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MORPHOLOGICAL DIFFERENTIATION IN TWO CLOSELY-RELATED MOUSE-TAILED BAT SPECIES (CHIROPTERA: RHINOPOMATIDAE) CAPTURED FROM MALAKAND DIVISION, KHYBER PAKHTUNKHWA, PAKISTAN

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ABSTRACT

Morphological differences aid in limiting intra-species variations. Present investigation was carried out to understand morphological differences in two closely related congeners, the greater mouse-tailed bat *Rhinopomamicrophyllum* (Brünnich, 1782) and the lesser mouse tailed bat *Rhinopomahardwickii* (Gray, 1831). Variations in external body, cranial and bacularfeatures were recorded and compared. During present survey, specimens of *R. microphyllum*(n=58) and *R. hardwickii* (n=25) were roosting at two different caves (N34º 26.783′ E71º 49.070′ and N34º 26.818′ E71º 48.973′) in Malakand division, Khyber Pakhtunkhwa (KPK). Out of these, 3 specimens of *R. microphyllum*and 5 specimens of *R. hardwickii* were captured. *R. hardwickii*from KPK was recorded only from Amb prior to the present investigation indicating range extension of the species.

Key words: Cranial measurements; baculum size; *R. microphyllum*; *R. hardwickii*; Malakand.

INTRODUCTION

The genus *Rhinopoma* E. Geoffroy, 1818 is globally represented by four species and three of them, the lesser mouse-tailed bat *R. hardwickii* Gray, 1831, the greater mouse-tailed bat *R. microphyllum*Brünnich, 1782 and the small mouse-tailed bat *R. muscatellum* Thomas, 1903 are reported in the Indian subcontinent(Simmons, 2005). Both these species have a small dermal ridge on their muzzle and are distinguishable on the basis of forearm length relative to their tail length. Forearm in *R. microphylum* is longer than *R. hardwickii* but tail in *R. microphyllum* is generally smaller than the forearm as compared to *R. hardwickii* which have a longer tail than their forearm. The greater mouse-tailed bat is distributed from Mauritania, Nigeria, Senegal, Arabia, Iran, Afghanistan, Pakistan, India, Sumatra and Cameroon to Egypt (Simmons, 2005). The species is relatively abundant in the Indian subcontinent with one endemic subspecies (*R. m. kinneari*). In Pakistan, the species has been reported in Punjab Province from Ara(district Chakwal) (Hinton and Thomas, 1926), Sakesar, Rohtas (Lindsay, 1927), Gujrat, Multan, Mailsi, Sadiqabad, Qutabpur and near Jhelum in Punjab (Roberts, 1997). In Sindh Province, colonies have been found in Sukkur, Gambat (district Khairpur) (Wroughton, 1916); Hyderabad, Karchat Hills (district Jamshoro) and Karachi (Roberts, 1997). The species from Balochistan Province has been reported from Lasbelai.e. South Balochistan (Gaisler, 1970). In Khyber PaktunkhwaProvince, the known localities of species are natural rock caves in the Malakand Hills (Roberts, 1997) andAmb(district Mansehra) (Hill, 1977; Roberts, 1997).

Rhinopomamicrophyllum is the largest of the three *Rhinopoma* found in the Indian subcontinent with forearm length of 68.0 mm (59.5 - 74.6 mm). The tail is short and usually does not exceed the length of the forearm (Roberts, 1997; Bates and Harrison, 1997).

According to Bates and Harrison (1997) *R. hardwickii*is widespread and believed to be common in the Indian Subcontinent. Both the species *R. hardwickii*and *R. microphyllum*use same type of diurnal roosts. Benda *et al*. (2004; 2006) reported the external body and cranial measurements of *R. hardwickii*from Eastern Mediterranean region, Southwestern Arabia, Afghanistan and India. Both the species were considered to be "Least Concern" (South Asian Chiroptera C.A.M.P. Report, 2002; Walker and Molur, 2003; IUCN, 2008).

Present study was planned to explore diversity of bats belonging to the genus *Rhinopoma* from Malakand division and to record their morphological features that help in species identification.

MATERIALS AND METHODS

Study Area: The present study was conducted in that part of the country which is characterized as sub-tropical dry mixed deciduous scrub forest and dry subtropical temperate semi-evergreen scrub forest (Roberts, 1997). The area is administratively designated as Malakand Division and is located at 34˚20´ and 35˚ 20´ North latitudes and 71˚-15´ and 72 ˚30′ East longitudes between the Himalayan and Hindu Kush foothills. It covers a broad altitudinal range. The climatic conditions are diverse and vary with altitude. Various climatic zones found in the study area, in order of increasing altitude include; a) semi-arid humid-temperate zone (450-600m), b) warm temperate zone (600-1100m), c) temperate zone (1100-1500m), d) cool temperate zone (1500-1900 m), e) cold temperate zone (1900-3200m), f) alpine pastures (2300-4700m), and e) snow and ice zone (4700-7690m). The high mountainous region occurs in north and forms southern watershed of the valley thereby draining into the Chitralriver whereas the western low mountainous region spreads from the east of Swat in the north-south direction and covers a large part of Khyber Pakhtunkhwa. The Swat river traverses the Malakand Division and serves as a natural boundary between Malakand and Bajaur. Further up in the north, The Swat river also makes boundary with Dir district.

The Malakand Division comprises of five districts and two Federally Administered Tribal Agencies which include Buner, Shangla, Swat, Dir and Malakand districts, and Bajaur and Mohmand Agencies (Fig. 1).

Sampling Strategy: Bats were collected over a duration of two years (2010- 2012) in Malakand Division from a variety of habitats such as croplands, plantations, mountainous caves, old buildings, abandoned wells, ruins, houses, tree groves, crevices, old bridges, ponds and canals. Local people were also interviewed regarding the exact location of bat roost and determined using a global positioning system device (Garmin etrax H GPS). Mist nets of 12 m (n = 1), 9 m (n =2) and 6 m (n = 3) size were erected either in “L” or “V” shape at strategic positions on a pair of 3 m long bamboo poles in such a way that the last shelf of each net remained one foot above the ground. All the nets were opened simultaneously at sunset and were checked continuously to disentangle any captured bat.The number of euthanized bats was intentionally kept low to avoid unnecessary killing. Field number, sex, age, exact locality and district of capture of each bat were noted on the plastic bottle containing absolute alcohol. Each specimen was weighed up to 0.1 g (Pesola balance 10050, Swiss made) and brought to the laboratory for further studies. Body measurements were taken following Bates and Harrison (1997) using a scale and digital Vernier Caliper (0-150mm).

Cranial Measurements: Eye balls, tongue, brain tissue and excessive flesh were removed from skulls using forceps and cotton. Skulls thus cleaned were kept overnight in a dilute solution (0.2 % of Potassium Hydroxide (KOH)), absolute alcohol and acetone, respectively. Each of the dry skulls was stored in a properly labeled vial padded with cotton. The craniodental measurements were taken following Bates *et al.* (2005) and Javid*et al.* (2011).

Bacular Measurements: Penis of the male bats was cut down as close to the surface of the body as possible so that the baculum is not damaged. The cut penis was placed in a test tube half filled with cold water and boiled for two minutes. The boiled penis was then transferred to a plastic tube containing 5% KOH and a pinch of alizarin red powder. After 24 hours, the stained bacula were dissected out of the tissue under a dissecting microscope with fine forceps and stored in glycerin in a labeled test tube (Bates *et al*. 2005). Once a stained baclum is obtained, various bacular measurements were recorded following Lidicker and Yang (1986) under a microscope at 40X magnification using a stage and an ocular micrometer.

RESULTS AND DISCUSSION

During the present study, *R. microphyllum*(n=3) and *R. hardwickii*(n=5) were captured from Tura Gata tehsil Dargai in Malakand Division and their external body, cranial and bacular features were compared with Rahman *et al*. (2015), Javid *et al*. (2012), Benda *et al*. (2009), Davis (2007), Bates and Harrison (1997), Roberts (1997), Schlitter and Qumsiyeh (1996) and Qumsiyeh and Jones (1986).

The face, ears and connecting membrane on the forehead and chin of *R. microphyllum*was naked as described by Bates and Harrison (1997) and Roberts (1997). Ears were large and prominent while tragus was bluntly sickle shaped (Roberts, 1997). Muzzle had a smalldermal ridge and eyes were large and bright.Pelage was short and fine. It was grey brown on the dorsal surface and paler below. The lower back and the posterior lower abdomen were naked. All these features were the same as described by Roberts (1997) and Bates and Harrison (1997).

Average body mass, forearm length, length of 1st and 2nd phalanges on 3rd metacarpal, 2nd phalanx on 4th metacarpal, 2nd phalanx on 5th metacarpal, tibia length and hind foot length recorded by Rahman *et al*. (2015) were within the ranges of measurements recorded during present study (Table 1). The specimens of *R. microphyllum* captured during present study were larger than their congeners with a forearm length comparable to Benda *et al*. (2009), Davis, (2007), Schlitter and Qumsiyeh (1996) and Roberts (1997). The tail was found

to be shorter than the measurements reported by Rahman *et al*. (2015), Benda *et al*. (2009), Bates and Harrison, (1997),Roberts (1997) and Schlitter and Qumsiyeh (1996). This was exactly the same as described by Bates and Harrison, (1997) and Roberts (1997). The range of the wingspan was 255.00 - 275.00 mm which was exactly the same reported by Sinha (1980). The average hind foot length was also exactly the same as reported by Rahman *et al*. (2015), Bates and Harrison, (1997) and Roberts (1997) (Table 1).Similarly, average length of 2nd metacarpal, length of 3rd metacarpal, length of 4th metacarpal and length of 5th metacarpal recorded during present study werelittle smaller than reported by Rahman *et al*. (2015).Likewise, average length of 1st and 2nd phalanx on 2nd metacarpal, 3rd metacarpal, 4th metacarpal and 5th metacarpal was almost similar to that of Rahman *et al*. (2015), respectively (Table 1).

The rostrum was relatively small. The sagittal crest was prominent, rises steeply over the frontals and was then sharply reflected backwards with an almost straight superior border. The supraorbital ridges were well developed. The general morphology of the mandible was similar to that of *R. hardwickii* but the coronoid processes more robust. These features are in line with the findings of Bates and Harrison (1997).The average condylo-canine length, maxillary toothrow length, mandibular too throw length, greatest length of skull, mandible length, posterior palatal width, zygomatic breadth, breadth of braincase, postorbital constriction and anterior palatal width of two *R. microphyllum*captured during the present study were similar to that of Rahman *et al*. (2015), Benda *et al*. (2009), Bates and Harrison (1997) except Schlitter and Qumsiyeh (1996) which was smaller than the Malakand population (Table. 2). Benda *et al*. (2006) reported specimens from Afghanistan and India with greatest skull length and condylocanine length slightly larger than the Malakand population.

R. hardwickii was a small bat with a tail usually exceeding the forearm length. Face was glandular and ears were connected across the forehead (Madkour, 1961). Large pinnae possess 10 transverse ridges (Qumsiyeh and Jones, 1986) and tragus was well developed. Eyes were black, large and prominent. A pronounced dermal ridge on the muzzle and a small nose-leafon snout were also present (Davis, 2007). Inter-femoral membrane was enclosed less than one fourth of the tail (Miller, 1907; Harrison, 1964). The second digit possesses two phalanges (Roberts, 1997). The dorsal pelage was grey-brown but the belly was essentially grey. The inter-femoral and wing membranes, posterior back and lower abdomen was naked while the chin was nearly naked (Bates and Harrison, 1997). All these features were the same as described by Bates and Harrison (1997) and Roberts (1997).The average body mass, head and body length, ear length, forearm length, wingspan, tibia length, hind foot length and tail length of the five *R. hardwickii* was 10.60 ± 2.86 g, 64.67 ± 3.00 mm, 19.09 ± 1.32 mm, 59.90 ± 1.21 mm, 307.40 ± 23.08 mm, 29.22± 0.82 mm, 14.72 ± 0.36 mm and 66.57 ± 2.15 mm, respectively. According to Roberts (1997) the head and body length, ear length, forearm length, hind foot length and tail length was 62 mm, 18 mm, 60 mm, 11.5 mm and 67 mm, respectively. All these measurements were smaller than the present study except forearm and tail length. Most of the metacarpal of the Malakand Division specimens were larger than reported by Javid *et al*. (2012) however phalanx length was almost similar to the present study (Table 3). Bates and Harrison (1997) collected *R. harrdwickii* from India and Pakistan. Their average head and body, tail and ear lengths were slightly greaterthan the measurements obtained during present study. Benda *et al*. 2009 reported the external body measurements of the specimens collected from Yemen. The average head and body length, and forearm length was smaller than Malakand population.Benda *et al*. (2004) reported the external body measurements of *R. hardwickii*collected from Libya with mean head and body length, tail length and forearm length 64.64 ± 1.277 mm, 72.69 ± 3.591 mm and 60.52 ± 1.475 mm, respectively. The head and body length was almost similar to the present study while forearm length and tail length was larger than the Malakand population.Benda *et al*. (2009) reported the body measurements of *R. hardwickii* collected from Afghanistan and India with average forearm length 59.20 mm ± 2.063 (SD) which is slightly small than the present study (Table 3).

All the cranial measurements reported by Javid*et al*. (2012) were slightly smaller from the present study except posterior palatal width, zygomatic breadth, postorbital constriction and anterior palatal width (Table 4). The average condylo-canine length was almost similar to that reported by Javid *et al*. (2012), Benda *et al*. (2009), Bates and Harrison (1997) and Qumsiyeh and Jones (1986). Similarly, the maxillary too throw length, postorbital constriction and anterior palatal width of four *R. hardwickii* captured during present study was almost similar to that reported by Javid *et al*. (2012), Benda *et al*. (2009), Bates and Harrison (1997) and Qumsiyeh and Jones (1986) (Table.4). The posterior palatal width was greater than the specimens reported by Javid *et al*. (2012). The zygomatic breadth was smaller reported by Qumsiyeh and Jones (1986) than that of present study, Javid *et al*. (2012), Benda *et al*. (2009) and Bates and Harrison (1997) (Table.4).

According to Bates and Harrison (1997) the baculum was very small. It has a bifid base, a simple tip and a deep groove on the ventral surface. All these features were exactly the same as that of the present study. Average total length of baculum (n = 1) of *R. microphyllum* captured during present study was 1.65 mm. The proximal branch length, proximal branch width, shaft length, baculum height, distal branch length and

distal branch width was 0.40 mm, 0.55 mm, 1.25 mm, 0.60 mm, 0.01 mm and 0.25 mm, respectively. The total baculum length of *R. hardwickii*was 1.1 mm reported by Javid*et al*. (2012) which was smaller than the present study. Similarly shaft length was also smaller than theMalakand population (Table 5).

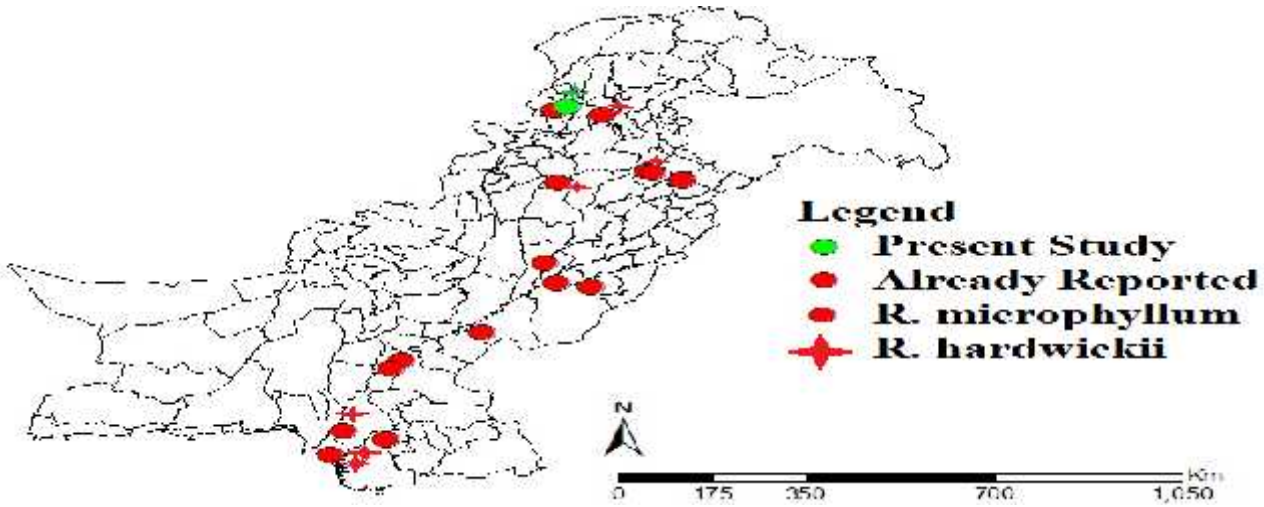

Fig. 1.Distributionmap of *R. microphyllum*and*R. hardwickii*.

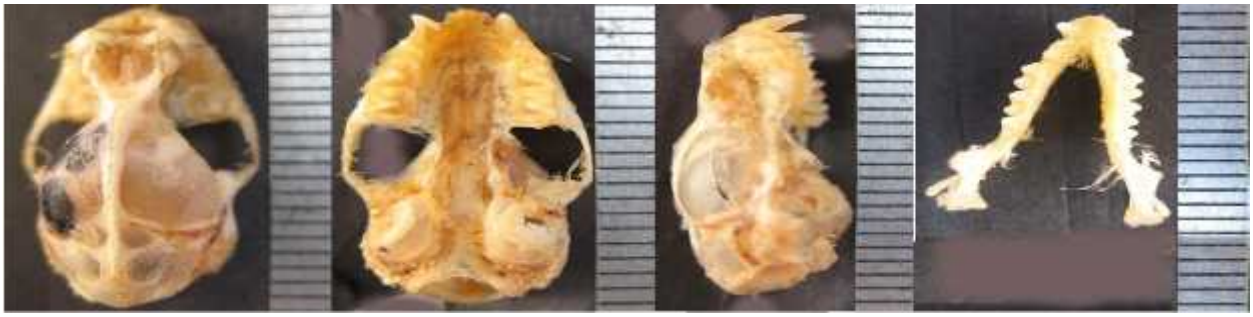

Plate 1. A close up of dorsal, ventral, lateral side of the cranium of *Rhinopomamicrophyllum*and dorsal view of lower jaw a specimen (BatLab No. 30) captured from Tura Gata tehsil Dargai in Malakand district, respectively.

Plate 2. Dorsal view of the baculum of greater mouse tailed bat *Rhinopomamicrophyllum*(Bat lab 314) captured in a cave from Tura Gata in Malakand district.

Plate 3. A close up of dorsal and, ventral side of the cranium of *Rhinopomahardwickii*and dorsal view of lower jaw a specimen (BatLab No. 313) captured from Tura Gata tehsil Dargai in Malakand district, respectively.

Table 1.Comparison of body mass (g) and external body measurements (mm) of *Rhinopomamicrophyllum*captured during present study with Rahman *et al*. (2015), Benda *et al*. (2009), Davis, (2007), Bates and Harrison (1997), Roberts (1997) and Schlitter and Qumsiyeh (1996).

Body Parameters	Present Study (n=3)	Rahman *et al.* 2015	Benda *et al.* 2009	Davis, 2007	Bates and Harrison, 1997	Roberts, 1997 (n = 6)	Schlitter and Qumsiyeh, 1996
BM	18.00±6.00(12.00-24.00)	19.09±1.36	29.7	10-12	-	-	-
HB	71.03±5.09(65.36-75.20)	65.29±2.20	88	50-63	75.3±6.2 (60.0-84.0)	74-90	-
E	20.04±1.76(18.08-21.50)	21.69±0.63	-	-	19.7±1.1 (18.0-22.0)	19-22	-
TRH	6.85±1.52 (5.10-7.79)	-	-	-	-	-	-
FA	67.45±4.60 (64.10-72.70)	68.71±1.05	66.36± 2.48 (62.5-71.1)	50-60	68.0±3.3 (59.5-74.6)	61-71	57-75
THC	8.80±0.95 (8.24-9.90)	15.43±0.24	-	-	-	-	-
2mt	47.46±3.23 (45.36-51.18)	52.02±1.63	-	-	-	-	-
1ph2mt	4.60±0.27 (4.30-4.82)	5.03±0.21	-	-	-	-	-
2ph2mt	4.58±0.09 (4.52-4.68)	4.36±0.31					
3rd met	48.57±2.95 (46.85-51.98)	52.41±1.86	-	-	-	-	-
1st Ph. 3rd met	9.53±0.83 (8.93-10.48)	9.97±0.42	-	-	-	-	-
2nd Ph. 3rd met	17.40±1.73 (15.77-19.22)	16.80±2.63	-	-	-	-	-
4th met	38.28±2.76 (36.35-41.44)	41.93±1.27	-	-	-	-	-
1st Ph. 4th met	14.49±0.31 (14.13-14.70)	15.23±0.62	-	-	-	-	-
2nd Ph. 4th met	11.52±0.84 (10.84-12.45)	11.11±0.56	-	-	-	-	-
5th met	43.19±2.60 (41.46-46.18)	47.10±0.66	-	-	-	-	-
1ph5mt	10.64±0.28 (10.34-10.89)	11.16±0.30	-	-	-	-	-
2ph5mt	9.80±0.75 (9.12-10.60)	9.78±0.47	-	-	-	-	-
WS	266.67±10.41 (255.00-275.00)	197.49±9.76	-	-	-	-	-
TIB	26.59±1.84 (25.18-28.67)	26.91±1.14	-	-	-	-	-
HF	15.51±0.70 (15.09-16.31)	15.93±0.43	-	-	15.0±1.0 (14.0-18.0)	15-16	-
T	51.45±1.18 (50.37-52.71)	57.20±2.80	68	48-68	58.1±5.6 (50.0-77.0)	46-55	41-63

n - The number of specimens; BM - Body mass; HB - Head and body; E - Ear; TRH- Tragus height; FA - Forearm; THC– Thumb with claw; 2mt - 2nd metacarpal; 1ph2mt - 1st Phalanx on 2nd metacarpal; 2ph2mt - 2nd Phalanx on 2nd metacarpal; 3mt - 3rd metacarpal; 1ph3mt - 1st Phalanx on 3rd metacarpal; 2ph3mt - 2nd Phalanx on 3rd metacarpal; 4mt - 4th metacarpal; 1ph4mt - 1st Phalanx on 4th metacarpal; 2ph4mt - 2nd Phalanx on 4th metacarpal; 5mt - 5th metacarpal; 1ph5mt - 1st phalanx on 5th metacarpal; 2ph5mt - 2nd phalanx on 5th metacarpal; WS - Wing span; TIB - Tibia; HF - Hind foot; T- Tail.

Table 2. Comparison of cranialmeasurements (mm) of *Rhinopomamicrophyllum*captured during present study with Rahman *et al.* (2015), Benda *et al.* (2009), Bates and Harrison (1997) and Schlitter and Qumsiyeh (1996).

Cranial Parameters	Present Study (n= 2)	Rahman *et al.* 2015	Benda *et al.* 2009	Bates andHarrison, 1997	Schlitter and Qumsiyeh, 1996
Condylo-canine length	18.29±0.95 (17.62-18.96)	18.61±0.21	18.64±0.563 (17.74-19.92)	18.9±1.1 (17.2-22.7)	-
Maxillary toothrow	7.30±0.18(7.17-7.43)	7.38±0.26	7.52±0.214(7.07-7.95)	7.5±0.3 (7.0-8.0)	6.4-7.9
Mandibular toothrow	8.11±0.11(8.03-8.19)	7.88±0.21	8.18±0.257(7.51-8.73)	8.2±0.3 (7.6-8.6)	-
Greatest length of skull	20.15±0.64(19.69-20.60)	19.64±0.21	20.77±0.568 (19.72-22.29)	20.9±0.9 (19.2-22.3)	18.4-22.1
Mandible length	14.38±0.63 (13.93-14.82)	14.41±0.26	-	14.8±0.7 (13.7-15.8)	-

Posterior palatal width	8.92±0.30(8.71-9.13)	4.96±0.19	9.20±0.347(8.47-9.82)	-	-
Zygomatic breadth	12.22±0.88 (11.59-12.84)	12.13±0.15	12.19±0.460 (11.40-13.08)	12.4±0.6 (11.4-13.4)	10.8-13.5
Breadth of braincase	8.74±0.53(8.36-9.11)	8.62±0.22	-	8.9±0.4 (8.2-9.4)	7.8-9.2
Postorbital constriction	2.65±0.11 (2.57-2.73)	2.66±0.23	2.64±0.178 (2.28-3.02)	2.8±0.2 (2.1-3.1)	-
Anterior palatal width	4.91±0.49(4.56-5.25)	9.31±0.27	5.32±0.302(4.75-6.12)	-	-

Table 3. Comparison of body mass (g) and external body measurements (mm) of *Rhinopomahardwickii*captured during present study with Javid*et al*. (2012), Benda *et al*. (2009), Davis, (2007), Bates and Harrison (1997), Roberts (1997) and Qumsiyeh and Jones (1986).

Body Parameters	Present Study (n=5)	Javid*et al*. 2012 (n=2)	Benda *et al*. 2009 (n=3)	Davi, 2007	Bates and Harrison, 1997	Robert, 1997 (n=9)	Qumsiyeh and Jones, 1986
BM	10.60±2.86 (7.00-13.00)	15.30±0.424(14.9-15.7)	9.90±0.529 (9.5-10.5)	10-12	-	-	-
HB	64.67±3.00 (61.30-68.01)	66.00±5.657(62.0-70.0)	61.3±5.033(56-66)	50-63	66.6±4.1 (55.0-73.0)	62 (55-69)	-
E	19.09±1.32 (17.20-20.02)	15.50±2.121 (14.0-17.0)	-	-	19.3±0.9 (17.0-21.0)	18 (16-20)	18-21
TRH	7.35±0.80 (6.11-8.01)	6.50±0.707	-	-	-	-	-
FA	59.90±1.21 (58.00-61.00)	54.00±0.000 (54.00-54.00)	59.02±2.411 (53.7-62.3)	50-60	59.2±2.6 (52.9-64.0)	60 (60-67)	52.4-60.0
THC	8.23±0.38 (8.01-8.90)	-	-	-	-	-	-
2mt	42.11±1.84 (39.11-44.00)	-	-	-	-	-	-
1ph2mt	5.23±0.54 (4.61-6.00)	-	-	-	-	-	-
2ph2mt	3.74±0.26 (3.50-4.01)	-	-	-	-	-	-
3rd met	43.57±1.60 (41.12-45.01)	39.00±0.000	-	-	-	-	-
1st Ph. 3rd met	9.19±0.34 (9.01-9.80)	9.00±0.000	-	-	-	-	-
2nd Ph. 3rd met	16.46±1.42 (14.20-18.00)	14.25±4.596	-	-	-	-	-
4th met	36.83±1.37 (34.50-38.01)	32.75±0.354	-	-	-	-	-
1st Ph. 4th met	12.17±0.52 (11.60-13.01)	11.50±1.414	-	-	-	-	-
2nd Ph. 4th met	10.64±0.51 (10.10-11.10)	10.50±0.707	-	-	-	-	-
5th met	41.63±1.43 (39.20-43.01)	37.50±0.707	-	-	-	-	-
1ph5mt	10.51±0.71 (9.50-11.11)	10.75±1.061	-	-	-	-	-
2ph5mt	9.85±0.79 (9.10-11.01)	-	-	-	-	-	-
WS	307.40±23.08 (280.00-338.00)	260.50±0.707	-	-	-	-	-
TIB	29.22±0.82 (28.10-30.01)	27.50±1.414	-	-	-	-	-
HF	14.72±0.36 (14.20-15.01)	14.00±0.000 (14.00-14.00)	-	-	13.4±1.2 (11.0-15.0)	11.5 (9-15)	12-15
T	66.57±2.15 (64.80-70.10)	59.00±2.828(57.0-61.0)	71.0±4.000 (67-75)	48-68	66.8±5.4 (56.0-78.0)	67 (57-77)	57-70

n - The number of specimens; BM - Body mass; HB - Head and body; E - Ear; TRH- Tragus height; FA - Forearm; THC– Thumb with claw; 2mt - 2nd metacarpal; 1ph2mt - 1st Phalanx on 2nd metacarpal; 2ph2mt - 2nd Phalanx on 2nd metacarpal; 3mt - 3rd metacarpal; 1ph3mt - 1st Phalanx on 3rd metacarpal; 2ph3mt - 2nd Phalanx on 3rd metacarpal; 4mt - 4th metacarpal; 1ph4mt - 1st Phalanx on 4th metacarpal; 2ph4mt - 2nd Phalanx on 4th metacarpal; 5mt - 5th metacarpal; 1ph5mt - 1st phalanx on 5th metacarpal; 2ph5mt - 2nd phalanx on 5th metacarpal; WS - Wing span; TIB - Tibia; HF - Hind foot; T- Tail.

Table 4. Comparison of cranial measurements (mm) of *Rhinopomahardwickii*captured during present study with Javid*et al*. (2012), Benda *et al*. (2009), Bates and Harrison (1997) and Qumsiyeh and Jones (1986).

Cranial Parameters	Present Study (n=4)	Javid*et al.* 2012 (n=2)	Benda *et al.* 2009	Bates and Harrison, 1997	Qumsiyeh and Jones,1986
Condylo-canine length	16.17±0.18 (16.01-16.42)	16.12±1.075 (15.36-16.88)	16.27±0.480 (15.23-17.62)	16.5±0.6 (15.5-17.5)	-
Condylo-basal length	-	17.78±0.898 (16.88-18.68)	-	-	15.6-16.9
Maxillary toothrow	6.08±0.07 (6.02-6.18)	5.84±0.359	6.29±0.179 (5.95-6.81)	6.4±0.2 (6.0-6.8)	5.7-6.3
Mandibular toothrow	6.72±0.13 (6.56-6.86)	6.10±0.718(5.59-6.60)	6.80±0.187 (6.38-7.21)	7.0±0.3 (6.5-7.5)	-
Greatest length of skull	18.20±0.48 (17.78-18.80)	19.68±0.108 (19.60-19.75)	18.33±0.639 (16.31-19.74)	18.7±0.5 (17.5-19.7)	-
Mandible length	12.38±0.23 (12.18-12.61)	11.28±1.652 (10.11-12.45)	-	12.8±0.4 (11.8-13.6)	11.3-12.4
Posterior palatal width	7.89±0.30 (7.58-8.29)	9.53±0.180	7.88±0.280 (7.33-8.47)	-	-
Zygomatic breadth	10.48±0.46 (10.12-11.15)	12.08±0.162 (11.96-12.19)	10.77±0.390 (9.81-11.58)	10.9±0.4 (10.1-11.7)	9.9-10.9
Breadth of braincase	8.25±0.20 (7.95-8.39)	7.61±0.018 (7.59-7.62)	-	8.2±0.2 (7.8-8.5)	-
Postorbital constriction	2.93±0.14 (2.72-3.01)	2.88±0.054(2.84-2.92)	2.85±0.466(2.50-5.27)	2.8±0.2 (2.5-3.2)	2.4-2.9
Anterior palatal width	4.26±0.40 (3.77-4.64)	4.98±0.934	4.68±0.275 (4.16-5.16)	-	-

Table 5. Comparison of bacular measurements (mm) of *Rhinopomamicro phyllum*captured during present study with *Rhinopomahardwickii* (Javid *et al.* 2012).

Bacular Parameters	Present study (n=1)	Javid*et al.* 2012 (n=1)
	R.microphyllum	***R.hardwickii***
Total baculum length	1.65	1.1
Proximal branch length	0.40	0.1
Proximal branch width	0.55	0.3
Distal branch length	0.01	0.00
Distal branch width	0.25	0.2
Width of distal extreme	0.43	-
Shaft length	1.25	1.0
Baculum height	0.60	0.4

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