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## Short Note

Arshad Javid\*, Muhammad Mahmood-ul-Hassan, Syed Makhdoom Hussain and Khalid Javed Iqbal

## Recent record of the Asiatic lesser yellow house bat (*Scotophilus kuhlii*) from Punjab, Pakistan

**Abstract:** *Scotophilus kuhlii* Leach, 1821 has only been reported from Chaklala and Chakri in Punjab, Pakistan. We captured five specimens from Lahore in a 2-year survey from June 2009 to May 2011. This is the first report of this species from Punjab province and the first from Lahore (31°29.223 N, 074°24.632 E) since the 1920s. The external body, cranial and bacular measurements of the captured specimens were compared with the available literature. The forearm length (n=5) was  $49.40 \pm 3.03$  mm, the greatest length of the skull (n=4) was  $18.98 \pm 0.61$  mm and C-M<sup>3</sup> (n=4) was  $6.27 \pm 0.49$  mm. The echolocation call parameters of 25 pulses from five calls of the species were also analyzed. The mean frequency of maximum energy was  $56.9 \pm 3.6$  kHz, the mean start and end call frequencies were  $103.5 \pm 12.3$  kHz and  $50.6 \pm 1.0$  kHz, respectively.

**Keywords:** baculum size; body and skull measurements; echolocation; Lahore.

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In Pakistan, Roberts (1997) reported 50 species of bats representing 23 genera and 8 families, and Walker and Molur (2003) expected more species. The taxonomic status of most of the species is unclear as almost 18 bat species are described by single specimens preserved either in the British Museum (UK), the Harrison Museum (USA) and the Punjab University Museum of Zoology (Pakistan) (Roberts 1997, Mahmood-ul-Hassan and Nameer 2006, Mahmood-ul-Hassan et al. 2009). The distribution ranges of most mammals have changed during the past century (Taber

et al. 1968), but little attention has been paid to bats (Mahmood-ul-Hassan et al. 2012, Javid et al. 2012a,b).

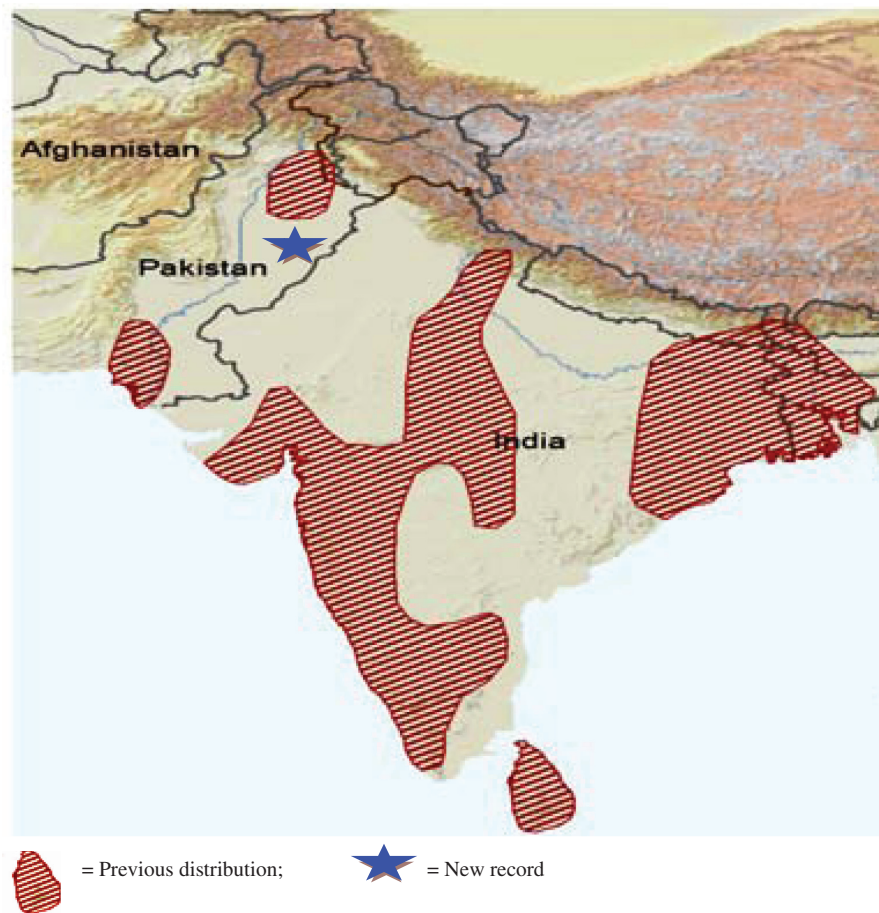
The genus *Scotophilus* is represented by 12 species with distribution ranges from South Africa to Indonesia and the Philippines (Simmons 2005). On the Indian sub-continent and in Pakistan, it is represented by two species (Bates and Harrison 1997, Srinivasulu et al. 2010a).

*Scotophilus heathii* Horsfield, 1831 is distributed from Afghanistan to South China, including Hainan Island, south to Sri Lanka, Vietnam, Cambodia, Thailand and Burma. In Pakistan, the species is common and widespread throughout the Indus plains. It has been collected from Kohat (Khyber Pakhtunkhwa), Islamabad city, Multan, Lahore and Sialkot districts (Punjab), Kashmir, Sakkur, Jacobabad, Mirpur Sakro, Dadu, Landi, Malir and Karachi (Sindh) (Wroughton 1915, 1916, Lindsay 1926, Siddiqui 1961, Taber et al. 1967, Walton 1974, Roberts 1997).

*Scotophilus kuhlii* Leach, 1821 was formerly questioned as *S. heathii* (Tate 1942, Ellerman and Morrison-Scott 1951), however, the taxon was later identified as a distinct species (Peterson 1968, Hill and Thonglongya 1972, Corbet and Hill 1992, Koopman 1993, Bates and Harrison 1997, Simmons 2005). The species often mixed with its congeners, representing a complex of several species, and further studies are needed to clarify current taxonomic status (Bates et al. 2008).

Recorded from Pakistan (Figure 1) to Taiwan, Malaysia to the Philippines and Indonesia (Bates and Harrison 1997; Simmons 2005; Bates et al. 2008), *Scotophilus kuhlii* roosts in crevices in buildings, caves, temples and hollows in palm trees, both in rural and urban landscapes (Wroughton 1915, Brosset 1962, Sinha 1986, Sun et al. 2008, Srinivasulu et al. 2010a). The present study was planned to confirm the presence of *S. kuhlii* in Punjab, where it was last recorded in the 1920s from Chaklala and Chakri (Hinton and Thomas 1926, Lindsay 1927).

A 2-year survey was conducted from June 2009 to May 2011 in northern (Margalla Hills National Park and Chinji National Park), central (Lahore, Kasur and Faisalabad) and southern Punjab (Lal Suhanra National Park).



**Figure 1** Distribution of *Scotophilus kuhlii* on the Indian subcontinent.

All of these areas were surveyed for 3 consecutive days in alternate months. A total of 30 sites were sampled in 26 field visits. Prospective bat roosts, such as old and undisturbed buildings, ruins, abandoned wells and farm houses, were visited. Local people were also interviewed to glean maximum information about the exact location of various bat roosts. Once located, the global position of each roost was determined using a Garmin etrax H Global Position System (Garmin International, Inc., Olathe Kansas, USA).

An ultrasonic detector (Peterson D1000X, Pettersson Elektronik AB, Uppsala Science Park, Dag Hammarskjolds, Uppsala, Sweden), a helpful tool for identifying sibling bat species, was used to maximize chances of locating bat roosts and to analyze echolocation calls (Jones and van Parijs 1993). Bat sounds were recorded in free-flight at foraging sites and were analyzed with the software Bat-Sound 4 (Pettersson Elektronik AB) using a sample frequency of 44.1 kHz with 16 bits/sample and a 512 point fast Fourier transform (FFT) with a Hanning window. Two echolocation calls (pulses) were selected at

random from each bat and were analyzed for species identification following Barlow and Jones (1997a,b).

On May 17, 2010 at 7:00 PM, mist netting efforts at Badian (31°29.223 N, 074°24.632 E) resulted in the capture of five *Scotophilus kuhlii* (1♂, 4♀). The specimens were placed in cotton bags and were weighed using a Pesola balance. The bats were euthanized and preserved in absolute alcohol. External body measurements were taken with a Vernier calliper following Bates and Harrison (1997). Bat skulls and baculum were prepared and measured according to the methods given by Bates et al. (2005) and Javid (2011).

The pelage of our specimens is soft and olive-brown and creamish on the ventral side. A distinct collar is apparent on the throat, the muzzle is wide and blunted, the ears are small compared to the head, the tragus is crescent-shaped, approximately half the size of the ears and is well separated from the pinna by a distinct notch. Similar features were recorded by Srinivasulu et al. (2010b). A smaller mean body mass and forearm length clearly differentiate the species from its congener in the Indian subcontinent, i.e., *Scotophilus heathii* (Table 1), and most of

**Table 1** Body mass (g), external, cranial and bacular measurements (mm) of *Scotophilus kuhlii* captured from Badian, Lahore (Punjab, Pakistan).

Body measurements	n=5	Bates and Harrison (1997)		Cranial measurements	n=4	Bates and Harrison (1997)	
		<i>S. kuhlii</i>	<i>S. heathii</i>			<i>S. kuhlii</i>	<i>S. heathii</i>
Body mass	22.2±2.6	–	–	Breadth of braincase	9.59±1.61	8.9(8.8–9.4)	10.5
Head and body length	72.1±8.1	69.8(60.0–78.0)	76.6	Zygomatic breadth	13.43±0.85	13.0(12.4–13.7)	16.5
Ear length	12.1±2.5	13.5(9.0–17.0)	21.1	Postorbital constriction	4.73±0.39	4.7 (4.4–5.1)	4.5
Tragus length	6.6±0.7	–	–	Condylar length	17.62±0.46	17.3(16.3–18.0)	20.4
Thumb length	6.4±0.9	–	–	Condylar-basal length	18.01±0.30	–	–
Claw length	2.7±0.5	–	–	Greatest length of skull	18.98±0.61	19.6(18.7–20.4)	22.1
Forearm length	49.4±3.0	49.0(44.0–56.4)	58.8	Maxillary tooththrow (C–M <sub>3</sub> )	6.27±0.49	–	8.2
3rd metacarpal length	47.3±4.6	48.8(44.4–58.8)	55.1	Anterior palatal width	5.79±0.36	–	–
3rd metacarpal: 1st phalanx	18.1±1.0	–	–	Posterior palatal width	7.86±0.92	–	10.0
3rd metacarpal: 2nd phalanx	13.6±0.7	–	–	Mandibular tooththrow (C–M <sub>3</sub> )	7.53±0.81	–	9.0
4th metacarpal length	44.9±3.1	48.3(43.7–57.2)	53.6	Mandible length	14.41±1.17	13.7(12.9–14.4)	17.4
4th metacarpal: 1st phalanx	15.4±1.6	–	–	Bacular measurements	n=1	–	–
4th metacarpal: 2nd phalanx	10.7±2.1	–	–	Total length of baculum	1.74	2.5	–
5th metacarpal length	41.1±3.3	45.0(42.1–53.9)	52.3	Length of shaft	1.52	–	–
5th metacarpal: 1st phalanx	9.3±0.6	–	–	Length of proximal branch	0.07	–	–
Wing span	293.2±35.5	–	–	Length of distal branch	0.15	–	–
Tibia length	20.1±1.6	42.40(38.0–46.0)	24.4	Width of proximal branch	1.05	–	–
Calcaneal length	8.0±1.2	–	–	Width of distal branch	0.49	–	–
Hind foot length	10.6±0.7	10.0(8.0–13.0)	12.9	Height of baculum	0.49	–	–
Tail length	42.4±4.0	47.5(40.0–65.0)	57.5	–	–	–	–
Penis length	5.0±0	–	–	–	–	–	–

Mean±standard deviation (minimum-maximum); n, number of specimens.

the external body and cranial measurements fall within the range given by Bates and Harrison (1997).

The average breadth of the braincase is slightly broader than the range, and the length of the baculum is smaller. The smaller condylar-canine and mandibular tooththrow lengths clearly identify *Scotophilus kuhlii*. Finally, the bluntly triangular shape of the baculum also fits the description by Srinivasulu et al. (2010a,b): The

base seems wider than the apex from a dorsal view and is very narrow with a wide base from a lateral view.

The analysis of 25 pulses from five calls of *Scotophilus kuhlii* showed that these bats emitted narrow-band frequency-modulated signals (Table 2). The calls were single harmonic. In southern China, Zhu et al. (2012) recorded frequency modulation (FM) echolocation calls with a dominant frequency of 45.72±2.09 kHz and up to

**Table 2** Echolocation call parameters of *Scotophilus kuhlii* bats recorded from Badian, Lahore (Punjab, Pakistan).

Call No.	FmaxE (kHz)	Start freq. (kHz)	End freq. (kHz)	Duration (ms)	IPI (ms)
M00009 (n=4)					
Mean	54.8	111.3	50.0	3.3	72.1
SD	0.3	5.6	1.6	0.1	0.6
M00010 (n=3)					
Mean	56.8	106.3	51.7	2.8	75.7
SD	0.6	2.5	0.6	0.2	4.8
M00011 (n=7)					
Mean	60.1	114.9	50.4	2.5	52.7
SD	5.1	2.9	0.6	0.4	14.9
M00014 (n=6)					
Mean	54.5	89.0	50.5	2.4	68.5
SD	2.2	12.2	1.2	0.3	3.1
M00017 (n=5)					
Mean	47.9	83.2	42.5	2.0	50.0
SD	22.4	35.0	20.3	0.1	26.1
Combined (n=25)					
Mean	56.9	103.5	50.6	2.5	63.7
SD	3.6	12.3	1	0.5	12.9

FmaxE, frequency of maximum energy; Start freq, start frequency; End freq, end frequency; IPI, interpulse interval.

four harmonics. Such differences could suggest the existence of two cryptic bat species, as was previously reported for *Pipistrellus pipistrellus* in Europe (Jones and van Parijs 1993, Barlow and Jones 1997b) or, more recently, *Scotophilus dinganii* in southern Africa (Jacobs et al. 2006).

*Scotophilus kuhlii* has a strong dispersal capacity and close association with human activity (Hisheh et al. 2004), which may explain the new records of the species

from Lahore. Cranial, bacular and echolocation call parameters, which are among the major characteristics for species identification, are described for the first time in Pakistan, where bats should be the focus of further studies to support their conservation.

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