $S^2 / \overline{X} < 1$, Distribution is uniform

If $S^2 / \overline{X} = 1$, Distribution is random

If $S^2 / \overline{X} > 1$, Distribution is clumped

Where, S^2= variance = $1/n \sum (X-\overline{X})^2$

Where, $\overline{X}$ = mean value

These data were analyzed using Microsoft Excel 2007 and spatial distribution pattern was assessed by using ARCGIS 9 and preparing GIS maps.

4.4.2 Species Diversity Index

The diversity of species was measured by using Shannon Weiner diversity index.

Shannon Weiner diversity index is designated as H, which is calculated as:

$$H = -\sum (n_i / N) \log_e (n_i / N)$$

Or, if $P_i = n_i / N$

$$H = -\sum P_i \log_e P_i$$

Where,

n_i =Importance values for each species.

N =Total Importance value.

4.4.3 Significant difference of traps and species occurrence in different habitats

Kruskal-Wallis Rank Sum was used to test the significant difference in the trapping efficiency of different traps. It is a non parametric test, which is an alternative to ANOVA when data are not normally distributed. Similarly, Paired Sample Wilcox test was used to find the significant difference in the occurrence of small mammals between two habitats. It is also a non parametric test which is an alternative to paired t-test when sample data are not normally distributed.

Following two hypotheses were tested by these non-parametric tests;

i. There is no significant difference in the trapping efficiency of different traps.

ii. There is no significant difference in the occurrence of small mammals between two habitats.

R-Software was used for the statistical analysis. R Console 2.15.2 was used for all tests. It is free and widely used software program designed by different experts. Data of 2011 and 2012 were merged as per need for statistical analysis.

5. RESULTS

5.1 Species occurrence

Altogether 14 species of small mammals representing three orders and six families were recorded during this study period. Among these, seven species including Small Indian Civet (*Viverricula indica)*, Large Indian Civet (*Viverra zibetha)*, Masked Palm Civet (*Paguma larvata)*, Asian Palm Civet (*Paradoxurus hermaphrodites)*, Indian Crested Porcupine (*Hystrix indica)*, Jungle Cat (*Felis chaus)* and Indian Grey Mongoose (*Herpestes edwardsi)* were captured on camera trap. Three species such as Pygmy White-toothed Shrew (*Suncus etruscus)*, Anderson's Shrew (*Suncus stoliczkanus)* and Asiatic Long-tailed Climbing Mouse (*Vandeleuria oleracea)* were trapped on pitfall traps. Four species such as House Rat (*Rattus rattus)*, Long-tailed Field Mouse (*Apodemus sylvaticus)*, Little Indian Field Mouse (*Mus booduga)* and Asian House Shrew (*Suncus murinus)* were trapped in Elliot traps and one species Indian Grey mongoose (*Herpestes edwardsi)* was recorded through direct observation.

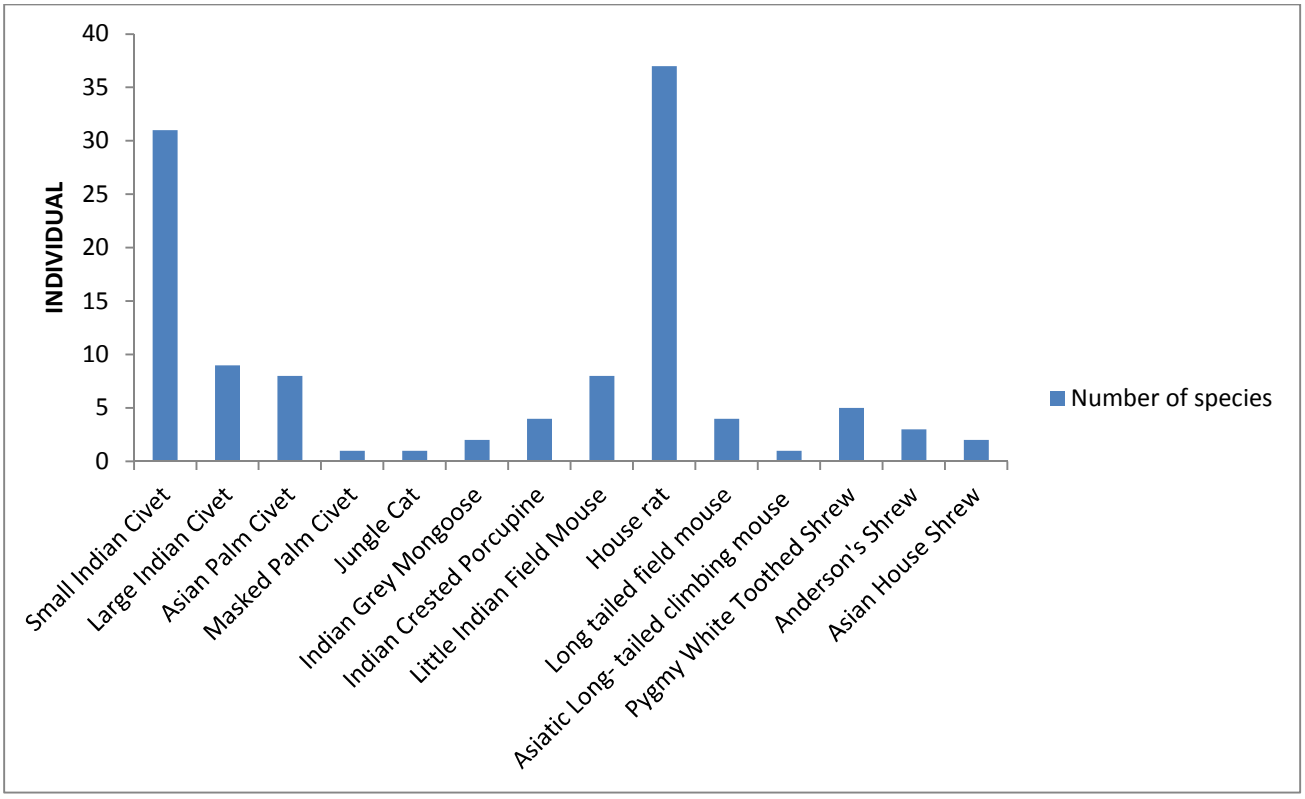


Figure 4. Number of species of small mammals.

Riverine and Sal forest habitats

A total of 10 species (71%) including Small Indian Civet, Large Indian Civet, Asian Palm Civet, Masked Palm Civet, Indian Crested Porcupine, Indian Grey Mongoose, Pygmy White-toothed Shrew, Anderson's Shrew House Rat and Asiatic Long Tailed Climbing Mouse occurred in riverine forests. Among them four species (40% of the species of riverine forest), Asian Palm Civet, Masked Palm Civet, Anderson's Shrew and Asiatic Long Tailed Climbing Mouse were recorded only in riverine forests. (Table 2).

Similarly 10 species of small mammals were found in sal forests (Table 2). Among them Jungle Cat, Asian House Shrew, Little Indian Field Mouse, Long Tailed Field Mouse were recorded only from sal forest habitat.

Six species of small mammals were common to both forest habitats. They were Small Indian Civet, Large Indian Civet, Indian Grey Mongoose, Indian Crested Porcupine, Pygmy White-toothed Shrew and House Rat.

5.2 Abundance of Species

Altogether 116 individuals of small mammals of three orders were captured in 1,080 trap nights during December 2011 to May 2012. Six species belonged to Carnivora, five species to Rodentia and three species to Soricomorpha (Table 2). The orders Carnivora, Rodentia and Soricomorpha composed of 45%, 46% and 9% of all captures respectively (Table 3). The abundance of Small Indian Civet was the highest (i.e. 7.75 with eight individuals) which is followed by House rat 6.15 with six individuals. Masked Palm Civet, Indian Grey Mongoose, Asiatic Long Tailed Climbing Mouse and one Jungle Cat showed the lowest abundance with just one individual each during the present study (Table 2).

Table 2. Analysis of abundance of small mammals in riverine and sal forest in 2011 and 2012.

S.N	Name of species	Plots						No. of Individuals	No. of plot Species Occurred	Abundance Of species
		Riverine			Sal					
		A1	C1	E1	F5	G5	H5			
1	Small Indian Civet	3	0	20	7	1	0	31	4	7.75
2	Large Indian Civet	3	2	2	0	2	0	9	4	2.25
3	Asian Palm Civet	3	0	5	0	0	0	8	2	4
4	Masked Palm Civet	0	0	1	0	0	0	1	1	1
5	Jungle Cat	0	0	0	0	1	0	1	1	1
6	Indian Crested Porcupine	0	1	0	0	2	1	4	3	1.33
7	Indian Grey Mongoose	1	0	0	0	1	0	2	2	1
8	Pygmy White-toothed Shrew	0	2	2	1	0	0	5	3	1.66
9	Anderson's Shrew	2	0	1	0	0	0	3	2	1.5
10	Asian House Shrew	0	0	0	2	0	0	2	1	2
11	Asiatic Long-tailed Climbing Mouse	0	0	1	0	0	0	1	1	1
12	Little Indian Field Mouse	0	0	0	0	6	2	8	2	4
13	House Rat	7	2	1	9	12	6	37	6	6.16
14	Long-tailed Field Mouse	0	0	0	2	2	0	4	2	2
Total		19	7	33	21	27	9	116		36.65

Riverine and Sal forest habitats

Forty individuals of civet, cat, mongoose and 19 individuals of rodents, shrews and porcupines of orders rodentia and soricomorpha were present in riverine forest (Annex-III). The abundance of small mammals in riverine forest was 28.66, i.e. 29 individuals. Small Indian Civet was the most abundant (11.5) with 12 individuals (Annex IV). Masked Palm Civet, Indian Crested Porcupine, Indian Grey Mongoose were the least abundant with one individual each. The result showed that, the abundance of small mammals in riverine forest was higher than the abundance in sal forest. Among 59 individuals recorded from riverine forest, thirty nine individuals were

trapped by camera trapping, twelve individuals from Elliot trapping and eight individuals by pitfall trapping (Annex-IV).

Civets, Cats and mongooses were represented by 12 individuals and rodents, shrews, and porcupines by 45 in sal forest (Annex-IV). The abundance of small mammals in sal forest was 27.5, i.e. 28 individuals (Annex-V). House Rat was the most abundant with nine individuals followed by Small Indian Civet and Little Indian Field Mouse each with four individuals. Indian Grey Mongoose, Jungle Cat and Pygmy White-toothed Shrew were least abundant with one individual each. Out of 58 captured individuals in sal forest, Fifteen individuals were trapped by camera trapping, Forty one individuals by Elliot trapping and single individual by pitfall trapping (Annexes-II and III).

Diversity Index

Shannon Weiner diversity index showed the diversity of small mammals of CNP. Shannon Weiner diversity indices of small mammals in CNP for 2011 and 2012 were 0.80 and 0.67 respectively. The diversity index of small mammals for both 2011 and 2012 together was 0.70

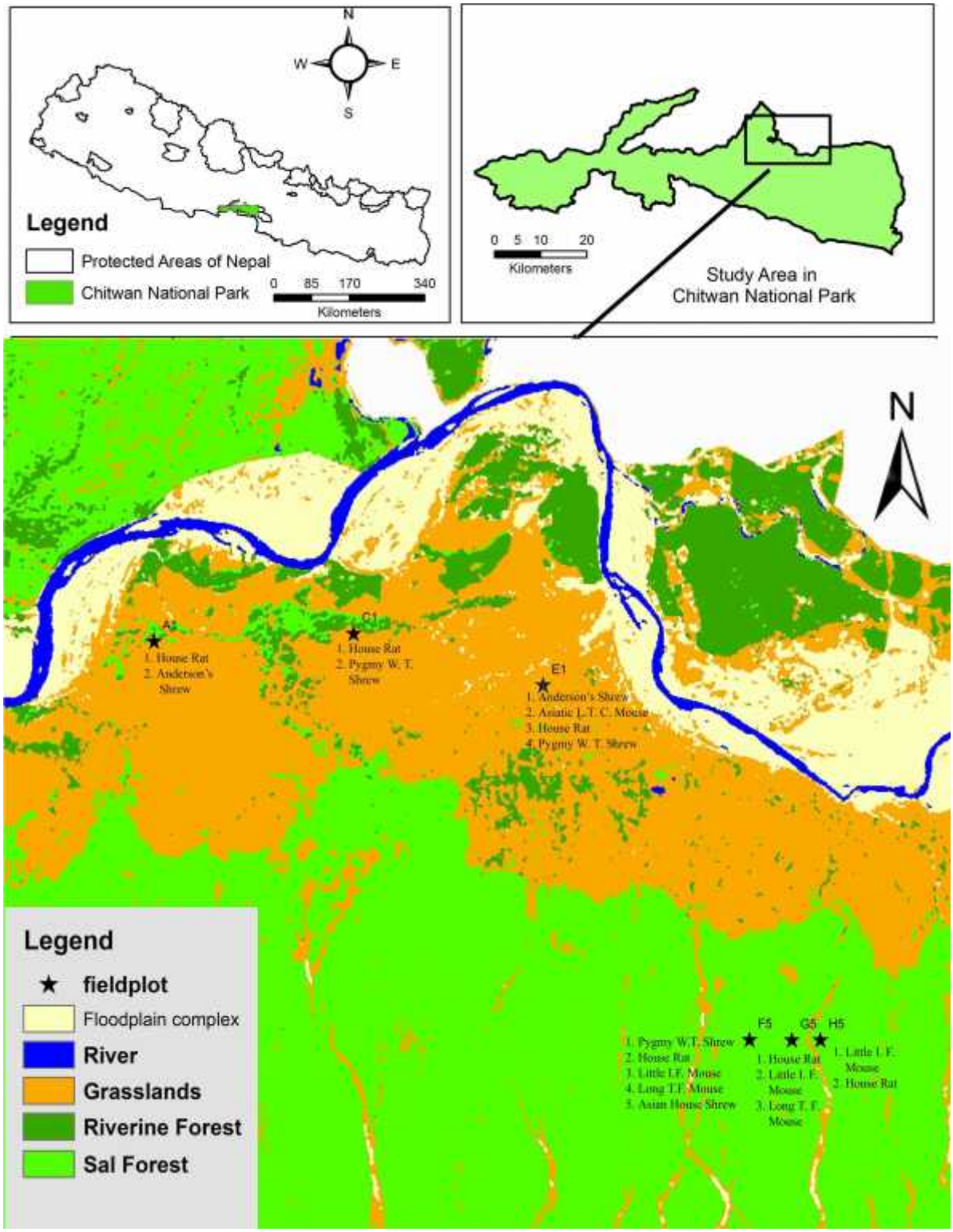
Table 3. Detail table of observed small mammals with their orders and families

S.N	Order	Family	Scientific Name	Common Name	Local Name	Habitat	No. of individuals
1	Carnivora	Viverridae	*Viverricula indica*	Small Indian Civet	Sano Nir Biralo	Riverine and Sal	31
			Viverra zibetha	Large Indian Civet	Thulo Nir Biralo	Riverine and Sal	9
			Paradoxurus hermaphrodites	Asian Palm Civet	Taadi Nir Biralo	Riverine	8
			Paguma larvata	Masked Palm Civet	Gajale Nir Biralo	Riverine	1
		Felidae	*Felis chaus*	Jungle Cat	Ban Biralo	Sal	1
		Herpestidae	*Herpestes edwardsi*	Indian Grey Mongoose	Thulo Nyauri Muso	Riverine and Sal	2
2	Rodentia	Hystricidae	*Hystrix indica*	Indian Crested Porcupine	Jure Dumsi	Riverine and Sal	4
		Muridae	*Mus booduga*	Little Indian Field Mouse	Sano Khet Muso	Sal	8
			Rattus rattus	House Rat	Ghar Muso	Riverine and Sal	37
			Apodemus sylvaticus	Long tailed field mouse	Laampuchre Khet Muso	Sal	4
			Vandeleuria oleracea	Asiatic Long- tailed climbing mouse	Laampuchre Rukh Muso	Riverine	1
3	Soricomorpha	Soricidae	*Suncus etruscus*	Pygmy White - toothed Shrew	Setadaante Pudke Chhuchundro	Riverine and Sal	5
			Suncus stoliczkanus	Anderson's Shrew	Anderson ko Chhuchundro	Riverine	3
			Suncus murinus	Asian House Shrew	Ghar Chhuchundro	Sal	2
Total	3	6		14			116

5.3 Distribution pattern of small mammals

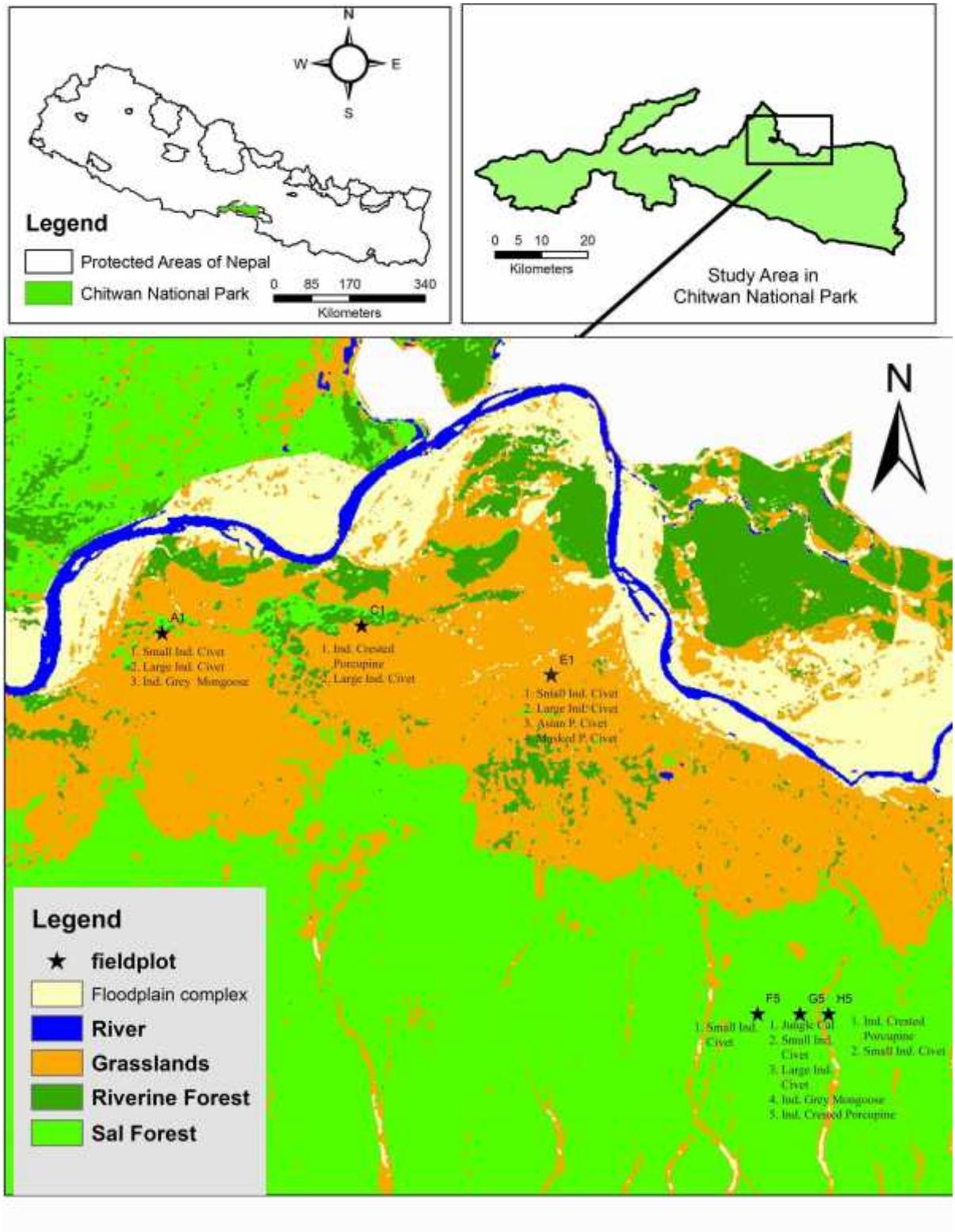
Distribution pattern of small mammals was clumped with a variance to mean ratio of 1.17. Similarly, the distribution patterns of small mammals in riverine and sal forests were clumped with variance to mean ratio 1.13 and 1.21 respectively. Chi-square test, a goodness of fit showed that there was no significant difference in distribution of small mammals between two habitats ($\chi 2$=0.034, df=1, α=0.05). Spatial distribution pattern of small mammals was evaluated by the generation of GIS map representing the distribution areas of small mammals in CNP.

House rat dominated plots of both habitats. Large Indian Civet was distributed in all three plots of riverine forest habitat. Small Indian Civet, Asian Palm Civet, Pygmy White-toothed Shrew and Andersom's Shrew were distributed in two plots of riverine forest. Similarly Small Indian Civet, Indian Crested Porcupine, Little Indian Field Mouse and Long-tailed Field Mouse were distributed in two of the plots of sal forest (Annex-I). Higher numbers of species were trapped in E1 plot of riverine and G5 plot of sal forest.



Map Source: Thapa(2011)

Figure 5. Distribution map of species belonging to family Muridae and Soricidae.



Map Source: Thapa(2011)

Figure 6. Distribution map of species belonging to family Viverridae, Felidae, Hystricidae and Herpestidae.

5.4 Assessment of habitat

Kruskal Wallis test revealed that there was no significant difference (χ2=3.258, P-value>0.05, df=2, α=0.05) in the trapping efficiency of different traps. All the traps trapped more or less the same number of species in total (Figure 7).

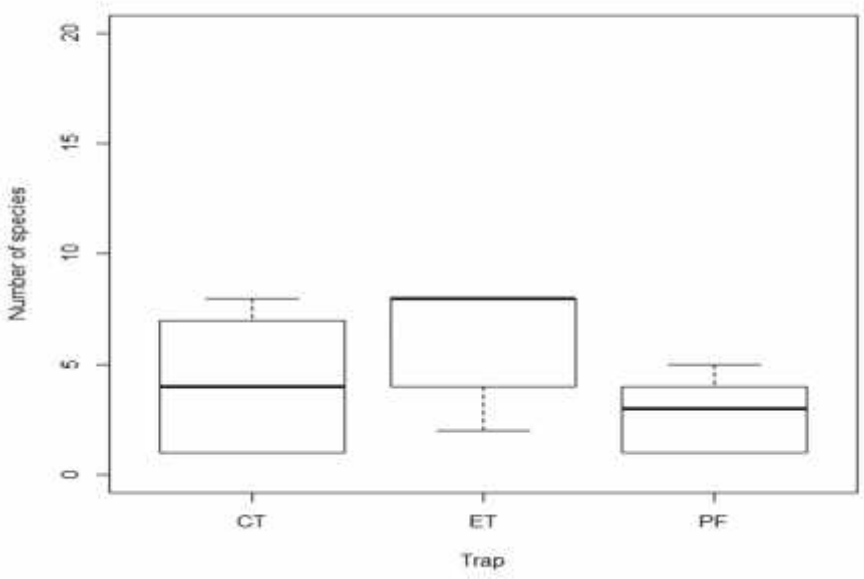


Figure 7. Box plot showing number of species of small mammals trapped by traps, where CT is Camera Trap, ET is Eliot Trap and PF is Pitfall Trap. The dark line in the box plot represents the median or mid value and its arm represents the quartile value of the species richness.

Wilcox test showed that there was no significant difference [χ2=0.18, P-value > 0.05, df=1, α=0.05] in occurrence of small mammals between two habitats. However, riverine forest has the higher number of small mammals than sal forest (Figure 8).

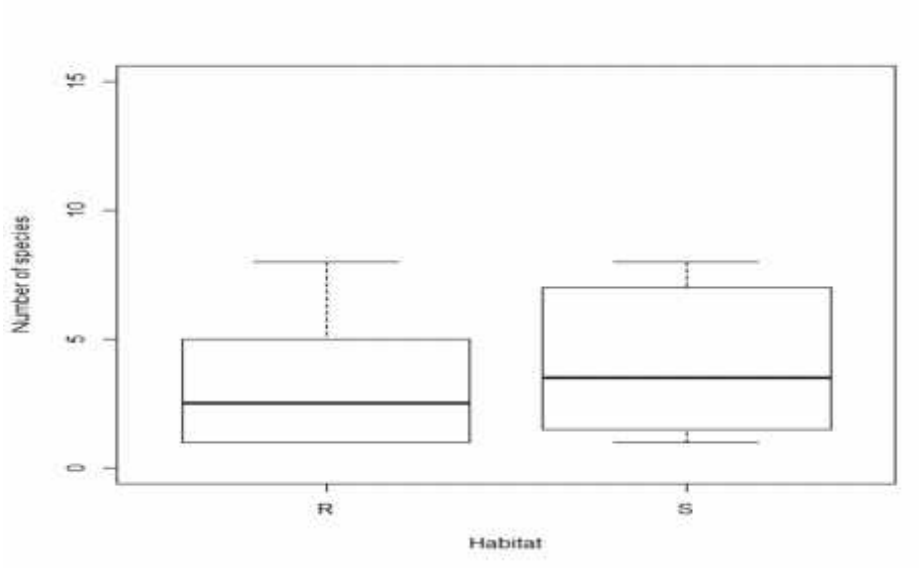


Figure 8. Comparison of number of species of small mammals between two habitats, where R is riverine forest and S is Sal forest. The dark line in the box plot represents the median or mid value and its arm represents the quartile value of the species richness.

Table 4. Habitat characteristics

The assessment of habitat was done on the basis of animals captured in the particular plot. Different factors such as moisture content, ground cover, canopy cover and vegetation around the plot was considered.

Habitat		Remarks
Riverine (Plots: A1, C1, E1)	Sal(Plots: F5, G5, H5)	
Plot A1: • Ground surface with high moisture content and high leaf litter. • Vegetation includes herbs and shrubs like *L. macrophyla*, *C. oppositifolia* and trees like *T. nudiflora*, *B.*	**Plot F5**: • More ground vegetation cover in sal forest. Ground surface with dry, rough soil with less moisture content. Open shruby vegetation. • Canopy covers about	• Plot A1 was around 200 m distant from the river. Availability of fruiting plants. Presence of dead fallen logs which supports habitat for small mammals. Presence of mikania.

ceiba, M. chisia, etc. - Canopy covers about 60%. - Occurrence of Small Indian Civet, Large Indian Civet, Asian Palm Civet, Indian Grey Mongoose, Anderson's Shrew and House Rat.	55-60% with tree species like *Terminalia tomentosa*, *T.* bellerica, *B. latifolia* etc. - Small Indian Civet, Pygmy White-toothed Shrew, Asian House Shrew, House Rat and Long-tailed Field Mouse were recorded here.	- In plot F5, Lesser species of small carnivores were recorded. This habitat was found to be appropriate for rodents and mouse. Presence of *Saccharum spp* within plot.
Plot C1: - Ground surface was similar to plot A1 and presence of same kind of vegetation. - Canopy covers about 70%. - Large Indian Civet, Indian Crested Porcupine, Pygmy White-toothed Shrew and House Rat occurred in this plot.	**Plot G5**: - Similar type of ground surface as like plot F5. - Canopy covers about 50-55%. - Occurrence of Small I Civet, Large Indian Civet, Jungle cat, Indian Crested Porcupine, Indian Grey Mongoose, Little Indian Field Mouse and House Rat.	- Human disturbed area due to jungle walks by the tourists and tour guides. Absence of fallen logs in C1 plot. - A small rivulet flows across the plot G5. More species of small carnivores were found here. This plot was with *Saccharum spp* partly.
Plot E1: - Presence of lesser	**Plot H5**: - Moisture content in	- Rapti river runs from left side of plot E1 i.e.

ground cover with lesser leaf litter. J Canopy covers about 55-60%. J Animals with four species of civet, Pygmy White-toothed Shrew, House Rat and Asiatic Long-tailed Climbing Mouse were found.	ground surface was very less. Ground cover with *Saccharum spp.* J Shrubs and trees are similar to F5 and G5 plots but more open. J Canopy covers about 50%. J Occurrence of Indian Crested Porcupine, Little Indian Field Mouse and House Rat.	Around 200-250 m far from plot. J Absence of nearby water source in plot H5. This plot was more open and visible than rest two plots of sal forest. Presence of small rocks and stones for the probable habitat.

6. DISCUSSION

6.1 Occurrence of small mammals

Riverine and sal forests of CNP look good habitat for small mammals as ten species of small mammals were recorded from each habitat types. Six species were common in both the habitats (Table 2). The different species recorded in 2011 but not in 2012 were Masked Palm Civet, Asian Palm Civet, Jungle cat, Indian Crested Porcupine, Indian Grey Mongoose and Long-tailed Field Mouse. Four species were common to 2011 and 2012, i.e. Small Indian civet, Large Indian civet, Pygmy White-toothed shrew and House Rat. Small Indian Civet was found as dominant species among the small carnivore and House Rat was as dominant species among rodents, shrews and porcupine. Dahal et al. (2011) identified Small Indian Civet as the dominant species in CNP. Bhattarai (2012) recorded six different species of small mammals in 252 trap nights in Parsa Wildlife Reserve and reported Common Mongoose, Indian Crested Porcupine, Asian House Shrew, Lesser Bandocoot rat, Small Indian Civet, and Common Palm Civet using Sherman Live traps in the grasslands with *Cynodon dactylon*, *Saccharum spontaneum* etc. He identified shrew as the dominant species. In this study, small mammal species were recorded from the area where vegetation included *Trewia nudiflora*, *Bombax ceiba* etc. Four species of civets were found in this study period but Joshi (1995) has included Spotted Linsang under the civet group. Little Indian Field Mouse was captured from G5 plot Sal forest. The plot G5 was nearer a stream and about 100m distance from grassland. Rodents of CNP have not been studied but there is a report on the biodiversity of small mammals in the western tarai of Nepal (Adhikari 2001). He recorded thirteen species from 12,816 trap nights. Although Indian Grey Mongoose, Small Indian Mongoose and Crab eating Mongoose occur in the area,only Indian Grey Mongoose was recorded during the study period. Dahal et al. (2011) recorded 12 species of small mammals including fishing cat and Large Indian Hare from Kasara and Tiger Tops Tented Camp areas. Large Indian Hare was recorded on buffer zone forest of Ghailaghari, Chitwan. CNP is rich in small mammal species diversity with 14 species with Shannon index of diversity of 0.70.

6.2 Abundance of small mammals

Abundance of small mammals in riverine forest was comparatively higher than the sal forest. Civets, cats and mongooses were more abundant in riverine forests. It might be due to the presence available food and fruits in riverine forest. Joshi (1995) reported that Asian Palm civet feed on nectar of *Bombax ceiba* and sap of *Vallaris solanaceae*, as both of the plants are dominant species of riverine forest. He indicated that Asian Palm Civet and Large Indian Civet feed primarily on fruits specially the berries of Palm and Figs (Bartels 1964, Alcala 1969). Other plant species like *Ficus glomerata, Ziziphus mauritina, B. stipularis* etc are highly preferred by civets are available in riverine forests. Fruits, seeds, berries are major diet of civets which are abundant in riverine forest. The seeds of fruits were found in 84.5% of 193 scats of Asian Palm Civet and the other 15.5% contained parts of insects, molluscs, small reptiles, birds and small mammals. This information assures that more fruits are found in riverine forest. Civets prefer to rest in dense vines and dense vines are found mostly in riverine forest (Joshi 1995). So, the abundance of small mammals (small carnivores) was higher in riverine forest. Similarly the abundance of small mammals (Rodents, Shrews and Porcupine) is higher in sal forest habitat. As sal forest is the area with the dense ground vegetation cover and termite moulds than in riverine forest. Nembang (2003) reported that the abundance of small mammals was high in the area with dense ground vegetation cover and proximity to water source. His study suggested that higher abundance of small mammals is due to the presence of higher vegetation cover. Adhikari (2001) reported similar situation from the study of Bardia. Pattern (1997) also described the positive correlation between rodent diversity, plant diversity and cover. Similarly, Brooks (1995) showed that small mammal communities differ with shrubs, herbs diversity and cover. This study showed similar results. The abundance of rodents, shrews and porcupines were less in riverine forest due to the presence of low ground vegetation cover in comparison to sal forest. Similarly low abundance of civets, cat and mongoose in sal forest was due to the unavailability of fruits, berries and seeds as well as absence of dense vines to rest.

6.3 Distribution of small mammals

The distribution pattern of small mammals was heterogeneous in all the plots of CNP. The distribution of small mammals was highly related with habitat heterogeneity and is also an important factor for conservation. The present study showed that distribution pattern of small

mammals is clumped. Nembang (2003) evaluated that distribution pattern of small mammals was patchy and random. Such kind of clumped distribution is a result of aggregation of individuals in response to various factors like daily or seasonal weather change, habitat differences, reproductive phenomenon or the social attractions (Odum 1996). In CNP or any other natural habitat the resources such as food availability, water, cover are not distributed equally and uniformly which leads uneven distribution. The dense ground vegetation cover creates niche types that play a major role in determining out small mammal community structure and diversity in forest ecosystem (Pattern 1997, Price and Waser 1985). The distribution and abundance of small mammals greatly varies over time, probably partly in response to climatic variation (Brown and Heske 1990) and is influenced by the vegetation composition, cover and species richness (Prakash 1990). Vegetation structure is a major part in explaining the abundance and distribution of small mammals (Moro and Gadal 2007).

To obtain a trap success, bait is an important component. Different factors such as age, sex, species and food availability in nature determines the preference of bait by an individual (Patrick 1970). During this study, Rodents highly preferred bait rolled with a mixture of oat porridge and peanut butter. Similarly chicken bait was preferred by small carnivores. Little Indian Field Mouse and Asiatic long-tailed Climbing Mouse were caught in low number. The oat-baited traps notably increased the event of capturing more number of rodents (Gurnell 1976) which was true for this study, as marked animals were caught in following captures.

6.4 Assessment of habitat

All the three traps trapped more or less same number of species during this study. The reason behind this study might be that camera traps were effective for capturing small carnivores like civets and small cat but not effective for capturing rodents and shrews. Elliot traps were small for capturing those small carnivores. All the three types of traps were not equally successful in capturing the species. The efficiency of traps was not significantly different as all Elliot traps, pitfall traps and camera traps were of similar sizes. There was no significant difference in trapping of three traps. Probably it might be due to the variation in the habitat but not with the efficiency of traps. The trap ability of small mammals is influenced by different agents like weather, season, population structure, habitat type and behavior of animals (Gurnell 1976).

7. CONCLUSIONS AND RECOMMENDATIONS

The study on occurrence, abundance, and distribution of small mammals in riverine and sal forests of CNP showed following results:

- CNP has a quite diverse assemblage of small mammalian species that included Small Indian Civet, Large Indian Civet, Asian Palm Civet, Masked Palm Civet, Indian Crested Porcupine, Indian Grey Mongoose, Jungle Cat, Little Indian Field Mouse, House Rat, Long tailed field mouse, Little Indian Field Mouse. Asiatic Long-tailed Climbing Mouse, Pygmy White-toothed Shrew, Anderson's Shrew and Asian House Shrew.
- From 1,080 trap nights, altogether 116 individuals (14 species) were captured across the study area.
- The occurrence and abundance of small mammals was higher in riverine forest than in sal forest but it was not significantly different. Occurrence in riverine forest was 51% whereas in sal forest was 49%.
- The occurrence of species belonging to the order Carnivora were more in riverine forest whereas the occurrence of species belonging to order Rodentia and Soricomorpha were more in sal forest.
- The Shanon Weiner diversity index of small mammals was 0.70.
- Small mammals were distributed in clumps in their natural environment.
- Ground surface of riverine forest was with high moisture content and leaf litter. Trees like *Trewia nudiflora*, *Bombax ceiba*, *Maesa chisia*, etc. were the dominant species with approximate 60-65% canopy cover. Somilarly, sal forest was dominated by *Shorea robusta*, *Terminalia tomentosa*, *Terminalia bellerica*, *Buchanania latifolia* etc with open shrubby vegetation. Ground surface was with less moisture containing dry soil. Canopy covers about 50-55%.

Based on the study, following recommendations have been put forward:

- This study was restricted to eastern sector of CNP. An extensive study of small mammals is recommended to cover the whole park.

- A detail survey of small mammals including both Volant and non-Volant species should be conducted to obtain baseline data although this study excludes the study of volant small mammals.
- Research in small mammals and their relationship with other fauna should be encouraged and provided.
- Sign based survey is most in order to accumulate more information's about small mammals.
- The study on specific species ecology of small mammals should be carried out.

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ANNEXES

Annex I. Observation table of small mammals.

S.N	Name of species	Plots						No. of Individuals	No. of plot Species Occurred
		Riverine			Sal				
		A1	C1	E1	F5	G5	H5		
1	Small Indian Civet	3	0	20	7	1	0	31	4
2	Large Indian Civet	3	2	2	0	2	0	9	4
3	Asian Palm Civet	3	0	5	0	0	0	8	2
4	Masked Palm Civet	0	0	1	0	0	0	1	1
5	Jungle Cat	0	0	0	0	1	0	1	1
6	Indian Crested Porcupine	0	1	0	0	2	1	4	3
7	Indian Grey Mongoose	1	0	0	0	1	0	2	2
8	Pygmy White Toothed Shrew	0	2	2	1	0	0	5	3
9	Anderson’s Shrew	2	0	1	0	0	0	3	2
10	Asian House Shrew	0	0	0	2	0	0	2	1
11	Asiatic Long Tailed Climbing Mouse	0	0	1	0	0	0	1	1
12	Little Indian Field Mouse	0	0	0	0	6	2	8	2
13	House Rat	7	2	1	9	12	6	37	6
14	Long Tailed Field Mouse	0	0	0	2	2	0	4	2

Annex II. Number of captured species in different traps in riverine forest.

S.N	Plots	Traps		
		Camera	Elliot	Pitfall
1.	A1	6	8	2
2.	C1	3	1	2
3.	E1	30	3	4
Total		39	12	8

Annex III. Number of captured species in different traps in sal forest.

S.N	Plots	Traps		
		Camera	Elliot	Pitfall
1.	F5	8	12	1
2.	G5	6	21	0
3.	H5	1	8	0
Total		15	41	1

Annex IV. Analysis of abundance of small mammals in riverine forest.

S.N	Name of species	Plots			No. of Individuals	No. of plot Species Occurred	Abundance Of species
		A1	C1	E1			
1	Small Indian Civet	3	0	20	23	2	11.5
2	Large Indian Civet	3	2	2	7	3	2.33
3	Asian Palm Civet	3	0	5	8	2	4
4	Masked Palm Civet	0	0	1	1	1	1
5	Jungle Cat	0	0	0	0	0	0
6	Indian Crested Porcupine	0	1	0	1	1	1
7	Indian Grey Mongoose	1	0	0	1	1	1
8	Pygmy White Toothed Shrew	0	2	2	4	2	2
9	Anderson's Shrew	2	0	1	3	2	1.5
10	Asian House Shrew	0	0	0	0	0	0
11	Asiatic Long Tailed Climbing Mouse	0	0	1	1	1	1
12	Little Indian Field Mouse	0	0	0	0	0	0
13	House Rat	7	2	1	10	3	3.3
14	Long Tailed Field Mouse	0	0	0	0	0	0
Total		19	7	33	59		28.66

Annex V. Analysis of abundance of small mammals in sal forest.

S. N.	Name of species	Plots			No. of Individuals	No. of plot Species Occurred	Abundance of Species
		F5	G5	H5			
1	Small Indian Civet	7	1	0	8	2	4
2	Large Indian Civet	0	2	0	2	1	2
3	Asian Palm Civet	0	0	0	0	0	0
4	Masked Palm Civet	0	0	0	0	0	0
5	Jungle Cat	0	1	0	1	1	1
6	Indian Crested Porcupine	0	2	1	3	2	1.5
7	Indian Grey Mongoose	0	1	0	1	1	1
8	Pygmy White Toothed Shrew	1	0	0	1	1	1
9	Anderson's Shrew	0	0	0	0	0	0
10	Asian House Shrew	2	0	0	2	1	2
11	Asiatic Long Tailed Climbing Mouse	0	0	0	0	0	0
12	Little Indian Field Mouse	0	6	2	8	2	4
13	House Rat	9	12	6	27	3	9
14	Long Tailed Field Mouse	2	2	0	4	2	2
Total		21	27	9	57		27.5

Annex VI: Photographs.

Small Indian Civet in camera trap

Pygmy White toothed shrew

Marking of captured animal

Handling of rodent for its detail measurement

Masked Palm Civet in riverine forest.

Large Indian Civet

Researcher with Academic Supervisor

Setting of camera traps for small mammals

Jungle Cat in sal forest

Elliot trap damaged by Rhino

Sal Forest of CNP

Setting of Pitfall traps