



Original Article

**Characteristics of the First Record of Bat (Mammalia: Chiroptera) Fauna from Peshawar and Adjacent Areas, Khyber Pakhtunkhwa, Pakistan**

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**ABSTRACT**

The present research was conducted to explore the bat fauna of districts Charsadda, Kohat, Mardan and Nowshera, Khyber Pakhtunkhwa, Pakistan during July 2011 to May 2013. A total of (N=213) bats of 5 genera and 10 species belonging to 4 different families of order Chiroptera were collected. They were belonging to family Pteropodidae (1 species): the Indian flying fox, *Pteropus giganteus* Brunnich; family Hipposideros (1 species): the fulvus leaf-nosed, *Hipposideros fulvus* Gray; family Rhinopomatidae (2 species): the lesser mouse-tailed bat, *Rhinopoma hardwikei* Gray and greater mouse-tailed bat, *Rhinopoma microphyllum* Brunnich; family Vespertilionidae (6 species): the kellaert's pipistrellus, *Pipistrellus ceylonicus* Kelaart; Indian pipistrellus, *Pipistrellus coromandra* Grey; Javan pipistrellus, *Pipistrellus javanicus*, Gray; least pipistrellus, *Pipistrellus tenuis* Temminck; Asiatic greater yellow bat, *Scotophyllus heathii* Hosefield; and Asiatic lesser yellow house or Kuhl's pipistrellus bat, *Scotophyllus kuhlii* Leech. *Pipistrellus tenuis* was the smallest, however, *R. hardwikei* is the medium sized, moreover, *R. microphyllum* is the largest bats compared with all collected species. Further, *S. heathii* is a bat with greater body weight; furthermore, *S. kuhlii* can only be distinguished from the *S. heathii* by its small size, while all other structures are almost similar. Due to lack of education, most of the were aware about the importance of bats in the study area. This paper provided education and awareness about bats to the farmers and general the public in the study areas. **Key words:** Bat fauna, Hipposideridae, Pteropodidae, Rhinopomatidae, Vespertilionidae.

**INTRODUCTION**

Peshawar is a large valley situated between 33°-04' and 33°-34' North latitudes; 70°-29' and 72°-01' East longitudes; 34°0'28 North and 71°34'24 East altitudes. However, Mardan,

Charsadda, Kohat and Nowshera are its adjacent areas (Perveen and Jamal, 2012). Kohat is located between 33°-04' and 33°-34' North latitudes; 70°-29' and 72°-01' East longitudes. The height of it varies from 650-1000 m above the sea level. Mardan lies between 34°-05' and 34°-32' north latitudes; 71°-48' and 72°-25' east longitudes and altitudes of 283 m (928 ft) in South-West. Charsadda is located at 34°13'7 North, 71°37'33 East and has an altitude of 300 m (987 feet) and lies 29 km from the provincial capital of Peshawar. Nowshera is located between 34°01'64 and 34°0'59 North latitudes; 71°97'47 and 71°58'29 East longitudes; altitude of 270 m (889 ft) in the South-West (Figure 1). All study areas are beautiful, lush green and provided true natural habitats for development of the bat fauna (Perveen and Jamal, 2012, Perveen and Rahman, 2012).

The bats are mammals of the order Chiroptera whose forelimbs form webbed wings, making them the only mammals naturally capable of true and sustained flight, however, they are contributing to a large part of the mammalian biodiversity (Mayer *et al.*, 2010). They are sub-divided into 2 groups: Megabats and Microbats (Koopman *et al.*, 1993; Bates and Harrison, 1997; Wilson and Reeder, 2005) with 1150 Known species existing worldwide (Schipper *et al.*, 2008). However, about 119 bat species were found in the subcontinent including Pakistan, India, Sri Lanka, Nepal, Maldives and Northern Myanmar (Bates and Harrison, 1997). Of the mammalian fauna of Pakistan, bats have contributed 28% fauna including Palearctic, Indomalayan and Ethiopians (Roberts, 1997; Perveen and Rahman, 2014). Palearctic fauna are comprised certainly of species that from Baluchistan and Himalaya regions. Except Arctic and Antarctic regions and some isolated oceanic Islands, bats inhabit everywhere (Hutson *et al.*, 2001) in the world. Tropical, subtropical and temperate regions, including vegetative terrestrial ecosystems are richer with respect to bat fauna (Hill and Smith, 1984; Fenton, 1992; Emmons and Feer, 1997; Vaughan *et al.*, 2000), where they are active through the year for fulfilling their energy and metabolic needs (Audit and Fenton, 1988; Hickey and Fenton, 1996; Turbill *et al.*, 2001; Chruzez and Barcalay, 2002). The microbats inhibit greater around 30 °C (Hock, 1951; Kulzer *et al.*, 1970; Geiser and Brigham, 2000). As insect availability decreases at low temperature (Hickey and Fenton, 1996), therefore, they undergo hibernation in the temperate zones throughout the winter (Park *et al.*, 2000). However, bats are not studied more in Pakistan, therefore, information about their complete taxa is unknown (Roberts, 1997; Mahmood-ul-Hassan *et al.*, 2009). Moreover, bat fauna of Pakistan comprised of 50 species with 26 genera and 8 families (Roberts, 1997).

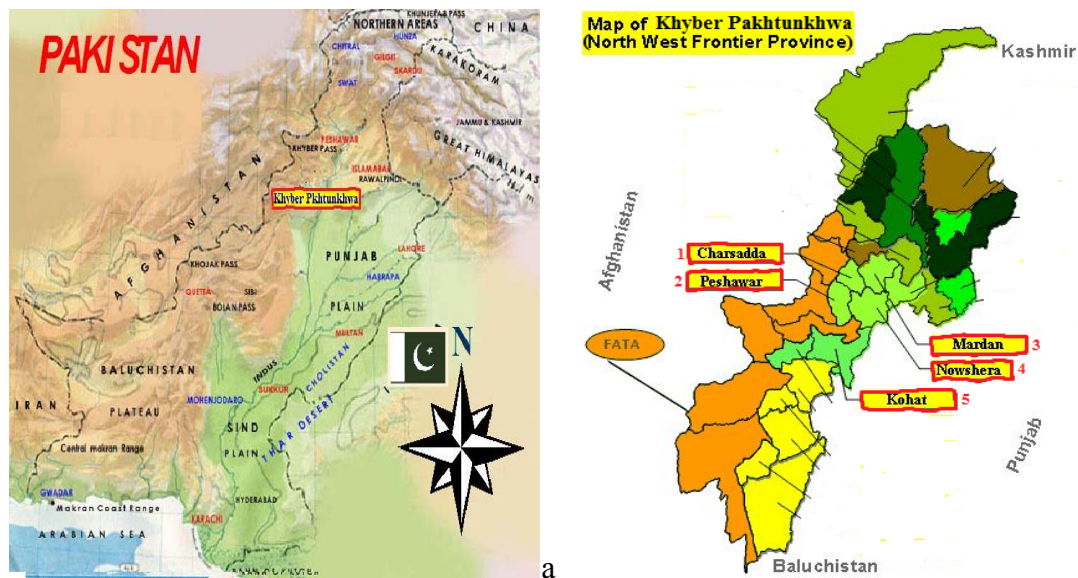
The pattern of distribution of the mammals becomes reshape in the tropical regions of the world, due to habitat loss, deforestation and anthropogenic interference (Lane *et al.*, 2006; IUCN, 2009). Bats play an important role as bio-indicator (Jones *et al.*, 2009) and perform significant ecological services (Fuji and Tuttle, 1991). Pakistan has vast crops and fruits diversity, therefore, fruit bats are considered as vermin for poaching those ripe fruits (Roberts, 1997). Fruit bats disperse seed and pollinate a large variety of plants (Mickleberg *et al.*, 1992). About 163 species produce 400 plants, products useful to men (Fujita and Tuttle, 1991). Farmers and biologists of Pakistan considered them as non-significant animal, therefore, less research has been conducted for them (Butt and Beg, 2001). Considering their important ecological role and incomplete taxa in Pakistan, the present study is designed to describe characteristics of the bat fauna of Peshawar and adjacent areas for the first time in the Pakistan.

## MATERIALS AND METHODS

In the present research, the bat fauna (Mammalia: Chiroptera) have been collected from 5 different quadrates, i.e., Charsadda, Kohat, Mardan, Nowshera and Peshawar in Khyber Pakhtunkhwa (KP), Pakistan (Figure 1) during July 2011-May 2013.

The study procedure was adapted from De-Blase, 1980; Bates and Harrison, 1997; Dietz and Halverson, 2004, however, it was modified to facilitate the present research. The bat

species were collected using mist nets from 5 quadrates of the study area as mentioned above. Different mist nets of 6, 9 and 12 m sizes were used to capture bats (Perveen and Rehman, 2012). Nets were checked continuously to disentangle any captured bat. The collected specimens were brought to the laboratory, Department of Zoology, Hazara University (HU), Garden Campus, Mansehra, KP, and Pakistan. They were fainted by using cotton swab soaked in chloroform (100%) and preserved at low temperature (-5 °C) in a freezer. The wingspan and forearm of the bat species of each specimen were taken and compared them with Roberts, 1997; Mahmood-ul-Hassan *et al.*, 2009 and Srinivasulu *et al.*, 2010. Then they were preserved in ethanol (100%) and detail identification has been done by literature available, experts, keys and already preserved specimens present in Zoological Museum, HU. Each specimen has been given a specific field number, collector's name, date and time of capture, exact locality, sex, name of tehsil/district etc on the tags and placed one by one on a white paper for photography (dorsal and ventral sites) by use of digital camera, Kodak (8.2 megapixels), Tokyo, Japan. A total of 216 mist net nights were utilized and 213 individuals were captured from all quadrates of the study areas.



**Figure 1.** Map of study area where from a collection of bat fauna (Mammalia: Chiroptera) has been made during July 2011-May 2013; (a) map of Pakistan yellow with red highlighted showing location of Khyber Pakhtunkhwa; (b) map of Khyber Pakhtunkhwa yellow with red highlighted 1-5 showing location of different quadrates, i.e., Charsadda, Kohat, Mardan, Nowshera and Peshawar (OCHA Pakistan, 2009).

## RESULTS

The present study was conducted to record the bat fauna of Peshawar and adjacent areas including Charsadda, Mardan, Nowshera and Kohat, one of the provinces, Khyber Pakhtunkhwa in Pakistan during July 2011-May 2013. Bat species (10) were belonging to 4 families including, 1 from each Pteropodidae, Hipposideridae, 2 from Rhinopomatidae and 6 from Vespertilinidae were collected, which are as follows:

### (1) Indian flying fox, *Pteropus giganteus*

The Indian flying fox, *Pteropus giganteus* Brunnich, 1782 is a large size fruit bat. It is dark brown in color with body weight:  $1121.93 \pm 38.87$  gm; head and body length:  $270.87 \pm 6.0$  mm; forearm length:  $174.10 \pm 1.73$  mm and tibia length:  $50.17 \pm 1.58$  mm. Its snout is entirely long and hairy, while ears are tall, black and pointed at tips. The wings are massive, long and

pointed. The thumb or first digit has greater claw, while the claw of the second digit is small. The feet are large with blunt claws. The pelage of this species is long, varies in color at the shoulder and ventral surface, independent of age, sex and climate variations. Its body weight and fore-arm length are the greatest than all collected bats. It is frugivorous or nectarivorous, i.e., it eat fruits or lick nectar from flowers. At dusk, it forages on ripe fruits, while ingesting pulp of fruits, it expels waste that pollinates and disperses seeds. It is gregarious and roosts in colonies with numbers up to 1,000 individuals during daytime. At the present, it was 8% of total collected species only from Charsadda (Figure 2: photograph 1).

### (2) Fulvus leaf-nosed bats, *Hipposideros fulvus*

The fulvus roundleaf-nosed, *Hipposideros fulvus* Gray, 1838 is a small bat. It is varies from dull yellow to pale grey in color with body weight:  $8.67 \pm 0.58$  gm; head and body length:  $49.67 \pm 1.53$  mm; forearm length:  $42.00 \pm 1.00$  mm and tibia length:  $8.98 \pm 0.88$  mm. It has square nose-leaves, however, its ears are 20-23 mm long with broadly rounded tips and larger than those are of its close relatives. No sexual dimorphism is found. The dorsal fur may be reddish brown, dull yellow, dull brown, light gray or golden orange and the ventral fur ranges from creamy white to pale gray. It has morphological similarities to *H. ater* Templeton, 1848, while it is slightly larger than *H. ater*. Its habitat preferences are relatively broad, including dry plains, thorn scrub and thick tropical forests. It is also found at a wide range of elevations. It uses porcupine, *Hystrix indicus* Miers, 1886 (Rodentia: Hystricidae) and Python, *Python sebae* (Gmeline, 1788) (Squamata: Pythonidae) burrows, caves or abandoned buildingd fro their roosts. Optimal roosting sites are cool and damp, usually with flowing water nearby. At the present, it was 1.6% of total collected species only from Mardan (Figure 2: photograph 2).

### (3) Lesser mouse-tailed bat, *Rhinopoma hardwickii*

The lesser mouse-tailed bat, *Rhinopoma hardwickii* Gray, 1831 is a medium sized bat. It is dark pale greyish to dark brown in color with body weight:  $26.60 \pm 1.96$  gm; head and body length:  $73.17 \pm 1.46$  mm; forearm length:  $53.06 \pm 0.76$  mm and tibia length:  $12.61 \pm 0.52$  mm. Its tail is elongated and mouse like, longer than the *R. microphyllum* Brunnich, 1782 and exceeds the forearm in length. Pelage is generally like that of *R. microphyllum* in color and texture. The feet are thin and delicate, while the chin looks like naked. The belly color is essentially grey. Its wing membrane, inter femoral membrane, lower abdomen and back are naked. It covers with soft fur on the body, but not on its face, rear abdomen and rump. The lower parts are paler in color. The snout has a small triangular shaped nose leaf. It is well adapted to its arid habitat. It has slits or valves just above their nostrils, which can open or close in response of will, helping to keep the dust out. Nostrils are also able to survive without a source of fresh water. As it obtains most of the water, it requires from its food. The kidneys are also able to produce highly concentrated urine, in order to conserve precious water. The large rhomboid-shaped ears have transverse ridges across the pinna and connect across the forehead with well-developed tragi. The uropatagium (flap of skin between hind limbs) is small and envelops less than a 4<sup>th</sup> part of the tail. It has a short skull with a loose tympanic bone and inflated lacrimal region, which is the broadest at the squamosal region of the zygomatic arch. It has 28 teeth with dentition is as follows: 1/2, 1/1, 1/2, 3/3.

It is found in arid or semi-arid desert habitat, wherever roosts at adequate food may be found. This includes dry scrub, rocky areas, caves, deserted monuments, abandoned buildings, wells and other underground features. It has been recorded in oases and wadi gorges having salt cedar, *Tamarix* sp L or oleander, *Nerium oleander* Aiton vegetations. In the hot summer months, it can be found resting in cracks, nooks and even the amongst large rocks. It occurs up to altitudes of 1,100 m (3,600 ft) above sea level. It is insectivorous, feeding primarily on beetles comprising up to 50% Neuropterans (net-winged insects, includes the lacewings, mantidflies, antlions and their relatives) and Lepidopterans (moths), however, it may also consider as pests of humans. It is well adapted to live in hot and dry

climates. During the hot months, these bats move into covered shelters to escape the heat. It hunts for insects at heights ranging from 5-10 m off the ground, often being mistaken for birds due to their pattern of swooping and gliding. It roosts in colonies both small, ranging in size from 4-10 individuals to large numbering may be 1000. Female tends to group, especially lactating mothers. It hangs using both the thumbs, feet and generally uses a shelter for a single day only before moving on. Male matures within 16-17 months of age. Female becomes sexually mature in 9 months of age and are monstrous, i.e., it has one oestrus cycle per year. The mating season is generally during February-April. Gestation lasts from 95-100 days and only one offspring is produced in a brood, usually in June-July. The young bats take flight at the age of 5-6 weeks.

It is considered a primitive bat in terms of echolocation, primarily due to the reason that bat produces signals with 4 or more harmonics with limited frequency variation. The bats make a variety of sounds, primarily constant frequency (CF) sounds of 48 millisecond (ms) duration, with pronounced second harmonics. The choice of frequency depends upon whether the bat is flying alone, in which case the calls have a frequency of 32.5 kHz or in a group, when bat choose 1 of 3 frequencies, 30, 32.5 and 35 kHz, therefore, as to avoid jamming each other. While landing or flying in groups around the roost-site, it emits frequency modulated (FM) sounds of 3 ms duration. After landing, they produce a multi-harmonic pure tone of 100 ms duration, in which the main frequency predominates. As mentioned above, it feeds primarily on insects, which are caught in flight. Its flight is rather unique amongst bats, as it initially flutters its wings and then partially glides. Most bats use echolocation to locate prey and avoid obstacles, allowing it to fly in complete darkness. The ultrasound calls, which emit through the nostrils, consist of long, high frequency chirps (of around 32 kHz). Feeding as much as possible during the summer months, it builds up fat in its abdominal region, in preparation for the winter, when food is scarce. During the winter season, it enters a period of dormancy (hibernation) or lives off its fat reserves. After awakening from its winter dormancy in late February, it enters its breeding season, which lasts middle of April. At the present, it was 5.3% of total collected species only from Charsadda (Figure 2: photograph 3).

#### **(4) Greater mouse-tailed bat, *Rhinopoma microphyllum***

The greater mouse-tailed bat, *Rhinopoma microphyllum* Brunnich, 1782 is the largest of all 3 species of the family Rhinopomatidae. It is dark pale greyish to grey brown in color with body weight:  $19.09 \pm 1.36$  gm; head and body length:  $80.35 \pm 3.0$  mm; forearm length:  $68.71 \pm 1.05$  mm and tibia length:  $15.93 \pm 0.43$  mm. It is one of the few bats in the world to have a tail as long as the head and body combined, however, its tail is relatively short than that of the *R. hardwickii*. It has soft, greyish-brown or dark brown fur on the body, with a paler abdomen. The chin, rump, ear, rear part of the abdomen, connecting membrane of the fore-head and face are without hairs or bare. It has large ears, which connect across the forehead by a flap of skin and each has blunt sickle shape tragus. It has the ability to hang by its thumbs as well as its feet. Its wingspans are short as compared to other bat species of the Rhinopomatidae.

It can live arid areas, with rainfall usually less than 300 mm and with sparse vegetation. It is a true desert species, which is adapted to this habitat by having valve or slit-like nostrils. It is even known to have lived in the ancient pyramids of Egypt for over 3,000 years. It roosts in crevices, small caves, mines, underground tunnels, wells, old monuments and buildings. It can tolerate low relative humidity and light. Human disturbance in roost sites and use of pesticides for locusts affect it but are not consider major threats at the present. It lives in large colonies, sometimes containing over a 1000 individuals. Its diet is varies depending on the time of year and the location. For example, a population of bats in Iran was found to feed almost exclusively on Coleopteran (beetles), while in Israel, during the summer months, it is known to feast on carpenter ants, *Camponotus spp.* (Hymenoptera: Formicidae) during its

massive nuptial flights, in which male and female ants emerge from nests to mate. Over autumn, it accumulates fat and almost doubles in weight, allowing it to survive for several weeks without any food or water during the harsh winter months when insect prey is scarce. As a result, it does not need to hibernate and instead remains active throughout the year. A female mate in spring, around March, gives birth to a single young in June or July after a gestation period of around 18 weeks. The young one is weaned after 6-8 weeks and becomes sexually mature in their second year of life. At the present, it was collected from Peshawar and Mardan and was 25.6% of total collected species (Figure 2: photograph 4).

#### **(5) Kelaert's pipistrellus, *Pipistrellus ceylonicus***

The Kelaert's pipistrellus, *Pipistrellus ceylonicus* Kelaert, 1852 is relatively large bat. It is grey brown in color with body weight:  $8.90 \pm 0.99$  gm; head and body length:  $47.91 \pm 1.16$  mm; forearm length:  $35.95 \pm 1.33$  mm and tibia length:  $7.03 \pm 0.49$  mm. It is a common species and widely distributed all over the world. Pelage of the body is included ears and naked area of the face. The dorsal pelage is varying in color, grey brown to golden brown. Hairs of the ventral surface are also varying in color, i.e., dark at base and pale grey at tip. Wings are uniformly dark brown in color. It has comparatively greater wingspan, while body weight is normal. It is found in varied habitats from arid regions to humid mountainous forests. It roosts in human habitations in both rural and urban areas, in old dilapidated buildings, crevices, cracks in walls, tree hollows, and holes in trees, caves, wells, old temples and under overhanging ledges. It roosts either singly or in colonies of few hundred individuals. It is an early flyer, which includes numerous twists, turns and goes straight. It hunts mainly beetles, moths, flies (Diptera) and other insects. Two young ones are born after a gestation period of 50-55 days. Its population seems to be doing well over its range. At the present, it was 5.3% of total collected species only from Peshawar (Figure 2: photograph 5).

#### **(6) Indain pipistrellus, *Pipistrellus coromandra***

The Indain pipistrellus, *Pipistrellus coromandra* Grey, 1838 is a small bat. It is clove brown in color with body weight:  $5.59 \pm 0.80$  gm; head and body length:  $37.58 \pm 1.96$  mm; forearm length:  $29.14 \pm 0.89$  mm and tibia length:  $6.56 \pm 0.38$  mm. Morphologically, it is difficult to differentiate from least pipistrellus, *Pipistrellus tenuis* Temminck, 1840. It is uniform brown on the dorsal surface, while prominently pale on ventral surface and pelage color is varying among individuals. Its body weight and fore-arm length are relatively lesser than the *P. ceylonicus*. It is found in different habitat types from forests, agricultural landscapes to urban areas. It roosts in trees, crevices, cracks in walls, ceilings of houses, tiles of huts, old buildings, temples, under bark, in holes of large trees, signboards and tree hollows. It lives in small groups of few individuals. However, it is an early flyer with a slow fluttering flight and hunts on flies, ants and other small insects. It has 3 breeding seasons in which 2 young ones are born. At the present, it was 9% of total collected species only from Peshawar (Figure 2: photograph 6).

#### **(7) Javan pipistrellus, *Pipistrellus javanicus***

The Javan pipistrellus, *Pipistrellus javanicus*, Gray, 1838, is a medium size insectivorous bat. Pelage color is varying among different individuals of this species. Some are uniform brown on the dorsal, while buffy brown on the ventral surface. However, it is clove brown in color with body weight:  $7.6 \pm 0.5$  gm; head and body length:  $49.6 \pm 2.7$  mm; forearm length:  $31.8 \pm 0.6$  mm, tail length: 28.9 mm and tibia length:  $8.2 \pm 0.2$  mm. The wings, ear and inter-femoral membrane are naked and uniformly dark brown. Their body weight and fore-arm length are varying from other pipistrellus. It has small eyes, short and broad muzzle without nose-leaves, tail entirely enclosed within the inter-femoral membrane and a tragus in its ear. Wrists and feet are without thickened pads. Metacarpal of 5<sup>th</sup> finger is as long as metacarpal of 4<sup>th</sup> finger. Ears are blackish-brown, short and rounded with a distinct fold at the hind edge.

Tragus is long, relatively straight and rounded at the tip. Fur of upper-parts is dark brown with much darker bases, fur of under-parts is paler and with darker bases. Wing membranes are blackish-brown. Baculum (penis bone) is present in the proximal half of the relatively long penis (10.8 mm long when erected), a character consistent among members of the genus *Pipistrellus*. In the relaxed state, the most of the organs are not supported by the baculum folded downwards. Two pairs of upper incisors and narrow diastema are present between outer upper incisor and upper canine tooth. Two pairs of upper premolars are present, first premolar is small and displaced inwards. At the present, it was 4.3% of total collected species only from Peshawar (Figure 2: photograph 7).

#### **(8) Least pipistrellus, *Pipistrellus tenuis***

The least pipistrellus, *Pipistrellus tenuis* Temminck, 1840 is the smallest bat than all collected species. It is chestnut brown in color with body weight:  $5.56 \pm 0.65$  gm; head and body length:  $37.99 \pm 1.58$  mm; forearm length:  $28.99 \pm 0.94$  mm and tibia length:  $6.05 \pm 0.48$  mm. This individual is difficult to determine and discriminate, based on external characteristics alone. The pelage on the dorsal side is just like *P. coromandra*, i.e., uniform dark brown, however, on the ventral surface is paler. Hair tips are buff with darker brown bases, however, tragus is slightly curved. The forearm of this species was the shortest than all collected species. It feeds on small insects over clearings, fields and forests. It roosts in attics, under roofs, crevices, walls and sometimes in foliage. It is found in a wide range of habitats including towns, villages, arid zones to wet and humid areas. It is equally abundant in forested areas, rural and urban landscapes. It roosts in hollows of trees, holes, crevices, cracks in walls, ceilings of old buildings and dead leaves of trees etc. It inhabits primary and secondary hills, mountainous and mossy forests. It is adapted to highly disturbed habitats, gardens and mangrove forests. Houses and buildings should protect as important roost sites. It is an early flyer, with a varied flight pattern from a jerky flight with many twists and turns to a slow fluttering and floating flight to an erratic flight as the evening progresses. Often it hunts close to ground, however, trees lines and hedgerows may be important for commuting and feeding for it. Its diet is varied and seasonal. It feeds on beetles, cockroaches (Orthoptera), wingless ants, termites (Isoptera: Termitidae), moths, and dipterans in winter; on a wide variety of insects in summer and beetles during monsoon. There are likely to be 2 peaks (breeding seasons) of reproductive activity in tropical regions, i.e., one in February-March and other in July-August. Female is born 1-3 young ones per year. Pregnant females can be collected throughout the year. Colony size is often small, usually  $< 25$  but stable. At the present, it was collected from all study sites and 21.3% of total collected species (Figure 2: photograph 8).

#### **(9) Asiatic greater yellow bat, *Scotophyllus heathii***

The Asiatic greater yellow bat, *Scotophyllus heathii* Hosefield, 1831 is a bat with greater body weight. It is pale yellow in color with body weight:  $38.60 \pm 3.80$  gm; head and body length:  $65.29 \pm 2.20$  mm; forearm length:  $61.86 \pm 1.04$  mm and tibia length:  $13.05 \pm 1.15$  mm. The tail is long and inside the inter femoral membrane, only terminal tail about 2-3 mm is projecting free. The ears are naked and smaller than the head. The pelage is short and fine, while longer on the throat and nap of the neck. The back is chestnut brown; however, dorsal fur is yellow-brown and looks a little bit green. Ventral fur is lighter than dorsal fur. Like many bats, females have delayed ovulation, with ability to store sperm. The seasonal changes in hormones allow them to deposit fat before onset of winter. It is found in a variety of habitat types, including urban and rural areas. It roosts in buildings, caves, crevices, cracks, old buildings, among leaves, crowns of palms, hollows of trees and among leaves of banana, either singly or in colonies of  $>50$  individuals. The tropical rainforests are important habitat for this species. Its roosting places are protected as its habitats. It forages in open spaces in rainforests and its diet mainly consists of insects, but can take fruits in captivity. It emerges late from the roosting site as a low flyer and flies at a steady speed. One or 2 young ones are

born after a gestation period of 115 days. It sometimes uses for research of mammalian reproduction, because, it is monoesters with pre-implantation embryonic development. At the present, it was 23% of total collected species only from Mardan trapped by mist nets (Figure 2: photograph 9).

#### (10) Kuhl's pipistrellus, *Scotophilus kuhlii*

The Asiatic lesser yellow house or Kuhl's pipistrellus bat, *Scotophyllus kuhlii* Leech, 1821 can only be distinguished from the *S. heathii* by its small size, while all other structures are almost similar. It was first named in 1817, under the name *Vespertilio kuhlii*, in a work by Kuhl entitled *Die Fledermäuse Deutschlands* (The bats of Germany). The specific epithet was chosen by Natterer, who had collected the first specimens and commemorates Kuhl; under the rules of the ICZN, however, Kuhl himself is regarded as the authority, as the first to report the name. As this species has recently been split from the related *Pipistrellus hesperidus*, much of the information available on its biology may relate to *P. hesperidus*. However, the biology of these 2 small *Pipistrellus* spp is likely to show many similarities.

It is chestnut brown in color with body weight:  $21.50 \pm 1.29$  gm; head and body length:  $67.38 \pm 1.57$  mm; forearm length:  $53.77 \pm 1.73$  mm and tibia length:  $12.29 \pm 0.44$  mm. It is a small bat with a long tail, a well-developed inter femoral (tail) membrane, and a knife-shaped tragus in front of the ears. The fine, dense fur is light brown to reddish brown on the back, with the individual hairs having salty black bases. The pelage color is chest brown dorsally, while pale ventrally. The under parts are paler, often whitish, however, the wing membranes are dark brown to black, with a characteristic white margin, particularly between the foot and 5<sup>th</sup> finger of the hand. There is regional variation in the coloration of this species. The male is slightly smaller than the female.

It forages over a variety of habitats from elevations of up to 2,000 m, from oases in deserts, to temperate grassland, to forest, although it is usually found near permanent water. It can be found in temperate forests, subtropical or tropical dry shrub land, shrubby vegetation, rural gardens, and urban areas. It forages over variety of habitats, including agricultural and urban areas (including around streetlights). It feeds on small insects, including Diptera, Psocoptera (booklice, barklice or barkflies) and Coleoptera. Summer maternity colonies are located in crevices in buildings. It forages winter sites include rock crevices and cellars. It is usually associated with human settlements, forages in forest as well as semi-desert. It is probably a sedentary species.

This species may roost in colonies numbering from around 30-100 individuals and like other pipistrelle bats, it is typically one of the first bat species to emerge in the evening, when it forages for small aerial insects with a slow but acrobatic flight. The species may be found in agricultural and urban areas, and often roosts in rock crevices and loose bark. It may be hibernate or to be active from around January-September. Male is in breeding condition in August and September, with dominant reproductive males roosting alone and courting females along specific routes. The female gives birth to a single young or twins each year, during spring or early summer. At the present, it was 2% of total collected species only from Nowshera (Figure 2: photograph 10).

## DISCUSSIONS

The true flight mammals bats (Chiroptera) are divided as the fruit bats (Megachiroptera) act as seeds disperser and plants pollinator; and the insect eating bats (Microchiroptera) as predator or biological pests control agent. Their 7 species belonging to 5 genera and 4 families were reported during July 2011-May 2013 from Chrsada, Kohat, Mardan, Noshera and Peshawar, Khyber Pakhtunkhwa, Pakistan.



The reported families Pteropodidae (Megachiroptera), Hipposidridae and Rhinopomidae covered each 14.3% and Vespertilionidae (Megachiroptera) covered 57.1% biodiversity of bats of study areas. Therefore, each one species, the flying fox, *Pteropus giganteus* is belonging to family Pteropodidae; fulvus leaf-nosed bat, *Hipposideros fulvus* to Hipposidridae and greater mouse tailed bats, *Rhinopoma microphyllum* to Rhinopomidae, however, 2 genera and 4 species Indian Pipistrellus, *Pipistrellus coromandra*; least Pipistrellus, *P. tenuis*; Javan Pipistrellus, *P. javinacum* and greater Asiatic yellow house bat, *Scotophilus heathii* to Vespertilionidae.



1



2



3



4



5



6



7



8



9



**Figure 2: Bat species**

The present study was the first pioneering study to record the bat fauna Khyber Pakhtunkhwa, Pakistan. Fenton *et al.*, (1993) stated that bats are good indicators of different ecosystems and can migrate by crossing the physical barriers the other mammals cannot do, as they are the only mammals capable of true flying. Bates and Harrison (1997) recorded that bats are the only mammals that have true flight capacity. Therefore, during the present research characteristics of collecting bats have been described together with their flying importance. Simmons (2005) stated that among all the bat species, *P. giganteus* is the world largest bat due to their largest body size and weight. Mayer *et al.* (2010) recorded that bats are tremendous detector of a number of climatic and environmental factors such as global climate change, forest disturbances, habitat loss, fragmentation, urbanization and agriculture intensification. Considering their ecological importance, present study was conducted in various habitats and localities to identify their number and baseline information in Pakistan. Bates and Harrison (1997) stated that all over the Indian subcontinent different species of Chiroptera are distributed including 119 species of bats belonging to 8 families and 37 genera from Afghanistan, Nepal, India, Pakistan, Sri Lanka, Northern Myanmar, Maldives and Tibet. While during the present study 10 bat species were recorded for the first time in the limited territory of the Pakistan.

Walker and Molur (2003) considered family Pteropodidae as data deficient in South Asia while Murray (1884) and Eates (1968) reported the colonies of *P. giganteus* from Malir in Karachi, Pakistan. Fifteen years ago, *P. giganteus* was reported as rare species in Pakistan (Roberts, 1997), however, large colonies of these bats exist in Baghi-Jinnah, Lahore (Personal observation); moreover, Roberts (1997) also reported this species from Mohlandar Mango Garden, Governor House, Lahore in 1992. The present study documented *P. giganteus* from Charsadda which is in the vicinity of Peshawar while this is a first and new record in this area. The reason of the availability of this species from mentioned area is that these are the fruit bats and this area is very much richer in fruit orchards like persimmon, *Diospyros kaki* (Thunberg, 1784); guava, *Psidium guava* (Linnaeus, 1753), ber, *Ziziphus jujuba* (Miller, 1768); loquat, *Eriobotrya japonica* (Thunb.) (Rosales: Rosaceae) and litchi, *Litchi chinensis* Sonn (Sapindales: Sapindaceae). While the detail study of the fruit bats of this area may also be provided upon availability of another species belong to genus *Rousettus* which was not found during present study. Roberts (1997) reported *P. giganteus* from Jhelum, Multan and Mailsi in the Punjab and also from Malakand in Khyber Pakhtunkhwa.

During the present research, *R. microphyllum* was reported for the first time from Takht Bahi and Frontier Region (FR) in the vicinity of Peshawar because the environmental factors were favorable for the same species in these two areas, i.e., geographical occurrence, temperature and food availability. Roberts (1997) reported *P. coromandra* from Dir, Chitral and Swat districts while this species was also collected in the present study from Peshawar district. Roberts (1997) also reported *P. javanicus* from Gharial Murree Hills, but very little information is available about it in Pakistan. Roberts (1997) recorded *P. tenuis* from Chitral and Sinha (1980) from Malakand, while during the present study; it was recorded from Peshawar. Three mentioned areas were located in the province Khyber Pakhtunkhwa. Therefore, one can argue that this species was found in diverse habitat and geographical factors of the areas. *Scotophilus heathii* was also reported from Islamabad, Multan, Lahore, Kashmore, Sakkar, Jaccobabad, Mirpur, Sakro, Dadu, Landi, Malir and Karachi (Sindh) (Wroughton, 1916; Lindsay, 1926; Siddiqui, 1960; Taber *et al.*, 1967; Walton, 1974; Robert, 1997). During the present study, it was also collected from Chrsada, Kohat, Mardan, Noshera, and Peshawar, Khyber Pakhtunkhwa. Roberts (1997) reported *H. fulvus* from Sukkar and thatta (Southern Sindh) as well as Panjgur and Hoshab (Southern Baluchistan), Rawalpindi and Chaklala while during the present study this species has been collected from Peshawar.

The present study area, Peshawar is more toward the Northern-South of the adjacent areas and away from the equator. The chiropteran biodiversity of Pakistan included 50 species, 25 genera and 8 families (Mahmood-ul Hassan and Nameer, 2006) while in the present research 7 species, 5 genera and 4 families were identified within the limited territory of Peshawar and its four areas found in vicinity for the first time. All reported species were earlier defined in other areas of Pakistan but for the first time reported in Charsada, Kohat, Mardan, Noshera and Peshawar, Khyber Pakhtunkhwa, Pakistan. The biodiversity differences were due to geographical and ecological differences. As the insects are the main source of food for Microchiropteran bats as they are abundant in the warm areas, therefore, the biodiversity was different among the study areas. The present study is continuing for further bats finding in the study areas.

## CONCLUSION

During the present research, 188 specimens of 10 bat species belonging to 4 different families Pteropodidae, Rhinopomatidae, Hipposideros and Vespertilionidae of order Chiroptera were collected. They were colonial, however, mostly terrestrial but some found near water. Moreover, they were mostly found in hide places like caves and crevices. Their roosting sites were very vast and they foraged on large varieties of food.

## RECOMMENDATIONS

The bats are neglecting group of animals, however, they play important role in pollination of flowering plants and crops but some of them are carrier of diseases, therefore, their research and study is very important. A detailed study is required for further exploration of bat fauna in the study areas.

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