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A Contribution to the Bats Inhabiting Arid Steppe Habitats in Central Mongolia

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A contribution to the bats inhabiting arid steppe habitats in central Mongolia

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Abstract

Bats of the steppe habitat require particular attention in Mongolia because of increasingly frequent droughts and the looming specter of global warming which could have a devastating impact on their population. Especially the bats in arid steppe region lack of water resources. All bat species we trapped in Erdenesant, Tov aimag, were using hand dug wells as water source indicating the significance of water availability. Many wells have been dried out or polluted in Mongolia in recent years due to warming effect of climate change and artisanal mining activities, but the extent of their impacts on bat populations have to be determined.

Keywords: bats, Vespertilionidae, arid steppe, central Mongolia, Erdenesant

1. Introduction

Recent political, economic, and ecological changes in Mongolia are leading Mongolians away from nomadic herding practices and traditional land use (National Environmental Action Plan, 2002). These changes will affect wildlife ecology. Poorly planned, unmanaged, and improperly regulated rural development is becoming an increasing threat to ecosystems, biodiversity, and the livelihood of nomadic herds. Although the government of Mongolia is taking steps towards protecting wildlife species, paucity of ecological data for many species has become major concern in this country.

Scientific study of mammals of Mongolia started in the first quarter of the last century mainly by Russians. Since then, the study of mammals of the country is relatively well advanced. At present, a total of 132 species of mammals have been recorded to Mongolia, but most information available to us is presence-and-absence type data. There are many species and groups of mammals in Mongolia that have not, as yet, been looked at in detail. Bats are the group that has to date received almost no detailed research in Mongolia. A general idea as to the bat fauna of Mongolia can be found from following sources BANNIKOV (1954), DULAMTSEREN (1970), MALLON (1985), SHAR (2003), and DOLCH et al. (2007).

At present the Mongolian bat fauna consists of 14 bat species that belong to the Vespertilionidae family (table 1). In addition one species, Botta's serotine (*Eptesicus bottae* Peters 1869), has been listed as a species that may occur within Mongolia. Although the status and distribution of many of these species are still not sufficiently known, none of them are endangered at either global or regional level according to there cent Red Listing assessment for Mongolian mammals (CLARK et al. 2006).

This project enabled Mongolian bat biologists to carry out pilot research, in 2007, on bats inhabiting the Mongolian steppe and was a research specifically focused on bats inhabiting arid steppe habitat in the country. The overall goals of this project were a) to collect information on the composition, population size and basic habitat of the species of bat b) to understand the basic ecology and threats to bats in Erdenesant in central Mongolia and c) to evaluate the possibility of establishing a longer term bat monitoring site.

2. Study area

This study took place in Erdenesant located at 47°26'N 104°57'E in central Mongolia (Figure 1). Wildlife Science and Conservation Center of Mongolia (WSCC) aimed at monitoring wildlife species inhabiting Erdenesant as a basis for developing a better wildlife monitoring system for detecting ecosystem change occurring in this area. Erdenesant is characterized by a chain of narrow mountain ranges and adjacent grassland area in the arid steppe zone with rich biodiversity. A wide

variety of wildlife species typical of arid steppe of Mongolia are found here. There is a small lake with a small island to the south side of the mountain, which dries up in some years. There is no forest but elm trees growing along dry river beds are found in some gorges. The drying up of water sources and increasing livestock numbers pose serious threats to the steppe habitat of this area.

Table 1. Bat species identified as occurring within Mongolia (from CLARK et al. 2006)

Scientific name	**Common name**	**Regional assessment**	**Global assessment**
Eptesicus gobiensis Bobrinskii, 1926	Gobi big brown bat	Least Concern	Least Concern
Eptesicus nilssonii Keyserling and Blasius, 1839	Northern bat	Least Concern	Least Concern
Eptesicus serotinus Schreber, 1774	Serotine	Not Evaluated	Lower Risk
Hypsugo savii Bonaparte, 1837	Savi's pipistrelle	Data Deficient	Least Concern
Murina leucogaster Milne-Edwards, 1872	Greater tube-nosed bat	Data Deficient	Least Concern
Myotis brandti Eversmann, 1845	Brandt's bat	Data Deficient	Least Concern
Myotis daubentonii Kuhl, 1817	Daubenton's bat	Least Concern	Least Concern
Myotis ikonnikovi Ognev, 1912	Ikonnikov's bat	Data Deficient	Least Concern
Myotis mystacinus Kuhl, 1817	Whiskered bat	Least Concern	Least Concern
Nyctalus noctula Schreber, 1774	Noctule	Data Deficient	Least Concern
Plecotus auritus Linnaeus, 1758	Brown long-eared bat	Least Concern	Least Concern
Plecotus austriacus Fischer, 1829	Grey long-eared bat	Data Deficient	Least Concern
Vespertilio murinus Linnaeus, 1758	Particolored bat	Least Concern	Least Concern
Vespertilio superans Thomas, 1899	Asian particolored bat	Data Deficient	Least Concern

Note: DOLCH et al. (2007) recommended adopting new classification by SPITZENBERGER et al. (2006) which used genetic and morphological characteristics: *Plecotus auritus as P. ognevi and Plecotus austriacus as P.kozlovi*.

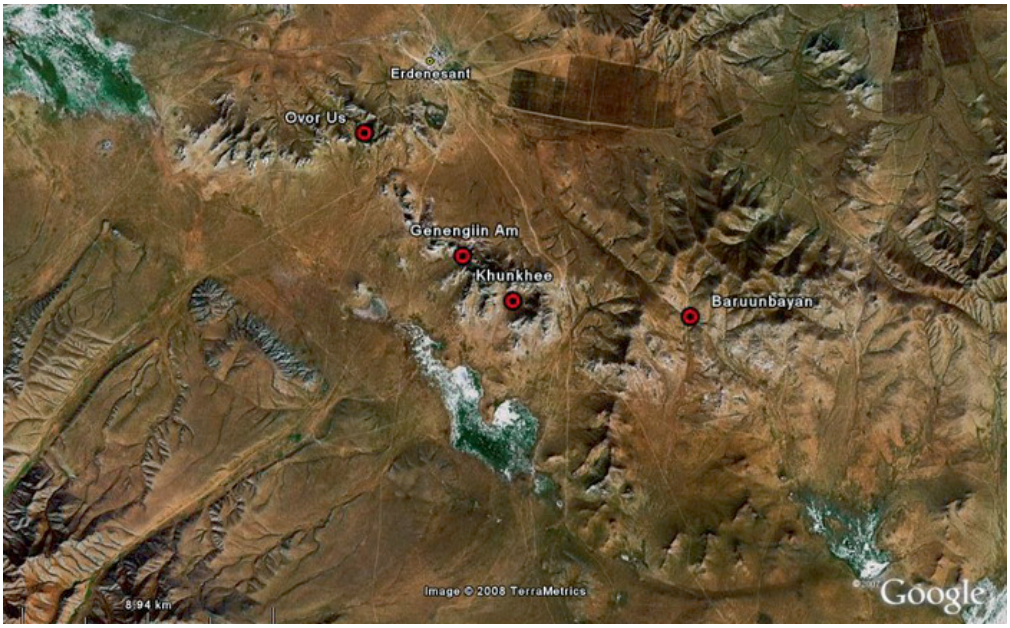

Fig. 1: Google Earth image of Erdenesant study area and trap locations.

3. Methods

The study was conducted during the summer season 2007 in Erdenesant, central Mongolia. Bats were mist netted at different places along flight paths and near wells at the end of July. Trapping efforts were conducted at 4 localities; Genengiin Am, Khunkhee, Baruunbayan, and Ovor Us. At each location only two mist nets were used due to limitations in the size of the gorges. These mist nets were placed in small rocky gorges or in gorges containing elm trees. Mist nets were usually opened from 21:00 - 01:00 hours (few times after 02:00). Bats were collected, held in a plastic box, processed next morning and released after measure and marking. After this processing was completed we then put the bats into rock cervices or caves where we had previously discovered bats roosting and hiding. Species name, age, sex, weight, and standard body measurements were recorded in data sheets which had been prepared in advance. Nomenclature of the species name used was that in the Mongolian Mammals Red List (CLARK et al. 2006); although we fully aware of recommendation on the *Plecotus* species taxonomy by SPITZENBERGER et al. (2006). Publications of DULAMTSEREN 1970, SOKOLOV & ORLOV (1980), PUCEK (1981), STRELKOV (1988), HELVERSON (1989), and DIETZ & HELVERSON (2004) were used for species identification. Determination of the age of the animals was based on the detection of the epiphyseal cartilage (ANTHONY 1988). We used dial calipers to take body measurements with body mass being measured with a digital balance. Air temperature during trapping was taken at the beginning and end of each trapping session and at 15 minute intervals during the trapping utilizing a Kestrel 3000 pocket thermometer. Bats were marked with metal wing bands from the Zoological Society of London (Dr. Paul RACEY of Aberdeen University kindly provided the bands). The bands were attached to forearms of the bats according to KUNZ (1996).

Bat activity was measured as the number of bats observed flying near the mist net within a 5 meters distance. The number and frequency of each species of bats trapped were recorded and the frequency of bats captured per hour was used as the index for the population size of bats. Habitat and trap locations were photographed for future references. Morphometric data were checked for normality before running any analysis. Comparisons made between sexes and specie used only data from adult bats. We observed signs of threats to bats and their roosts and made notes.

4. Results

Given the scarcity of information on bat species diversity in Erdenesant and the aim of establishing a longer term bat monitoring location, we selected four sites along the mountain range to study bats in this area. They were selected based on information from previous years' observations and information on bat activity provided by local herders.

Trap localities in Erdenesant

1. Genengiin Am - a small narrow gorge confined between rocky slopes. Large boulder rocks and a line of elm trees make the suitable habitat for bats. There is a well with water close to surface, approximately 2 meters. Inner wall of this well was layered with natural rocks. We spent a total of 43 capture hours in this gorge and trapped 84 individuals of 5 species.

2. Khunkhee - a wide open gorge. We trapped bats near a large rock and ger (nomad people's dwelling) settlement where livestock is kept for spring season. There is no well or springs, but we had observed bats were often using a livestock corrals in this valley. A total of 6 hours were spent in this gorge and we trapped 6 individuals of 2 species.

3. Baruunbayan Khudag - a narrow barren gorge. A hand dug well is found herethe water level of this well was very low. Bats were observed flying up and down the gorge to use water from the well. A total of 7 hours was spent in this gorge and we trapped 13 individuals of 3 species.

4. Ovor Us - a beautiful gorge surrounded by rocky slopes. Large old elm trees are grown in line along the gorge and a dry well was found here. Local people told us this well dried out last year. We spent a total of 2.3 hours in this gorge and trapped 5 individuals of Brown long-eared bat.

Fig. 2: Habitat pictures of bat mist netting localities.

Air temperature was usually warmer before sun set, and dropped down gradually after the sun went down then slightly increased after 00:30. With air temperature change the humidity level also moved and will be low before sunset and after 01:00 in the night (fig. 3, 4).

Bat activity was high between 21:00 - 22:00 (1.4 bats per 30 minutes), then dropped and remained fairly constant until 01:00 - 01:30 (0.4 bats per 30 minutes) when we closed our nets (Figure 5). In order to increase the chance of capturing bats we usually opened the mist nets at 2100 and closed at 0100. Although the observed rate of 1.4 bats flying every 30 minutes seems very low, there is no comparative information available on hourly bat activities for Mongolia and we cannot therefore assess if it is a normal rate or not in this kind steppe habitat.

Table 2: Capture of bats in Erdenesant in four different localities

Species	**Localities**				
	Baruunbayan	***Genengiin Am***	***Khunkhee***	***Ovor Us***	**Total** (%)
Northern bat	2	11	0	0	13 (12 %)
Whiskered bat	7	13	2	0	22 (20 %)
Brown long-eared bat	4	28	4	5	41 (38 %)
Parti-coloured bat	0	23	0	0	23 (21 %)
Asian parti-coloured bat	0	9	0	0	9 (8 %)
Number of species	*3*	*5*	*2*	*1*	*5*
Total capture	*13*	*84*	*6*	*5*	*108*
Capture effort (H)	*7*	*43*	*7*	*2.3*	*59.3*
Capture per hour	*1.9*	*2.0*	*0.9*	*2.2*	*1.8*

A total of 108 bats were captured, measured, and released between July 22 and July 30 at four locations in Erdenesant (table 2): Northern bat *Eptesicus gobiensis* (13 individuals), Whiskered bat *Myotis mystacinus* (22), Brown long-eared bat *Plecotus auritus* (41), Parti-coloured bat *Vespertilio murinus* (23), Asian parti-coloured bat *Vespertilio superans* (9) .

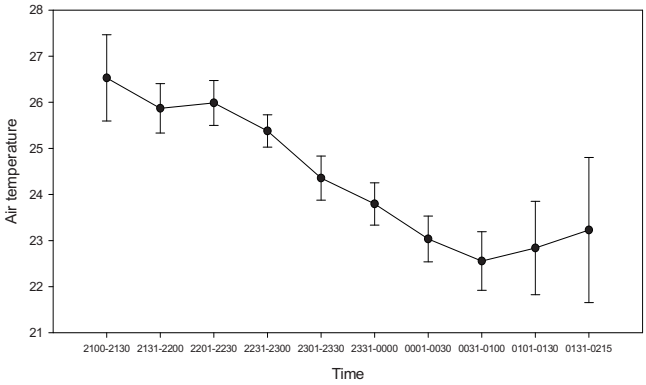

Figure 3: Air temperature variation during the mist netting hours (SD are shown as whiskers).

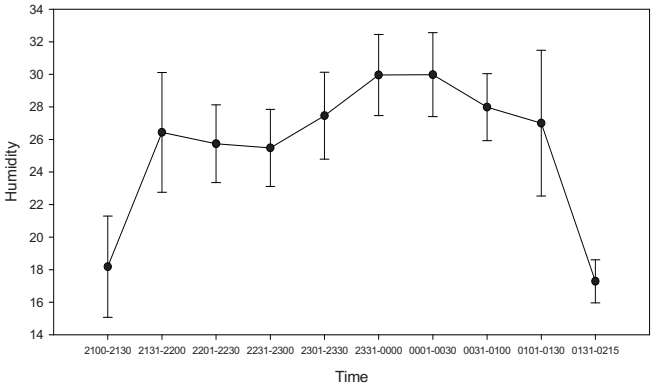

Figure 4: Humidity variation during the mist netting hours (SD are shown as whiskers).

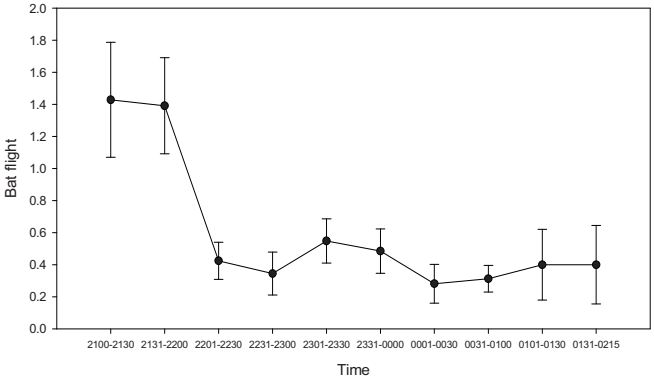

Figure 5: Bat activities during the mist netting hours (SD are shown as whiskers).

We ringed a total of 57 bats, including 11 Northern bats, 12 Whiskered bats, 13 Brown long-eared bats, 14 Parti-coloured bats, and, 7 Asian parti-coloured bats in Erdenesant. In Mongolia, only Whiskered bats had been previously ringed by German ringers in 1980s. We believe that the ringed bats in Erdenesant will help us understand many aspects of bat ecology from bat lifespan and local movements to habitat use etc.

Our record of Asian parti-coloured bat was the westernmost location of its distribution within Mongolia and the world (HORÁČEK *et al*. 2000, CLARK *et al*. 2006, DORJDEREM 2004).

In Erdenesant, the Brown long-eared bat was the most common bat and found in every location we worked. This species accounted almost 40% of total captured bats, followed by Whiskered bat and Parti-coloured bat which accounted 20% each.

In terms of bat species diversity, we found 5 bat species of 4 genera (*Eptesicus, Myotis, Plecotus and Vespertilio*), in Genengiin Am was the Brown long-eared bat the dominating species. The species-poorest site was Ovor Us Gorge with only one species - the Brown long-eared bat (fig. 8).

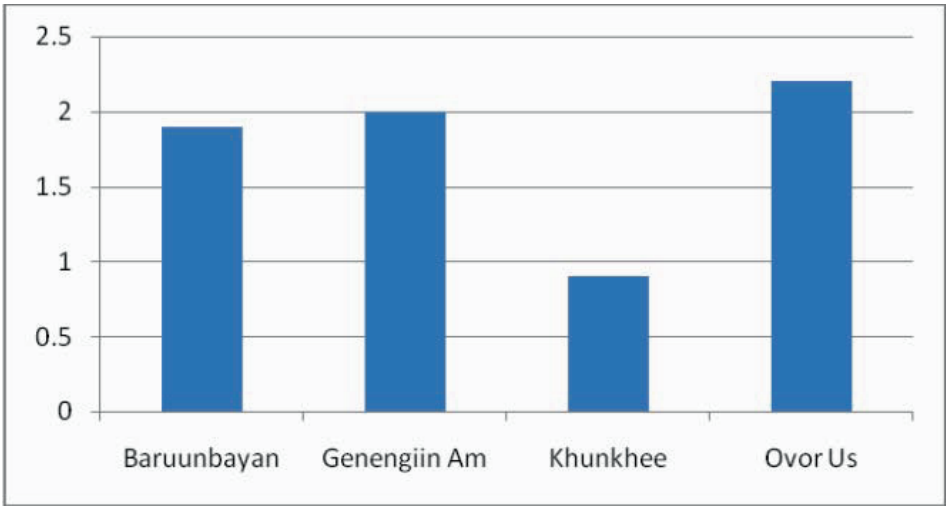

Fig. 6: Indices of bat capture frequency at four mist net locations.

The day we mist netted bats in Baruunbayan and Ovor Us, we had slight rain shower earlyl that day which continued for few hours. Although air temperature dropped and humidity level increased bats remained active and we were able to catch some of them. It would be interesting to see how many individuals and species would have caught if there was no rainfall prior to the mist netting.

We did not see any obvious threats to the bats, except for the potential loss of water sources. In the survey area, wells and small salty lake are the only source for water to bats and other wildlife with well water being used significantly by bats. The bats were also found to be using water from water containers used for livestock. In a rainy year the bats may be using the water in potholes that form on large boulder rocks. We wanted to observe this, but with no rain when we started working and little rain towards the end of our work there was insufficient to fill up the rock potholes. Therefore it was not possible to observe the use of rock pothole water by bats. We observed a rock marten almost every night at the well in Genengiin Am and surmised whether martens predate bats when they come to drink water from same well. Local herders told us that they never had any problem with bats, thus presumably human disturbance on bats is minimum in Erdenesant.

5. Discussion

Bats in Mongolia are found in variety of habitats from Gobi desert to taiga forest (SOKOLOV & ORLOV 1980, CLARK et al. 2006, DOLCH et al. 2007). Nearly half of Mongolian bat species have been recorded in water scarce arid areas; however, every single species is threatened by drying up of water sources regardless of major habitats they occur (CLARK et al. 2006).

There has been to date very limited information on bats habitat use in central Mongolia. In this survey the number of bats captured per hour was similar at three locations, Genengiin Am, Baruunbayan, and Ovor Us, with the latter having marginally more bats than the others. However the Genengiin Am was richer in bat diversity.

All species we trapped in Erdenesant were using hand dug wells as water source. There was a hand dug well with water close to surface (approximately 2 m down) in Genengiin Am but the wells in Ovor Us, Baruunbayan, and Khunkhee were dry, very low water, and no well respectively. The results in table 2 likely provide an indication as to the importance of wells with water close to the surface for bats inhabiting arid steppe areas. The presence of large elm trees and the narrow rocky gorge of Genengiin Am, and combination of these factors, may contribute to retention of a better moisture level compared to barren and wide open gorges and consequently the resulting higher bat species numbers and diversity. It is possible that the gorge with a well or springs is the most important foraging areas of the bats in Erdensant. Our observation indicates that the factors present at Genengiin Am gorge made it well suited for bats.

Bat species inhabiting arid steppe habitat should receive particular attention in Mongolia because continued droughts and climate warming are posing prolonged detrimental effects upon them. The absence of ongoing bat research and conservation projects indicate that bat conservation is at very early stage of development due to lack of the necessary basic ecological knowledge and awareness of bats in Mongolia. Therefore much needs to be done to collect more data on bat ecology and to increase public awareness on the subject. Our study shows the importance of Erdenesant for the conservation and understanding of bat species in an arid environment in central Mongolia. Bats are long lived animals and sensitive to the environmental changes therefore it is possible to use Genengiin Am and Ovor Us as long term bat monitoring sites.

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Appendix

Table 3: Morphometrics of Brown long-eared bat *Plecotus ognevi*

Variables	Female			Male			*t-test*	*P-value*
	N	Mean	SD	N	Mean	SD		
Body mass	23	8.8	0.8	12	7.8	0.8	3.63	*0.001*
Body length	24	49.6	4.7	12	48.5	2.0	0.78	0.441
Tail	24	46.0	3.0	12	44.5	1.7	1.58	0.123
Forearm	23	42.2	1.2	13	41.2	1.3	2.40	0.022
3rd finger length	23	68.0	2.4	13	66.1	2.7	2.12	*0.034*
5th finger length	23	53.9	2.0	13	51.8	1.9	3.01	*0.005*
Ear	23	31.8	2.5	13	32.4	2.0	-0.78	0.440
Tragus	20	14.4	1.2	14	13.9	0.9	1.17	0.253
Tragus Width	19	4.7	0.4	14	4.8	0.3	-0.80	0.428
Tibia	20	19.8	1.0	12	18.8	1.2	2.52	*0.017*
Hind foot	24	8.3	0.7	15	8.2	0.7	0.17	0.863
D1	24	8.1	0.6	15	8.0	0.6	0.59	0.556
Talon	21	2.9	0.4	13	3.3	0.3	-3.029	*0.005*
DSEU	21	5.7	0.2	14	5.6	0.2	0.80	0.428

Table 4: Comparative morphometrics of Parti-coloured bat *Vespertilio murinus,* Asian parti-coloured bat *Vespertilio superans*

Variables	***Vespertilio murinus***			***Vespertilio superans***			*t-test*	*P-value*
	N	Mean	SD	N	Mean	SD		
Body mass	20	9.4	1.2	9	15.0	1.4	-11.2	*0.0001*
Body length	20	53.5	4.5	9	64.3	4.0	-6.15	*0.0001*
Tail	19	36.4	3.2	9	38.8	3.8	-1.73	0.096
Forearm	20	42.6	1.3	9	48.0	1.5	-10.27	*0.0001*
3rd finger length	20	62.7	3.2	9	70.8	4.9	-5.27	*0.0001*
5th finger length	20	46.4	2.2	9	49.0	4.1	-2.247	*0.030*
Ear	20	11.0	1.2	9	12.5	0.9	-3.28	*0.003*
Tragus	19	3.6	0.4	9	4.3	0.6	-3.77	*0.0009*
DSEU	20	5.2	0.3	7	6.0	0.3	-5.72	*0.0001*

Table 5: Air temperature variation during the study hours (SD are shown as whiskers)

Time	Level	N	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
21.00-21.30	1	14	26.53	3.50	0.94	24.51	28.55
21.31-22.00	2	23	25.87	2.57	0.54	24.76	26.98
22.01-22.30	3	36	25.99	2.92	0.49	25.00	26.98
22.31-23.00	4	34	25.38	2.04	0.35	24.66	26.09
23.01-23.30	5	33	24.35	2.75	0.48	23.38	25.33
23.31-00.00	6	36	23.79	2.75	0.46	22.86	24.73
00.01-00.30	7	35	23.03	2.94	0.50	22.02	24.05
00.31-01.00	8	34	22.56	3.71	0.64	21.26	23.85
01.01-01.30	9	13	22.84	3.65	1.01	20.63	25.05
01.31-02.15	10	7	23.23	4.16	1.57	19.38	27.08

Table 6: Air humidity variation during the study hours (SD are shown as whiskers)

Time	Level	N	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
21.00-21.30	1	14	18.18	11.65	3.11	11.45	24.91
21.31-22.00	2	23	26.43	17.65	3.68	18.80	34.06
22.01-22.30	3	36	25.74	14.32	2.39	20.89	30.58
22.31-23.00	4	34	25.48	13.81	2.37	20.66	30.30
23.01-23.30	5	33	27.46	15.36	2.67	22.01	32.90
23.31-00.00	6	37	29.96	15.17	2.49	24.90	35.02
00.01-00.30	7	35	29.98	15.25	2.58	24.74	35.22
00.31-01.00	8	34	27.98	12.01	2.06	23.79	32.17
01.01-01.30	9	13	27.00	16.15	4.48	17.24	36.76
01.31-02.15	10	7	17.29	3.50	1.32	14.05	20.52

Table 7. Number of bats flying during the study hours

Time	Level	N	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
21.00-21.30	1	14	1.43	1.34	0.36	0.65	2.20
21.31-22.00	2	23	1.39	1.44	0.30	0.77	2.01
22.01-22.30	3	33	0.42	0.66	0.12	0.19	0.66
22.31-23.00	4	29	0.34	0.72	0.13	0.07	0.62
23.01-23.30	5	31	0.55	0.77	0.14	0.27	0.83
23.31-00.00	6	33	0.48	0.80	0.14	0.20	0.77
00.01-00.30	7	32	0.28	0.68	0.12	0.03	0.53
00.31-01.00	8	32	0.31	0.47	0.08	0.14	0.48
01.01-01.30	9	10	0.40	0.70	0.22	-0.10	0.90
01.31-02.15	10	5	0.40	0.55	0.24	-0.28	1.08

Table 8: Number of bats captured during the study hours

Time	Level	N	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
21.00-21.30	1	5	1.40	0.55	0.24	0.72	2.08
21.31-22.00	2	10	1.30	0.48	0.15	0.95	1.65
22.01-22.30	3	15	1.00	0.00	0.00	1.00	1.00
22.31-23.00	4	14	1.29	0.61	0.16	0.93	1.64
23.01-23.30	5	10	1.20	0.42	0.13	0.90	1.50
23.31-00.00	6	6	1.00	0.00	0.00	1.00	1.00
00.01-00.30	7	8	1.63	0.92	0.32	0.86	2.39
00.31-01.00	8	8	1.13	0.35	0.13	0.83	1.42
01.01-01.30	9	5	1.40	0.89	0.40	0.29	2.51
01.31-02.15	10	6	1.17	0.41	0.17	0.74	1.60

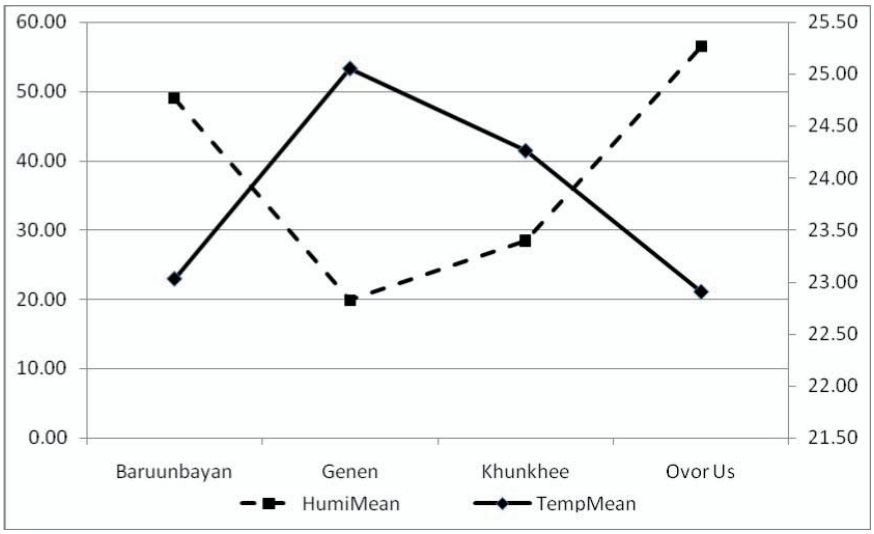

Fig. 7: Temperature and humidity condition during the mist netting operation at trap sites.

Fig. 8: Bat using a water container for livestock as water source.

Fig. 9: Sukhchuluun, Ariunbold, and Munkhzul (left to right) are collecting a bat captured in mist net.

Fig. 10: Study team processing bats next morning (left to right are Munkhkzul, Nyambayar, Sukhchuluun, Ariunbold).

Fig. 11: View of field camp after relocating in Ovor Us.

Fig. 12: Brown long-eared bat after catching a prey in the net.

Fig. 13: Brown long-eared bat with metal band.