



The Rufford Small Grants Foundation

Final Report

Congratulations on the completion of your project that was supported by The Rufford Small Grants Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Dr. Muhammad Mahmood-ul-Hassan
Project title	An Assessment of the Diversity and Creation of Bat Conservation Awareness at Margalla Hills National Park, Islamabad, Pakistan
RSG reference	12.04.09
Reporting period	1 year
Amount of grant	£6000
Your email address	drmmhassan@uvash.edu.pk ; drmmhassan@gmail.com
Date of this report	

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	Not achieved	Partially achieved	Fully achieved	Comments
Purchase of Equipment			Fully achieved	
Finalisation of study area map			Fully achieved	Please see Annexure 1
Preparation and finalisation of data entry sheets			Fully achieved	Please see Annexure 2
Mist netting			Fully achieved	
Recording of echolocation calls		Partially achieved		Since reference calls for any of Pakistani bat species is not available in the literature, there is a possibility that recorded calls of some species are not correctly identified
Field training			Fully achieved	
Presentations to school children			Fully achieved	
Publication and distribution of awareness material.			Fully achieved	

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

Pakistan remained a victim of terrorism during the whole project period. Suicidal bombers very adversely hit Islamabad during the last year and as a result there was a high security alert within the Federal Capital Area (Islamabad). I was not allowed to work in the Margalla Hills National Park by the security agencies as it was quite risky. In spite of all these constraints, mist netting activity remained a regular part of this project. Mist netting however was done in areas adjacent to the Margalla Hills National Park during most of the project period (Annexure 1).

3. Briefly describe the three most important outcomes of your project.

1. Bat fauna of the Margalla Hills National Park and adjacent areas studied
2. One research papers published in *Acta Chiropterologica* and another accepted in *Journal of Animal and Plant Sciences* (Pakistan). The third one is under review in *Mammalia* (France)
3. The Egyptian tomb bat (*Taphozous perforatus*) was captured from the study area which is a new record from this area.
4. Bat education and awareness campaign for school children started in Pakistan.

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

We involved school and college teachers and the Zoo Education Officer (Lahore) in our bat education and awareness campaign. The school children visiting Lahore Zoo were asked to complete a questionnaire which indicated the awareness of that group. The education material developed locally was then distributed to the school children and a presentation on a multimedia was made. This presentation highlighted the ecological services rendered by the bats. Once again the students were asked to complete the same questionnaire. A marked difference in the awareness level of the students was recorded after this exercise.

5. Are there any plans to continue this work?

Yes. I have concrete plans to continue bat research and conservation activities in Pakistan. Three pronged action will be taken to achieve this objective. First, bat education and awareness campaign for school children will continue to be a significant part of activities. I shall continue to distribute bat education kit I have already developed among the target audience. Second, efforts to popularise bat science in academic and research circles in Pakistan will continue by disseminating the knowledge I have gained in the field. Regular workshops will be conducted in different universities to transfer field and laboratory techniques for capturing, handling recording and identification of bats in Pakistan. Third, field surveys will be made to capture, record and identify more bat species in Pakistan and modern laboratory techniques will be used to separate cryptic bat species.

6. How do you plan to share the results of your work with others?

The outputs of this project have been shared by publishing results in reputed international and national journals. One research papers has been pub for published in *Acta Chiropterologica*, another is accepted while the third one is under review. One M. phil. student also completed her thesis research through this funding. The activities have been published in *Small Mammal Mail* by Chiroptera Conservation and Information Network of South Asia and Pakistan Wildlife News.

7. Timescale: Over what period was the RSG used? How does this compare to the anticipated or actual length of the project?

The project was completed in time.

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Edirol R-09HR Digital Recorder with accessories (1 No)	250	250	Nil	Nil
Pettersson L60 Ultrasound Speaker (1 Nos)	130	130	Nil	Nil
Mist Net 716/6P, DENIER: 75/2, MESH: 16X16 mm, SHELVES: 5, LENGTH: 6m, HEIGHT 2,5, m, POLYETER,	360	360	Nil	Nil

Model no. 716/9P, Poland (6 Nos)				
GPS e Trex Vista HCX- with accessories	200	200	Nil	Nil
Field assistants (2 Nos @ £8/day for 35 days)	560	560	Nil	Nil
Fuel charges (80 L/round trip @ £ 0.75/L for 11 round trips)	660	660	Nil	Nil
Accommodation (@ £ 10.00/night/person for 6 person and 35 nights)	2100	2100	Nil	Nil
Training and education of faculty and post graduate students	1000	1000	Nil	Of this funding, an amount of 400 was used in the purchase of culture media for gunao and bolus analysis of the Indian flying fox and another 200 was spent on collecting data on public perceptions about bats.
Presentation to school children and their teachers in the schools	740	740	Nil	Nil

9. Looking ahead, what do you feel are the important next steps?

1. Bat conservation education for school children. Bats are generally considered loathsome and disliked by public in Pakistan. They are often associated with witchcraft and are thought to be responsible for transmitting diseases and entering in human ears. It is highly difficult to shift the existing paradigm and convince people about positive role of bats in ecosystem. It will take a lot of coordinated efforts to change the existing mindset and turn them from “bat-foes” to “bat-friends”. The only way to overcome this problem is to educate school children so that they should start admiring the role of bats at tender age and should become stewards for bat conservation in the country. So awareness raising campaigns for school children should continue as one of the important next step.

2. Bat surveys. Since bats are the least studied groups of mammals in Pakistan, extensive bat surveys should be conducted to document as many bat species from the country as possible. There are many bat species which have not been recorded after they were described from the country. *Hipposideros cineraceus* Blyth, 1853 and *Rhinolophus blasii* are the two such cases. So promoting further bat surveys in various areas should be second import step so that various species and their preferred habitats should be identified and strategies for their conservation should be devised.

3. Redefining distributional ranges and habitat analysis. The Egyptian tomb bat has been captured from Attock for the first time. Capture of the second county record from this area raises two scientific questions.

- a. Whether the species inhabited this area but could not be recorded by earlier surveyors?
- b. Has the species extended its range from south to north?

Thus one the important next step is to carry out serious scientific studies to redefine distribution of all the bat species using global positioning system.

4. Reconfirmation of the Bat taxa of Pakistan. Species form fundamental building blocks of biological diversity as they provide goods and services to sustain life on earth. Use of novel techniques in biology has made this era a new age of discoveries and new species are being discovered each day with an unprecedented rate across broad taxonomic and geographic spectra. Many new species of mammals, a group that was once considered to be fully explored, have recently been described throughout the world. These new mammalian species are described either from a previously poorly known geographical area or they have arisen as a result of using molecular genetic techniques. The later discoveries were made in such areas where geographic range of a well-known mammal species was actually the combined ranges of two or more cryptic species—one's not easily recognised by morphological features. Pakistan qualifies both the above mentioned conditions. It is not only poorly surveyed part of the world but also owing to its unique geographic position on the globe many of the cryptic small mammal species need to be reconfirmed taxonomically.

The same species of *Plecotus auritus* and *P. austriacus* can never exist in Pakistan and UK due to isolation of the two populations for thousands of years and the answer to this question can only be found if molecular genetics of the bats found in Pakistan is studied.

10. Did you use the RSGF logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

RSGF logo was used on all the banners, brochures and booklets which were displayed or distributed. RSGF was mentioned to all key stakeholders during field work and will be acknowledged in every publication from the study in the future.

11. Any other comments?

I am extremely grateful to RGSF for the provision of financial support. Two of my post-graduate students benefited from this grant. One of them completed her M. Phil. Thesis research while the other used a part of this grant to carry out his field work for PhD study. This grant played a key role in their research work which I am sure will contribute to the global efforts of biodiversity conservation. I am really thankful to and hoping for similar cooperation from RGSF in the future.

STUDY AREA

MARGALLA HILLS NATIONAL PARK (MHNP) AND ADJACENT AREAS

This national park is situated towards the north of the Federal Capital, Islamabad at 33°48'N, 73°10'E and has been placed in The World Conservation Union (IUCN) Management Category V (Protected

Landscape). It was declared as national park on 27 April 1980 under Section 21(1) of the Islamabad Wildlife (Protection, Conservation and Management) Ordinance, 1979. Prior to 1960, much of the area was a reserve forest. Subsequently, it was declared as a wildlife sanctuary comprising an area of 17,386 ha under the West Pakistan Wildlife Protection Ordinance, 1959.

The MNHP lies between 456 m to 1,580 m in above sea level. The topography is rugged, with numerous valleys and steep slopes. Rocks have been observed to date back to the Jurassic and Triassic ages. Limestone rocks are characteristic features of the region though shale, clay, and sandstone are also present. Soils are dark, with a high mineral content, and are capable of supporting good tree growth despite being shallow. The climate is subtropical semi-arid. The region lies in the monsoon belt and experiences two rainy seasons. Winter rains last from January until March, and summer rains from July to September. Temperatures range from 1-15 °C in winter and 20-40 °C during the summer. Annual average rainfall is 1,000 mm.

The vegetation is largely supported by the monsoon rains. The flora, which is mostly sub-tropical in origin, is a remnant of the natural communities from the great Indo-Himalayan ecosystem extending north-east into the greater Indian sub-continent and Southeast Asia. The Margalla Hills are one of the western-most extensions of this important bio-ecological region, and as such represents a contact zone with the arid Irano-Saharan ecosystem that extends south west. It is here that the natural ranges of several plants from both regions overlap. The southern aspects of these hills have thin soils. The rainfall is also marginal. The flora therefore has a short stature, and somewhat xeric (dry climate species) broad-leaved deciduous and evergreen forests. Along with that grows a diverse shrub under story. Tree stature diversity increases in ravines. Pines are dominant in the northern aspects and in elevations higher than 1,400 m, where it is cooler and precipitation is more effective. Groves of oaks are still found in some places. The common trees, shrubs, and herbs of the Park are as follows:

Trees: *Acacia catechu*, *A. camus*, *A. nilotica*, *A. modesta*, *Bauhinia variegata*, *Butea monosperma*, *Maytenus*, *rayleanus*, *Olea ferruginea*, *Phyllanthus emblica*, *Pinus roxburgii*, and *Quercus leucotrichophora*.

Shrubs: *Carissa opaca*, *Calotropis procera*, *Dodonaea viscosa*, *Justicia adhatoda*, and *Otostegia limbata*.

Herbs: *Allium jacquemontii*, *Arundo donax*, *Cannabis sativa*, *Centaurea iberica*, *Eulophia dabia*, *Geranium ocellatum*, *Hibiscus caesius*, *Incarvillea emodi*, *Pennisetum orientale*, *Saccharum spontaneum*, *Scilla griffithii*, *Tulipa stellata*, and *Typha elephantina*.

BAT TRAPS AT VARIOUS SURVEY SITES IN MNHP

Pakistan Museum of Natural History (PMNH). This site was surveyed twice, once on June 18, 2009 and then on November 28, 2009. Five mist nets were erected on the forest edge close to PMNH building. One of these was 12 m, two were 6 m while the remaining two were 9 m long. There was a complete canopy above the nets. The nets were erected in L shape to maximize bat capture. The nets remained erected for two hours. A total of 12 bats were trapped in the nets (Table 1). Of these nine were common pipistrelles (*Pipistrellus Pipistrellus*), one least pipistrelle (*Pipistrellus tenuis*) and two greater desert yellow house bats (*Scotophilus heathii*). The same strategy was adopted during the second visit but no bat was captured.

Shakar Parian. This site was surveyed once during the present study on November 29, 2009. The netting effort was the same as described above but no bat was captured.

Daman-e-Koh. This site was also surveyed once during the present study on November 30, 2009. The netting effort was the same as described above but again no bat was captured possibly due to low temperature in Islamabad.

National Agricultural Research Council (NARC). Mist netting was conducted four time at NARC. The nets were erected in a straight line along the bank of fish ponds within the premises of NARC. These fish ponds were surrounded by agricultural fields on three sides while a cattle shed was present on the fourth side. There were three 9 m, two 6 meter and one 12 m long mist net. Five bats were captured on June 19, 2009 and eight on September 29, 2009 while no bat was captured on December 17, 2009 and no bat was captured on March 26, 2010.(Table 1).

Marghazar Zoo. Mist nets were erected within the premises of Marghazar (Islamabad) Zoo on June 20, 2009. In spite of same netting effort the bats flew above the nets and no bat was captured.

Islamabad Fish Hatchery. Located within the Federal Capital, the Islamabad Fish Hatchery is vegetated by tall eucalyptus trees and other ornamental plants. With the same mist netting effort, we were able to capture three greater yellow desert bats (*S. heathii*) and two pipistrelles (*Pipistrellus* spp.) on September 28, 2009. All of them flew away while inexperienced students were disentangling them from the mist nets. So neither the age nor sex of these bats could be determined. During our second visit to this site, on March 25, 2010, five bats were captured with the same mist netting effort. Of these four were *P. pistrellus* and one *S. heathii* (Table 1).

Lohee Bher National Park. Lohee Bher Nationl Park is located between 33° 34.632' north and 73°07.53' east at an altitude of 500 metres at a distance of 16 kilometres from Islamabad on right side of Islamabad-Lahore Highway. The site is bounded in the north by Chaklala airport, in the west by Loheer Bher village and Soan River runs along the eastern and southern sides. The physical features of the site exhibit a variety of plateaus, hillocks, valleys, ravines, streams, plains and other forms of topography.

The rock formation is composed of tertiary sandstone and alluvial deposits. The western and northern portion is a plain with clay loam soil and the hillocks are made of alluvial material with a large number of stones cemented together (Leh conglomerate). The sandstone apparently belongs to the Sirmur and Siwalik series of the Sub-Himalayan system. The pebble ridges describe as alluvial deposits are a peculiar feature of the Rawalpindi district and most of the forests in the district are on the pebble ridges. Large isolated boulders in many places seem to point to a glacial epoch in the Pothowar plains.

The climate of the area is sub-tropical continental low lands, sub-humid Pothowar plateaus with a mean annual precipitation of 970 mm, most of which falls in monsoon during the months of July and August. The wind generally blows from northwest but during the monsoon season, its general direction is southeast. The main drainage systems are river Korang and Soan. A large number of seasonal nullahs flow though the site beside Korang River, a part of which passes through the area. The whole area encloses reasonable large chunk of private lands on three sides and eight villages are located around the area. Most of the animals as well as some migratory herds also graze in the area.

Table 1. Bat captures at various mist netting sites in Margalla Hills National Park (Islamabad) and adjacent areas.

Date	Exact locality	GPS Location	No. bats captured	Species (n)	Age	Sex	
						Male	Female

18.06.2009	PMNH		12	<i>Pipistrellus</i> <i>Pipistrellus</i> (9)	Adult	4	5
				<i>Pipistrellus tenuis</i> (1)	Adult	-	1
				<i>Scotophilus</i> <i>heathii</i> (2)	Adult	2	-
19.06.2009	NARC	N 33° 39.892 E 073° 07.108	5	<i>Pipistrellus</i> <i>Pipistrellus</i> (4)	Adult	2	2
				<i>Scotophilus</i> <i>heathii</i> (1)		1	-
20.06.2009	Marghazar Zoo	???	Nil				
28.09.2009	Islamabad Fish Hatchery	N 33° 40.966 E 073°06.932	5	<i>Pipistrellus</i> spp (2)			
				<i>Scotophilus</i> <i>heathii</i> (3)			
29.09.2009	NARC	N 33° 39.892 E 073°07.108	8	<i>Pipistrellus</i> <i>Pipistrellus</i> (3)	Adult	1	2
				<i>Pipistrellus tenuis</i> (2)	Adult	2	-
				<i>Scotophilus</i> <i>heathii</i> (3)	Adult	2	1
30.09.2009	Suburbs of Ratowal village	N 33° 28.644 E 072°43.638	4	<i>Taphozus</i> <i>nudiventrous</i> (3)	Adult	2	1
				<i>Taphozus</i> <i>perforates</i> (1)	Adult	-	1
28.11.2009	PMNH	???	Nil				
29.11.2009	Shakarparian	???	Nil				
30.11.2009	Damn-e-Koh	???	Nil				
17.12.2009	NARC	N 33° 39.892 E 073° 07.108	Nil				
18.12.2009	Tanaza Dam Kheri moorat	N 33° 27.594 E 072°44.066	Nil				
19.12.2009	Lohee Bher Park	N 33° 34.632 E 073°07.53	Nil				
25.03.2010	Islamabad Fish Hatchery	N 33° 40.966 E 073°06.932	5	<i>Pipistrellus</i> <i>Pipistrellus</i> (4)	Adult	1	3
				<i>Scotophilus</i> <i>heathii</i> (1)	Adult	1	
26.03.2010	NARC	N 33° 39.892 E 073° 07.108	Nil				
27.03.2010	Tanaza Dam Kheri moorat	N 33° 27.594 E 072° 44.066	Nil				
		Total	39			18	16

Actual Data: The number of specimens caught and brought to the laboratory 34.

The area was surveyed once during the present study, on December 19, 2009, when no bat was captured. The nets were erected along the bank of Korang River.

Ratowal village. A roost of the *Taphozous* bats was located with the help of a couple of students from Department of Zoology, University of Arid Agriculture, Rawalpindi in the suburbs of the Ratowal village on September 30, 2009. The roost was located almost two kilometers away from Tanaza Dam in Kheri Moorat. Bats were clinging within the cervices of a hill that ranged 15m long, in a north-south position, some 25 to 30 feet high from the ground. The fissure between the rocks was 4 cm wide and bats were hard to observe. Almost 40 to 50 bats were present in the roost, at 11:00 am hours Pakistan Standard Time, of which four were captured with the help of hand net in their attempt to flee off from this roost. Three of these were naked-rumped tomb bats (*T. nudiventris*) while the fourth one was the Egyptian tomb bat (*T. perforatus*). The same area was visited twice subsequently, on December 18, 2009 and March 27, 2010, but no bat was observed at this roost that probably had migrated to somewhere else.

Tanaza Dam, Kheri Moorat. This small Dam is located in the close proximity of Kheri Murat Livestock Research Farms in the neighborhood of Rest House building of Livestock Department. This small Dam is meant for storing monsoon water which is later supplied to the area. Since this water body was situated close to Ratowal hills, mist nets were erected on the bank of the dam with the assumption that bats will use this water body to forage insects. Neither any bat was captured nor heard during both the visits to this area.

BODY WEIGHT AND EXTERNAL BODY MEASUREMENTS

The body weight and external body measurements of all the bats captured from Margalla Hills National Park is described below.

***Pipistrellus pipistrellus*.** The body measurements of specimens from Islamabad are as follows. The mean body weight of twenty specimens captured from MHPN is 3.8 (± 1.63 SD). Head and body length is 51.1 mm (± 13.7 SD), tail length 23.0 mm (± 7.22 SD), hind foot length 6.7 mm (± 1.34 SD), forearm length 30.9 mm (± 3.36 SD), length of 5th metacarpal 36.2 mm (± 3.7 SD), length of 4th metacarpal 27.1 (± 3.5 SD), length of 3rd metacarpal 27.7 mm (± 2.8 SD), ear length 7.3 mm (± 1.1 SD) (Table 2).

***Pipistrellus pipistrellus*.** The mean body weight of three specimens captured from MHPN is 3.8 (± 1.04 SD). Head and body length is 35.3 mm (± 2.1 SD), tail length 23.8 mm (± 3.5 SD), hind foot length 6.4 mm (± 1.29 SD), forearm length 28.2 mm (± 0.6 SD), length of 5th metacarpal 24.2 mm (± 1.0 SD), length of 4th metacarpal 23.7 (± 0.8 SD), length of 3rd metacarpal 25.2 mm (± 0.3 SD), ear length 7.8 mm (± 0.3 SD) (Table 2).

***Scotophilus heathii*.** The mean body weight of seven specimens captured from MHPN is 37.7 (± 7.4 SD). Head and body length is 88.9 mm (± 24.9 SD), tail length 51.2 mm (± 4.5 SD), hind foot length 12.0 mm (± 1.79 SD), forearm length 61.7 mm (± 3.3 SD), length of 5th metacarpal 49.7 mm (± 2.1 SD), length of 4th metacarpal 47.9 (± 12.59 SD), length of 3rd metacarpal 55.5 mm (± 1.9 SD), ear length 13.3 mm (± 2.94 SD) (Table 2).

Table 2. External body and cranial measurements (mm) of five bat species captured from the Margalla Hills National Park and Adjacent area.

Body parameter	<i>P. pipistrellus</i>	<i>P. tenuis</i>	<i>S. heathii</i>	<i>T. nudiventris</i>	<i>T. perforatus</i>
		Mean \pm SD (n)			

BW	$3.8 \pm 1.63(20)$	$3.8 \pm 1.04(3)$	$37.7 \pm 7.37(7)$	$59.9 \pm 7.89(3)$	37.6(1)
HBL	$51.1 \pm 13.71(20)$	$35.3 \pm 2.08(3)$	$88.9 \pm 24.96(7)$	$91.7 \pm 4.04(3)$	82(1)
Tail	$23.0 \pm 7.22(20)$	$23.8 \pm 3.55(3)$	$51.2 \pm 4.54(7)$	$18.3 \pm 1.16(3)$	27.6(1)
Ear	$7.3 \pm 1.13(20)$	$7.8 \pm 0.29(3)$	$13.3 \pm 2.94(7)$	$16.0 \pm 1.73(3)$	18(1)
tragus	$4.8 \pm 0.77(20)$	$3.7 \pm 1.15(3)$	$7.5 \pm 1.09(7)$	$4.0 \pm 0.00(3)$	4(1)
FA	$30.9 \pm 3.36(20)$	$28.2 \pm 0.58(3)$	$61.7 \pm 3.26(7)$	$70.3 \pm 0.58(3)$	62(1)
Thumb	$4.0 \pm 1.16(20)$	$3.8 \pm 0.76(3)$	$7.2 \pm 0.26(7)$	$7.333 \pm 0.58(3)$	9(1)
Claw	$1.4 \pm 0.40(20)$	$2.0 \pm 0.00(3)$	$2.8 \pm 0.26(7)$	$2.5 \pm 0.00(3)$	3(1)
3rd Met Car	$27.7 \pm 2.82(20)$	$25.2 \pm 0.29(3)$	$55.5 \pm 1.92(7)$	$62.2 \pm 2.02(3)$	64.5(1)
1st ph 3rd Mt	$11.9 \pm 1.28(20)$	$11.8 \pm 1.78(3)$	$19.6 \pm 1.39(7)$	$27.2 \pm 0.29(3)$	27(1)
2nd ph 3rd Mt	$8.9 \pm 2.16(20)$	$8.7 \pm 1.04(3)$	$15.3 \pm 1.75(7)$	$29.2 \pm 1.16(3)$	30.5(1)
4th Met	$27.1 \pm 3.47(20)$	$23.7 \pm 0.76(3)$	$47.9 \pm 12.59(7)$	$50.3 \pm 1.75(3)$	48.5(1)
1st ph 4th Mt	$11.2 \pm 1.49(20)$	$11.2 \pm 0.76(3)$	$15.7 \pm 1.17(7)$	$13.0 \pm 2.65(3)$	11(1)
2nd ph 4th Mt	$8.6 \pm 1.21(20)$	$8.7 \pm 1.15(3)$	$12.1 \pm 2.11(7)$	$9.0 \pm 0.50(3)$	9.5(1)
5th Met Car	$36.2 \pm 3.70(20)$	$24.2 \pm 1.04(3)$	$49.7 \pm 2.09(7)$	$30.0 \pm 17.80(3)$	42(1)
HF	$6.7 \pm 1.34(20)$	$6.4 \pm 1.29(3)$	$12.0 \pm 1.79(7)$	$14.3 \pm 0.58(3)$	14(1)
Tibia	$12.3 \pm 1.35(20)$	$11.2 \pm 2.02(3)$	$24.6 \pm 1.49(7)$	$29.3 \pm 0.58(3)$	28(1)
Calcar	$4.7 \pm 1.28(20)$	$3.5 \pm 0.71(3)$	$6.9 \pm 2.20(7)$	$5.0 \pm 1.00(3)$	8(1)
Wing span	$141.8 \pm 21.35(20)$	$151.0 \pm 10.54(3)$	$331.3 \pm 70.77(7)$	$345.3 \pm 1.124(3)$	32(1)

Pipistrellus pipistrellus. The mean body weight of seven specimens captured from MHNp is 37.7 (± 7.4 SD). Head and body length is 88.9 mm (± 24.9 SD), tail length 51.2 mm (± 4.5 SD), hind foot length 12.0 mm (± 1.79 SD), forearm length 61.7 mm (± 3.3 SD), length of 5th metacarpal 49.7 mm (± 2.1 SD), length of 4th metacarpal 47.9 (± 12.59 SD), length of 3rd metacarpal 55.5 mm (± 1.9 SD), ear length 13.3 mm (± 2.94 SD) (Table 2).

Taphozous nudiventris. The mean body weight of three specimens captured from MHNp is 59.9 (± 7.9 SD). Head and body length is 91.7 mm (± 4.0 SD), tail length 81.3 mm (± 1.2 SD), hind foot length 14.3 mm (± 0.6 SD), forearm length 70.3 mm (± 0.9 SD), length of 5th metacarpal 30.0 mm (± 17.8 SD), length of 4th metacarpal 50.3 (± 1.75 SD), length of 3rd metacarpal 62.2 mm (± 2.0 SD), ear length 16.0 mm (± 1.7 SD) (Table 2).

Taphozous nudiventris. The mean body weight of one specimen captured from MHNp is 37.6. Head and body length is 82 mm, tail length 27.6 mm, hind foot length 14.0 mm, forearm length 62 mm, length of 5th metacarpal 42 mm, length of 4th metacarpal 48.5, length of 3rd metacarpal 64.5 mm, ear length 18.0 mm (Table 2).

ECHOLOCATION CALLS

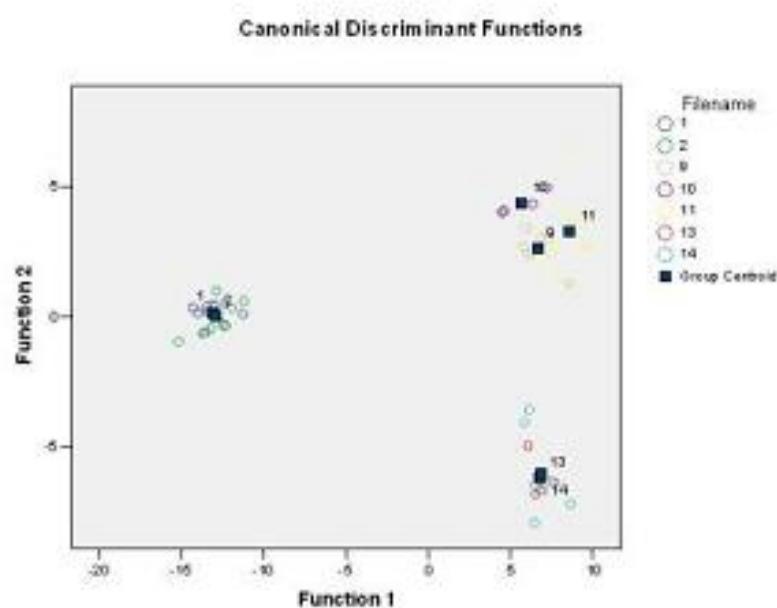
Calls were recorded using a Petterson D1000X Bat Detector (Petterson Electronik AB, Uppsala, Sweden). We used BatSound 4 and measured highest frequency (Fmax), lowest frequency (Fmin), Frequency with maximal energy (FMAXE), pulse duration (PD) and inter-pulse interval (IPI). Frequencies were measured from the spectrogram (256-point fast Fourier transform, Hamming window), with Fmin and Fmax as the lowest and highest frequencies against background noise.

A total of 30 sound files were recorded but only those with a good quality recording were analyzed. The mean values of various call parameters are mentioned in Table 3. Multivariate discriminant function analysis (DFA) with cross-validation was applied to call parameters from various species and results are shown in Fig. 2. Three separate clusters were obtained when files 1-14 for analyzed. At

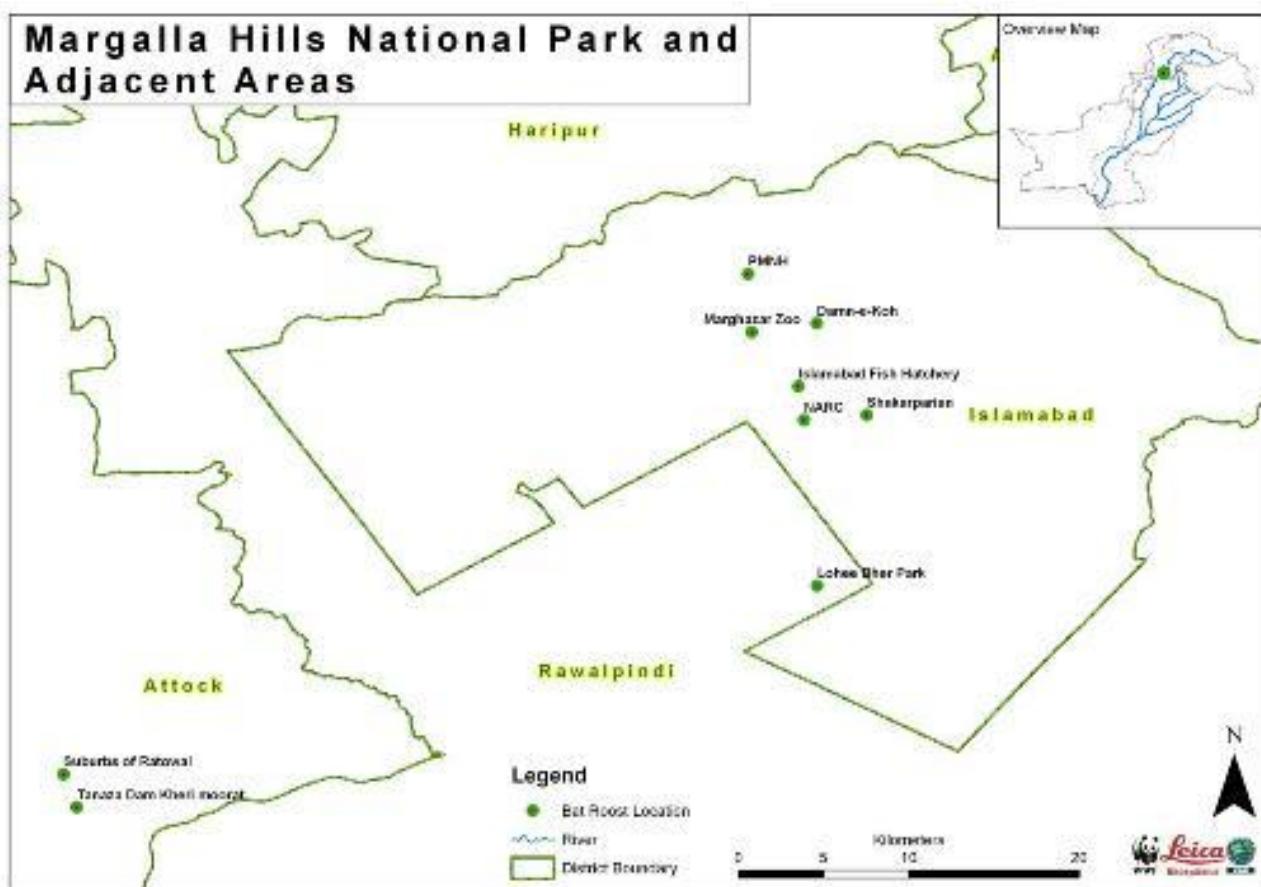
at this stage it is difficult to designate each cluster corresponds to a particular species but I guess that cluster with file name 1 and 2 represents *Pipistrellus pipistrellus*, cluster 9, 10, 11 represents *Scotophilus heathii* while the cluster 13, 14 represents calls of *P. tenuis*.

Table 3. Mean value of various call parameters of the free flying bats recorded at Margalla Hills National Park Islamabad.

Filename		F _{max}	F _{min}	PDUR	IPI	FMAXE
1	Mean	44.7	33.5	6.3	124.6	35.5
	Std. Deviation	2.3	1.3	1.4	51.8	1.7
2	Mean	46.9	32.4	10.1	175.0	35.2
	Std. Deviation	4.7	1.5	2.4	89.8	1.2
9	Mean	96.0	50.7	2.4	70.7	55.8
	Std. Deviation	7.3	0.8	0.2	3.9	1.8
10	Mean	66.5	51.8	1.7	75.9	54.6
	Std. Deviation	5.9	1.0	0.4	6.2	0.8
11	Mean	102.4	52.4	2.2	55.3	57.1
	Std. Deviation	5.4	1.1	0.2	13.8	1.6
13	Mean	83.2	49.6	1.7	53.6	68.3
	Std. Deviation	2.8	0.4	0.1	0.6	1.6
14	Mean	88.8	49.3	2.2	54.3	67.7
	Std. Deviation	11.1	0.5	0.2	0.5	3.3
17	Mean	92.1	51.2	2.2	57.1	66.6
	Std. Deviation	7.7	0.8	0.1	0.7	13.8
18	Mean	55.8	38.3	2.7	43.3	74.2
	Std. Deviation	10.2	1.0	0.7	2.1	14.7
28	Mean	71.8	52.5	5.6	54.7	65.6
	Std. Deviation	6.8	1.4	0.2	1.4	4.8



ANNEXURE 1

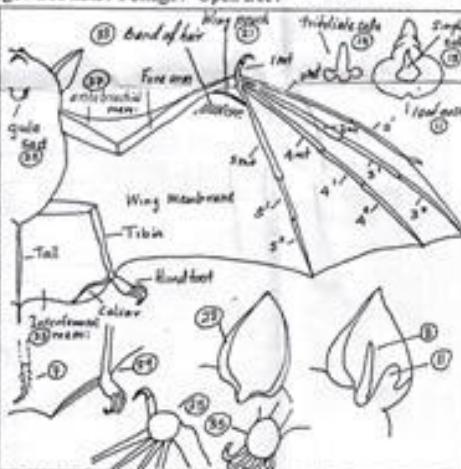


A map of the study area showing the exact location various mist netting stations at Margalla Hills National Park and adjacent areas

ANNEXURE 2

FIELD DATA SHEET FOR BATS

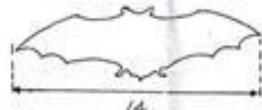
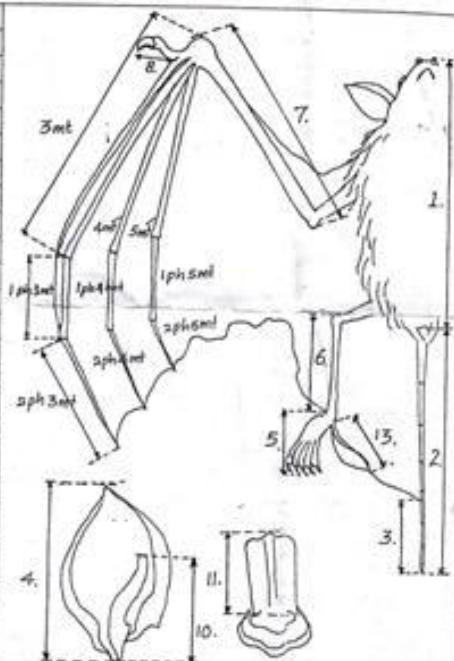
Sheet No:		Photo No:	Slide No:	Specimen No:
Name of collector: Dr. Muhammad Mahmood ul-Hassan		Date of collected:		
Locality Province:	District:		Town:	
Village:	River basin		N. Grid No:	
Nature of preservation	Dry:	Wet:	Tissue:	
Family:	Species:			
Weight:	Sex:	Adult/Sub-adult/juvenile:	Pregnant yes/not:	
Habitat:	Cave / Crevices / Abundant house / under bridge / tree hole / Foliage / Open tree /			
Coloration				
1. Dorsal pelage				
2. Dorsal fur root				
3. Dorsal fur tip				
4. Ventral pelage				
5. Ventral fur root				
6. Ventral fur tip				
7. Inside the ear				
8. Outside the ear				
9. Margins of the ear				
10. Nape area				
11. Wing membrane- dorsal				
12. Wing membrane- ventral				
13. Interfemoral mem.: dorsal				
14. Interfemoral mem.: ventral				
16. Throat				
Morphology & Counts				
1. 2 nd finger with claw	Present / absent	22. Gular sac	Present / absent	
2. Tail present/absent	Present / absent	23. Throat with black beard	Present / absent	
3. Free-tail	Present / absent	24. Throat	Hairy / naked	
4. ½ of the tail free	Present / absent	25. Inter-femoral membrane (Ifm)	Present / absent	
5. More than ½ of tail free	Present / absent	26. Dorsal part of Ifm hairy	Present / absent	
6. Enclosed with inter-femoral membrane (Ifm)		27. Ears jointed at inner base	Present / absent	
7. Emerging from upper surface of Ifm		28. Ear with pale borders	Present / absent	
8. Tragus:	Present / absent	29. Wings attached to ankles	Present / absent	
9. Tragus long/slender/straight/ blunt	Present / absent	30. Wings attached to tibia	Present / absent	
10. Tragus short/curved/rounded tip	Present / absent	31. Posterior back	Hairy / naked	
11. Anti-tragus	Present / absent	32. Posterior abdomen	Hairy / naked	
12. Nose leaf	Present / absent	33. Band of hair on wing membr:	Present / absent	
13. Sella simple	Present / absent	34. Foot	Hairy / naked	
14. Sella trifoliate	Present / absent	35. Enlarged pads on foot & thumb	Present / absent	
15. 2 nd & 4 th toes with 3 phalange	Present / absent	36. Nostrils tabular	Present / absent	
16. 2 nd & 4 th toes with 2 phalange	Present / absent	37. Antebrachial membrane	Present / absent	
17. 2 nd finger without phalange	Present / absent	38. Outer margins of tibia	Hairy / naked	
18. 2 nd finger with minute phal:	Present / absent	39. Dorsal surface of tibia	Hairy / naked	
19. 2 nd phal. of the 3 rd finer long	Present / absent	40. No. of mental grooves on lips		
20. 2 nd phal. of the 3 rd finer short	Present / absent	41. No. of upper incisors		
21. Wing pouch	Present / absent	42. No. of lower incisors		
Nose leaf shape				
1. Triangular	2. Truncate	3. Hart shape	4. Square shape	



Measurements (in mm)

- | | |
|---|--|
| 1. Head & body: | |
| 2. Tail: | |
| 3. Free tail: | |
| 4. Ear: | |
| 5. Hind foot: | |
| 6. Tibia: | |
| 7. Forearm: | |
| 8. Thumb + claw: | |
| 9. Fore foot | |
| 3^{rd} metacarpal (3mt): | |
| 4^{th} metacarpal (4mt): | |
| 5^{th} metacarpal (5mt): | |
| 1^{st} phal: on 3^{rd} metacarpal (1ph3mt): | |
| 2^{nd} phal: on 3^{rd} metacarpal (2ph3mt): | |
| 1^{st} phal: on 4^{th} metacarpal (1ph4mt): | |
| 2^{nd} phal: on 4^{th} metacarpal (2ph4mt): | |
| 10. Tragus height: | |
| 11. Nose leaf height: | |
| 12. Penis length: | |
| 13. Calcar length: | |
| 14. Wing span: | |

Diagram: leaf nose / ear (tragus/anti-regus)
• Side view of Sella



Diagram/ comments: (wing pouch/gular sac/ thumb disc/ foot disc/)