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COMMUNICATION

IN PLAIN SIGHT: BACULAR AND NOSELEAF MORPHOLOGY SUPPORTS DISTINCT SPECIFIC STATUS OF ROUNDFEAF BATS *HIPPOSIDEROS POMONA* ANDERSEN, 1918 AND *HIPPOSIDEROS GENTILIS* ANDERSEN, 1918 (CHIROPTERA: HIPPOSIDERIDAE)

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IN PLAIN SIGHT: BACULAR AND NOSELEAF MORPHOLOGY SUPPORTS DISTINCT SPECIFIC STATUS OF ROUNDLEAF BATS *HIPPOSIDEROS POMONA* ANDERSEN, 1918 AND *HIPPOSIDEROS GENTILIS* ANDERSEN, 1918 (CHIROPTERA: HIPPOSIDERIDAE)

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Abstract: The taxonomic status of Andersen's Roundleaf Bat *Hipposideros pomona* (Chiroptera: Hipposideridae) and its relationship with the taxa assigned to it has been confusing. Knud Andersen described *H. pomona* (based on specimens from southern India) and *H. gentilis* (based on specimens from Myanmar) in 1918. Subsequently, the latter taxon was included under the former as a subspecies. Owing to disjunct distribution, it was speculated that these two taxa are distinct. Discovery of the type material and additional vouchers of both taxa in the National Collection of Zoological Survey of India, Kolkata allowed detailed comparison. Based on the morphological, craniodental and bacular characters, we establish the distinctness of these taxa. A redescription of *H. pomona* Andersen, 1918 is provided.

Keywords: Disjunct distribution, redescription, taxonomic status.

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Author Details: BHARGAVI SRINIVASULU is interested in molecular phylogenetics, taxonomy and biogeography of endemic bats of peninsular India, and is currently focusing on roundleaf bats of South Asia. CHELMALA SRINIVASULU, who heads the Wildlife Biology and Taxonomy Lab at Department of Zoology, Osmania University, is working on molecular phylogenetics, taxonomy, ecology and biogeography of tetrapods of South Asia.

Author Contribution: Both the authors contributed equally in field work, designed and wrote the paper. BS conducted the museum studies.

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INTRODUCTION

The taxonomic status of *Hipposideros pomona* Andersen, 1918 sensu stricto has been confusing since its establishment. Knud Andersen's study on species allied to *Hipposideros bicolor* resulted in the description of two new species: *H. pomona* from southern India, and *H. gentilis* from northeastern India, Burma to west coast of Sumatra (Andersen 1918; Hill 1963; Hill et al. 1986; Douangboubpha et al. 2010) (Fig. 1). Andersen (1918) based his diagnosis of *H. pomona* in possessing broader than usual noseleaf, horseshoe and 'sella' (probably referring to posterior leaf) measuring 5.8mm and 5.2mm respectively, and forearm measuring 40.5 mm based on a single specimen from Coorg, southern India; while that of *H. gentilis* in possessing not broader than usual noseleaf, horseshoe and 'sella' measuring 4.5–5.5 mm and 3.7–4.8 mm, and forearm measuring 38.5–41.5 mm based on specimens from Masuri, Pegu (=Bago), Burma (=Myanmar). In addition to the nominate *gentilis*, Anderson (1918) described three other subspecies of *H. gentilis*—*sinensis*, *atrox*, and *major*.

Hill (1963) included *pomona*, *gentilis*, *sinensis*, *atrox* and *major* as subspecies of *H. bicolor*. Later, Hill et al. (1986) while revising *H. bicolor* considered *H. pomona* as distinct species including nominate form, *gentilis*, and *sinensis*, and assigned *atrox* and *major* to *H. bicolor*. A trend followed by subsequent authors (Yenbutra & Felten 1986; Zubaid & Davison 1987; Corbet & Hill 1992; Simmons 2005). The current known distribution of *H. pomona* sensu lato extends from India, Bangladesh, Nepal, Myanmar, Thailand, Laos, Cambodia, Viet Nam, south China and west Malaysia (Simmons 2005; Bates et al. 2008). Douangboubpha et al. (2010) opined that *H. pomona* (sensu Corbet & Hill 1992) might comprise two distinct species, pending further studies, with *H. pomona* being restricted in distribution to peninsular India and *H. gentilis* including the taxa *gentilis* and *sinensis* extending in distribution from northeastern India into Southeast Asia (Fig. 1).

Until now, there existed no information about the taxon *H. pomona* sensu stricto from southern India, as the type specimen (skin) was not traceable and the damaged skull (BMNH No. 18.8.3.4) in the British Museum of Natural History was the only material (Hill et al. 1986). During a museum study conducted by the authors, the type specimen in the type collection of the Zoological Survey of India, Kolkata was studied. Three more specimens from southern India (bearing ZSI No. 21535, and 7193 and 7196 collected from Travancore and Shevaroy Hills respectively) were found in the

collection of ZSI, Kolkata by the first author. These specimens were originally labelled *H. fulvus fulvus* and have been catalogued as *H. fulvus* (Ghosh 2008). This species has been collected from southern India in the recent past, and the specimens are in personal collections of bat researchers in Tamil Nadu which have not been taxonomically studied. This recent discovery of additional specimens in National Zoological Collection of Zoological Survey of India provided us with an opportunity to conduct detailed study and compare this taxon with *gentilis* from northeastern India, Andaman Islands, and Myanmar.

Through this communication, we present evidence based on morphometric, bacular, and acoustic characters that prompt distinct specific status of the populations assigned from southern India as *H. pomona*, and northeastern India and Southeast Asia as *H. gentilis*. We also provide a detailed description of *H. pomona* as the original description of the taxon lacks detail.

MATERIALS AND METHODS

The present study is based on museum specimens in the National Zoological Collection, Zoological Survey of India, Kolkata and the Natural History Museum, Department of Zoology, Osmania University, Hyderabad, Telangana State. We examined a total of 10 specimens of *H. pomona* sensu lato (four vouchers including the type specimen (skin only) of *H. pomona* sensu stricto, and six vouchers including one voucher specimen of *H. gentilis* sensu stricto from Sagaing, Myanmar about 560km north of the type locality of *gentilis*). External and craniodental measurements were taken (to the nearest 0.1mm) using a digital vernier caliper (Mitutoyo make) following Bates & Harrison (1997) and Srinivasulu et al. (2010). Measurements of the museum specimens were compared with published data (from Douangboubpha et al. 2010; Bates & Harrison 1997). External measurements included FA - forearm length, E - ear length, TI - tail length, Tib - tibia length, Hf - hindfoot length, 3mt - third metacarpal, 4mt - fourth metacarpal, 5mt - fifth metacarpal, 1ph3mt - first phalanx of third metacarpal, 2ph3mt - second phalanx of third metacarpal, 1ph4mt - first phalanx of fourth metacarpal, 2ph4mt - second phalanx of fourth metacarpal. Craniodental measurements included GTL - greatest length of the skull, CBL - condylobasal length, CCL - condylocanine length, CM³ - maxillary toothrow, C¹-C¹ - anterior palatal width, M³-M³ - posterior palatal width, ZB - zygomatic breadth, BB - braincase breadth,

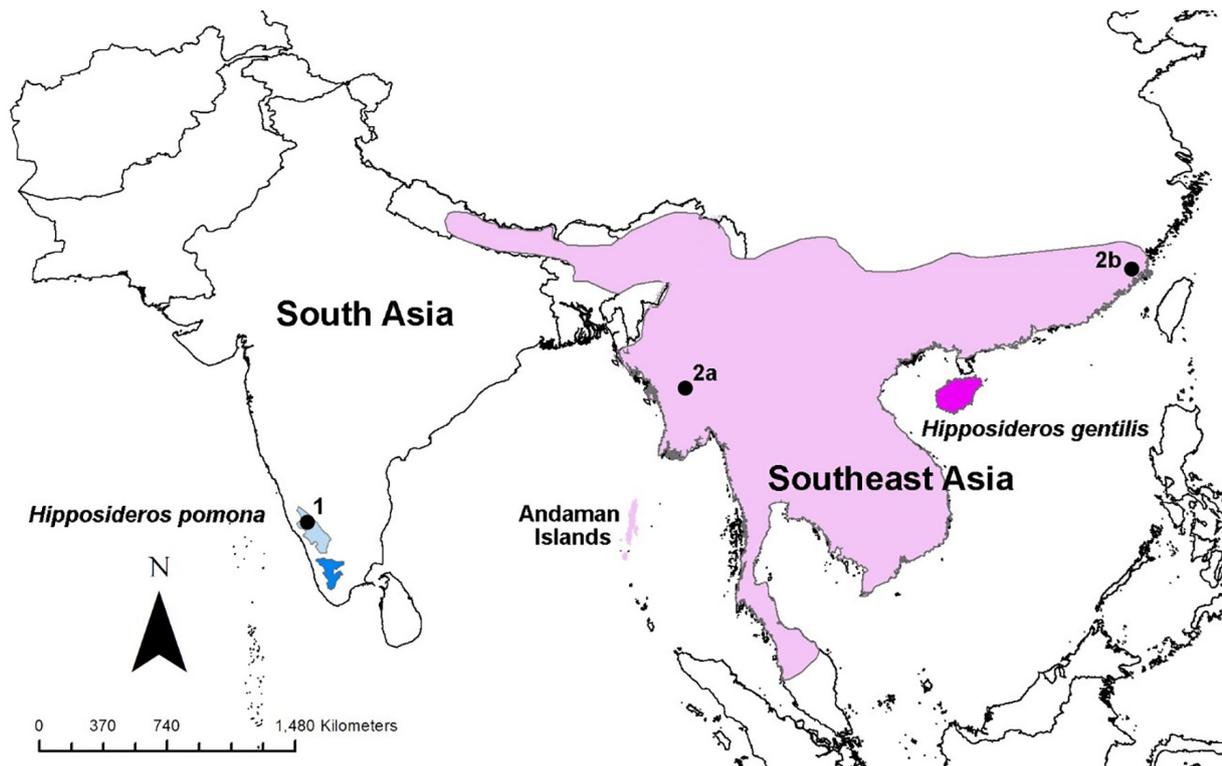


Figure 1. Distribution ranges of *Hipposideros pomona sensu stricto* and *Hipposideros gentilis sensu lato*.

Range of *H. pomona* depicted in blue [historic range - light blue shaded area & present range - dark blue shaded area] and *H. gentilis* in pink [dark pink range indicates the presence of a possible new subspecies vide Zhao et al. (2015)]; Black points indicate type localities: 1 - Haleri, Karnataka, India (*H. pomona*); 2a - Thayetmyo, Myanmar (*H. gentilis gentilis*); 2b - Foochow, Fujian, China (*H. gentilis sinensis*)

CM₃ - mandibular tooththrow, M - mandible length. Statistical analyses were conducted in R (R Development Core Team 2013). One-way ANOVAs were used to select significant ($p < 0.05$) variables for classification analysis. Of the 19 variables measured, 11 (GTL, CCL, CM³, C¹-C¹, M³-M³, ZB, FA, E, CM₃, M, and HF) were selected for a principal component analysis (PCA).

The bacula of two male specimens (one each of *pomona* [ZSI No. 21535] from Kerala, India and *gentilis* [ZSI 131zz] from Myanmar) were extracted and prepared following the protocol outlined in Topal (1958), and later stored in glycerol. The information on the echolocation calls were sourced from published literature and our studies in Andaman Islands, India.

Materials examined

Hipposideros pomona ZSI No. 21529, Holotype, male, collected from Haleri, few miles north of Mercara, Coorg District, Karnataka, by G.C. Shortridge on 15.ii.1913, specimen only. Skull in BMNH collection (BMNH No. 18.8.3.4).

H. pomona pomona ZSI No. 21535, male, collected from Travancore, southern India, by Lt. Col. Beddome in

1878, specimen and skull.

H. pomona pomona ZSI No. 7193, female, collected from Shevaroy Hills, Tamil Nadu by W. Daly, collection year not known, specimen only, skull in situ.

H. pomona pomona ZSI No. 7196, sex unknown, collected from Shevaroy Hills, Tamil Nadu by W. Daly, collection year not known, specimen damaged and tied up.

H. pomona gentilis ZSI No. 21511, male, collected from Sibsagar, Assam, by S.E. Pearl in 1872, specimen and skull.

H. pomona gentilis ZSI No. 22325, female, collected from Peshoke (=Pashok), Darjeeling District, West Bengal by C.A. Crump between June and August 1915, specimen and skull.

H. pomona gentilis ZSI No. 131zz, male, collected from Cave No. 5, Tsagain (=Sagaing), right bank of Irrawaddy, Upper Burma (=Myanmar), by J. Anderson in 1875, specimen and skull.

H. pomona gentilis (misidentified and labelled as *Hipposideros larvatus leptophyllus*) ZSI No. 24773-75, males, collected from Andaman Islands by Indraneil Das.

H. pomona gentilis NHMOU.CHI.80.2014, male,

collected from Baratang Island, Andaman Islands, by A. Gopi and T.A.H. Dar in 2014, specimen and skull.

H. pomona gentilis NHMOU.CHI.115.2014, female, collected from Burmadera near Mayabunder, Middle Andaman, Andaman Islands, by A. Gopi and T.A.H. Dar in 2014, specimen and skull.

Abbreviations used: BMNH - British Museum (Natural History); ZSI - Zoological Survey of India; NHMOU - Natural History Museum of Osmania University.

RESULTS

External measurements show that *pomona* is smaller than *gentilis* (FA 39.46–39.70 mm vs. 39.70–44.1 mm) with shorter ears (16.76–17.03 mm vs. 17.5–24.0 mm). In both the taxa the third metacarpal was the shortest, being shorter than both the fourth and the fifth metacarpals, with fourth being the longest of the three. Similarly, the first phalanx of the third metacarpal

was longer than the second and was almost equal to the combined lengths of the first and the second phalanges of the fourth metacarpal (Table 1).

The cranial measurements show that the condylo-canine length of *pomona* being smaller than that of *gentilis* (14.66mm vs. 14.6–16.3 mm). The zygoma are more widely placed in *gentilis* than in *pomona*. The anterior palatal width and the posterior palatal width are also greater in *gentilis* than in *pomona* (5.7–6.6 mm vs. 5.43–5.8 mm) signifying that the rostrum of *gentilis* is broad and long. The mandible measures shorter in *pomona* in comparison with *gentilis* (10.05–10.1 mm vs. 10.4–11.8 mm) (Table 2). The sagittal crest in *gentilis* is well developed, and extends up to the parietal region of the skull, whereas in *pomona* it is weakly developed. The lambdoid crests are also well developed in *gentilis*. The first lower premolar (pm_2) is half to two third the height of the second lower premolar (pm_4). The pm_4 is one third the height of the tall canine. The lower molars are equal to or shorter than the pm_4 . The coronoid process

Table 1. External measurements (in mm) of *Hipposideros pomona sensu stricto* (from southern India) and *H. gentilis sensu lato* (from northeastern India, Andaman Islands, and Southeast Asia)

Species	FA	E	TIB	Hf	3mt	4mt	5mt	1ph3mt	2ph3mt	1ph4mt	2ph4mt
<i>H. pomona</i> Holotype (ZSI 21529)	39.70	16.76 (approx.)	16.99	6.28	31.0	32.88	31.78	16.49	14.76	10.13	7.50 (approx.)
<i>H. gentilis</i> holotype (BM.93.11.15.2) Thayetmyo	39.70	-	18.0	-	29.2	31.3	30.4	17.6	15.5	11.0	8.0
<i>H. pomona</i> (ZSI 7193)	39.49	17.02	17.24	6.92	31.18	32.80	31.73	16.73	14.84	10.46	9.72
<i>H. pomona</i> ZSI 21535	39.46	17.03	17.29	6.97	30.15	32.04	30.69	17.67	15.46	10.74	8.51
<i>H. gentilis</i> No. 131zz	40.11	17.66	17.54	7.90	30.08	32.10	30.84	17.49	15.14	10.29	9.98
<i>H. gentilis</i> ZSI 21511	40.19	18.71	17.56	8.22	29.47	30.03	29.89	16.77	15.49	10.27	7.61
<i>H. gentilis</i> ZSI 24773	41.88	19.15	19.34	6.89	32.13	32.92	32.25	17.29	16.90	10.87	8.26
<i>H. gentilis</i> ZSI 22325	40.73	20.18	18.88	8.09	30.30	32.35	31.60	17.78	13.70	10.90	7.78
<i>H. gentilis</i> NHMOU. CHI.80.2014	41.81	19.68	17.66	6.59	30.83	31.53	31.07	17.15	16.64	10.21	8.32
<i>H. gentilis</i> NHMOU. CHI.115.2014	43.5	20.12	19.58	6.29	33.47	35.03	34.18	18.11	17.46	10.83	8.20
<i>H. gentilis</i> (vide Bates & Harrison 1997)	41.0±1.1 (39.5-43.2) (n=17)	23.3±1.0 (22.0-25.0) (n=16)	18.6±0.4 (18.2-19.1) (n=12)	7.0±0.6 (6.3-8.5) (n=9)	30.5±1.3 (28.9-33.5) (n=17)	32.0±0.9 (30.4-33.7) (n=17)	31.5±1.0 (29.6-33.2) (n=17)	17.6±0.7 (16.6-18.6) (n=17)	16.0±0.7 (14.7-17.4) (n=17)	10.7±0.5 (9.8-11.6) (n=16)	8.4±0.4 (7.5-9.2) (n=16)
<i>H. gentilis</i> (males, n=20) (Douangboubpha et al. 2010)	41.7±1.2 (39.5-44.6)	21.0±1.3 (19.0-23.6)	19.0±0.7 (17.9-20.1)	6.8±0.5 (5.5-7.8)	30.9±0.9 (29.9-33.0)	33.2±0.9 (31.8-35.3)	31.6±0.9 (29.7-33.2)	17.9±0.8 (16.5-19.5)	16.7±0.8 (15.3-18.0)	10.9±0.5 (9.8-11.5)	8.6±0.4 (7.5-9.3)
<i>H. gentilis</i> (females, n=16) (Douangboubpha et al. 2010)	42.2±1.2 (40.4-44.1)	21.1±1.4 (18.7-24.0)	18.6±0.8 (17.5-20.0)	6.5±0.5 (5.8-7.5)	31.6±1.0 (30.0-33.1)	33.7±1.2 (31.4-35.6)	32.9±2.9 (30.2-43.2)	18.0±1.0 (16.3-20.3)	16.7±1.3 (14.5-18.6)	11.1±0.4 (10.6-11.9)	8.7±0.5 (7.9-9.4)

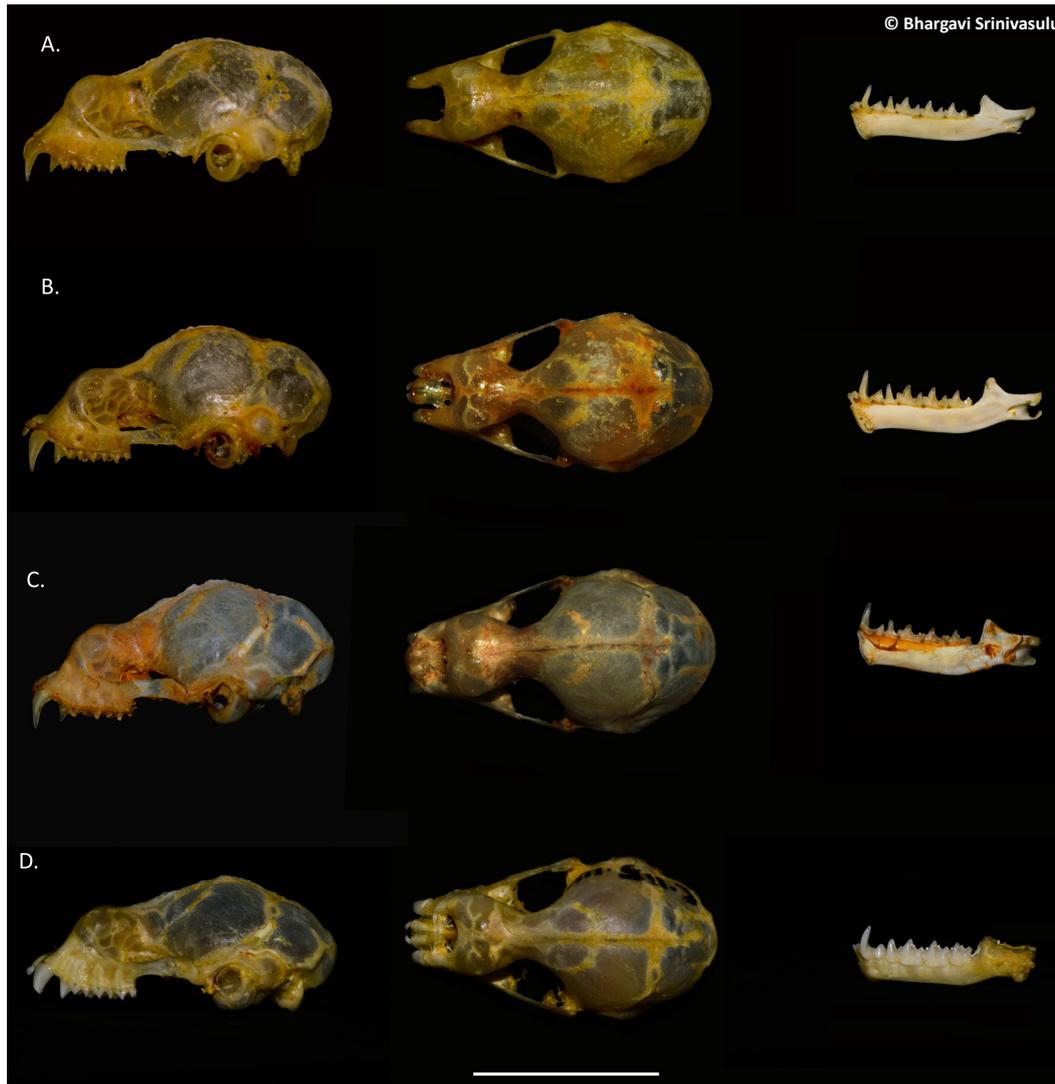


Image 1. Skull – lateral and dorsal view and mandible – lateral view of *Hipposideros pomona* sensu stricto (A. ZSI No. 21535, from Travancore (=Kerala), India) and *Hipposideros gentilis* sensu lato (B. ZSI No. 21511, from Sibsagar, Assam, India; C. ZSI No. 131zz, from cave No. 4, Tsagain, right bank of Irrawadi, Upper Burma; D.A. NHMOU.CHI.80.2014, from Baratang Island, Andaman Islands, India) (Scale – 10mm)

and the condyle of the mandible are well developed (Image 1A–D).

The structure of the noseleaf and the internarial septum in *pomona* varies from that of *gentilis*. The noseleaf of *gentilis* (Image 2C&D) is wider than long with the internarial septum being slightly narrow at the base, becoming parallel sided, and gradually narrows to a blunt tip (looking like a tapered triangle) almost touching the intermediate leaf. The internarial septum is separated from the walls of the anterior leaf by means of deep grooves due to which the narial lappets seem to be located away from the internarial septum. The nares are tear drop shaped and the well developed narial lappets are attached to the sides of the internal walls of the anterior leaf. The posterior and the anterior

leaves are of the same size while the intermediate leaf is smaller (Image 2C&D).

Principal component analysis on 10 individuals of *H. pomona* and *H. gentilis* from India, Southeast Asia, and the Andaman Islands generated three separate groups: *H. pomona* from India, *H. gentilis* from Southeast Asia, and *H. gentilis* sensu lato from the Andaman Islands (Fig. 2). These groups are clearly separated from each other (PC1 explained 73.41% of the variance), which shows that *H. pomona* and *H. gentilis* sensu lato are distinct. The present analysis also indicates the distinctness of *H. gentilis* from the Andaman Islands from the Southeast Asian forms. The factor loadings of 10 variables in the first PC were positive with the following factor loadings—E (1.242), FA (1.205), GTL (0.830), M (0.575),

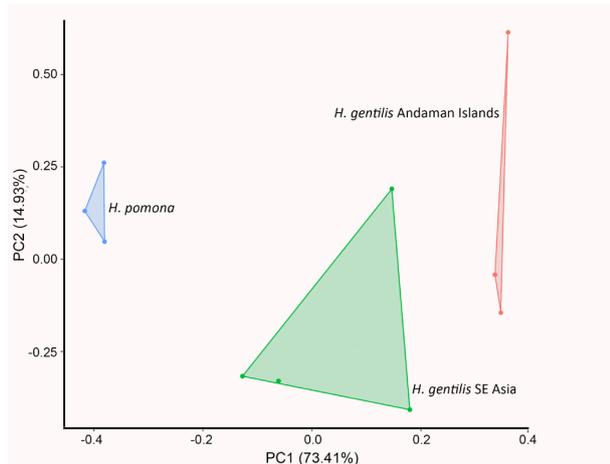


Figure 2. Principal component analysis of *Hipposideros pomona* sensu stricto and *Hipposideros gentilis*

CCL (0.567), ZB (0.395), M^3 - M^3 (0.267), CM^3 (0.249), CM_3 (0.232), and C^1 - C^1 (0.105). Only HF had negative factor loading (-0.043). This analysis supports that all the three taxa can be separated morphologically based on ear length and forearm length, and cranially based on greatest length of the skull, mandible length and condyle-canine length.

The penis is thin and long with a pointed tip in both the taxa. The baculum structure of *pomona* is distinct from that of *gentilis*. In *pomona*, the baculum is larger (1.367mm), bearing a long shaft ending with a bifid tip (present study) (Image 3A), while in *gentilis* it is simple, very small (0.4–0.8 mm) (present study; Douangboubpha et al. 2010), bearing a straight shaft narrowing to a bluntly rounded tip and a slightly expanded base (Douangboubpha et al. 2010) (Image 3B&C). Amongst the *gentilis* in some specimens both ends are same (present study based on specimens from northeastern India, Andaman Islands, and northern Myanmar) (Image 3C).

The echolocation calls of the taxon *pomona* from south India were recorded by Wordley et al. (2014) from Valparai Plateau, Tamil Nadu where in the average frequency at maximum energy (FMAXE) has 126.337 ± 1.25 (range: 123.7–128.2 kHz). Echolocation calls of *H. pomona* (= *H. gentilis*) recorded from Thailand (Douangboubpha et al. 2010) reported to be the average frequency at maximum energy (FMAXE) of 133.3 ± 3.9 (range: 127.3–139.3 kHz) in males and 133.9 ± 3.7 (range: 127.7–140.2 kHz) in female individuals. In Andaman Islands, the average frequency at maximum energy (FMAXE) of the echolocation calls produced by two populations *H. gentilis* (reported as *H. pomona*) were

126.5 ± 4.17 (range: 121.9–131.7 kHz) and 137.5 ± 2.1 (range: 133.3–140.3 kHz), respectively (Srinivasulu et al. 2017).

Basing on the distinctness of the structure of the baculum of the southern Indian specimen from that of Assam and Southeast Asia (present study; Douangboubpha et al. 2010), and on differences in morphometrics of the southern Indian specimens from that of *gentilis*, the peninsular Indian population is considered distinct here. The rest of the specimens from Nepal, northeastern India, Andaman Islands to Myanmar, southern China, Lao PDR, Thailand, Viet Nam, Cambodia, and Western Malaysia (Corbet & Hill 1992; Bates & Harrison 1997; Simmons 2005; Francis 2008; Douangboubpha et al. 2010) are here considered as *H. gentilis* Andersen, 1918. Owing to the disjunct distribution of the two taxa (Fig. 1), and considerable variations in bacular, morphological, and acoustic characteristics the resurrection of *H. gentilis* as a distinct species is well-supported.

Molecular phylogenetic studies to support the distinctness of *Hipposideros pomona* sensu stricto and *H. gentilis* sensu lato are in progress.

Systematic description

Hipposideros pomona Andersen, 1918

Andersen's Roundleaf Bat

Hipposideros bicolor pomona Andersen, 1918;

Haleri, Coorg, India

Holotype: *Hipposideros pomona* ZSI Reg. No. 21529, male, collected from Haleri, few miles north of Mercara, Coorg District, Karnataka, India by G.C. Shortridge on 15.ii.1913, specimen only. Skull extracted and in BMNH collection bearing No. 18.8.3.4.

Diagnostic characters

A small to medium sized bat, with an average forearm length of 39.6mm (38.1–40.84 mm). The noseleaf is longer than broad, and covers the muzzle. There are no supplementary leaflets. The internarial septum is thick, parallel sided, becomes broader as it is nearing the proximal end and slightly narrows to a broadly rounded tip. The skull is slender and has an average condylocanine length of 14.4mm (14.2–14.66 mm). The first lower premolar (pm_2) is small, triangular in outline, and is one half of the height of the second lower premolar (pm_4). The pm_4 is about one half to two third the height of the tall canine. The baculum is long with a straight shaft, the proximal end of which is broad

Table 2. Craniodental measurements (in mm) of *Hipposideros pomona sensu stricto* (from southern India) and *H. gentilis sensu lato* (from northeastern India, Andaman Islands, and Southeast Asia)

Species	GTL	CBL	CCL	CM ³	C ¹ -C ¹	M ³ -M ³	ZB	BB	CM ₃	M
<i>H. pomona</i> Holotype (BM.18.8.3.4)	-	-	-	5.80	-	-	8.5	8.2	6.0	10.1
<i>H. gentilis</i> holotype (BM.93.11.15.2) Thayetmyo	17.0	-	14.60	5.70	-	-	8.3	8.0	6.2	10.4
<i>H. pomona</i> ZSI 21535	-	-	14.66	5.43	3.15	5.61	8.31	8.84	5.58	10.05
<i>H. gentilis</i> No. 131zz	17.99	15.45	15.06	5.80	3.31	5.83	8.58	8.69	6.32	10.76
<i>H. gentilis</i> ZSI 21511	17.41	15.57	15.23	5.82	3.38	5.81	8.53	8.73	6.57	10.65
<i>H. gentilis</i> ZSI 24773	19.05	16.85	16.06	6.04	3.87	6.15	8.94	8.30	6.58	11.47
<i>H. gentilis</i> ZSI 22325	17.76	15.78	15.04	6.14	3.49	5.88	broken	8.42	6.58	10.51
<i>H. gentilis</i> NHMOU. CHI.80.2014	17.76	15.96	15.31	6.06	3.69	5.9	8.82	7.56	6.48	10.45
<i>H. gentilis</i> NHMOU. CHI.115.2014	19.15	16.80	16.40	6.35	3.9	6.35	9.29	9.44	6.97	11.66
<i>H. gentilis</i> (Bates & Harrison 1997)	17.9±0.3 (17.0-18.6) (n=15)	-	15.5±0.3 (15.0-16.0) (n=16)	6.0±0.1 (5.7-6.2) (n=17)	3.6±0.1 (3.5-3.8) (n=18)	5.8±0.1 (5.6-6.0) (n=18)	8.6±0.2 (8.3-9.0) (n=17)	8.1±0.1 (7.9-8.3) (n=16)	6.4±0.2 (6.0-6.8) (n=17)	10.8±0.2 (10.5-11.3) (n=19)
<i>H. gentilis</i> (males, n=20) (Douangboubpha et al. 2010)	18.0±0.5 (17.2-18.8)	15.8±0.4 (15.2-16.5)	15.6±0.5 (15.0-16.3)	6.2±0.2 (5.7-6.6)	3.5±0.1 (3.1-3.7)	6.1±0.2 (5.8-6.3)	9.0±0.2 (8.6-9.3)	8.2±0.1 (8.0-8.5)	6.5±0.2 (6.1-6.9)	11.2±0.4 (10.6-11.8)
<i>H. gentilis</i> (females, n=16) (Douangboubpha et al. 2010)	17.6±0.7 (15.6-18.5) (n=15)	15.7±0.4 (15.2-16.3) (n=15)	15.5±0.4 (14.8-16.3)	6.1±0.2 (5.7-6.4)	3.4±0.2 (2.8-3.6)	6.2±0.2 (5.6-6.3)	8.8±0.4 (7.6-9.4)	8.1±0.3 (7.0-8.5)	6.4±0.3 (5.9-6.8)	11.1±0.4 (10.5-11.6)

and bifid.

Descriptive characters

A small to medium sized bat with the forearm length ranging between 38.1–40.84 mm. Ears are large (16.76–19.0 mm) with ridges and rounded off tips. Feet are large (6.28–6.97 mm). The wing membrane and the interfemoral membrane are attached on either side of the ankles. In preserved specimens, the ventral fur is pale in colour; the fur along the flanks and toward the distal part of the body is pale at the base and light brown on the mid-portion, with pale tips; face has pale brown to darkish brown fur; while the dorsal surface is fawn to dark brown with pale hair bases. On the wing the third metacarpal is shorter than the fourth and the fifth metacarpal, with the fourth being the longest. The first phalanx of the third metacarpal is almost equal to the combined lengths of the first and second phalanges of the fourth metacarpal. The second phalanx of the third metacarpal is shorter than the first. The noseleaf is longer than broad and covers the muzzle (Image 2A&B). There are no supplementary leaflets. The internarial septum is thick, parallel sided and becomes broader as it is nearing the proximal end, and slightly narrows to a broadly rounded tip (Image 2A&B). The oval shaped nares are situated on either side of the tip

of the internarial septum. The narial lappets are fleshy and are located on the sides of the nares attached to the internal walls of the anterior leaf. There is not much of a gap between the internarial septum, the narial lappets and the internal walls of the noseleaf. The intermediate leaf is short and small, shorter than the posterior and the anterior leaves (Image 2A&B). Due to its small size the gap between the internarial septum and the intermediate leaf is more. The posterior leaf is slightly wider than the anterior leaf and is divided into four cells by means of three septa (Image 2A&B). Penis is thin, long with a pointed tip. The baculum is long (1.367mm) with a long straight shaft, the proximal end of which is broad and bifid (Image 3A). The distal end is four pronged, and shows an inner curvature on the ventral surface (Image 3A).

The skull is slender (Image 1A) and has an average condylo-canine length of 14.4 mm (14.2–14.66 mm). The rostrum is short with the CM³ measuring 5.4–5.7mm. The palate is narrow as is seen by the posterior palatal width being 5.3–5.6 mm and the anterior palatal width being 3.15–3.4 mm. The zygoma are slender toward the anterior portion, with a low jugal process on the posterior portion (Image 1A). The sagittal crest is weakly developed, and is visible on the anterior part of the braincase and not present on the posterior part.



Image 2. Noseleaf structure depicting the size of the noseleaf and the shape of the internarial septum of *Hipposideros pomona sensu stricto* (A. ZSI No. 21535; B. ZSI No. 7193) and *Hipposideros gentilis sensu lato* (C. ZSI No. 21511; D. ZSI No. 131zz). © Bhargavi Srinivasulu

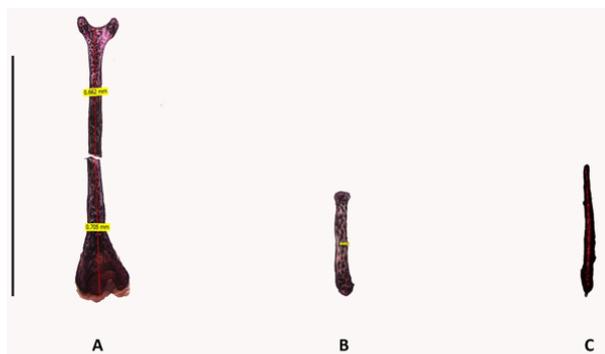


Image 3. Bacular morphology and size of *Hipposideros pomona sensu stricto* (A. ZSI No. 21535 from Travancore (=Kerala), India) and *Hipposideros gentilis sensu lato* (B. ZSI No. 131zz from cave No. 4, Tsagain, right bank of Irrawadi, Upper Burma; and C. NHMOU. CHI.80.2014, from Baratang Island, Andaman Islands, India) (Scale – 1mm). © Bhargavi Srinivasulu

The braincase is bulbous (8.84mm) and shows a slight depression over the parietal region in the lateral profile. The lambdoid crests are not well developed. The rostrum is bulbous with three nasal inflations, an elongated one located at the bottom, a kidney shaped inflation located on either side, and a round inflation on the top of the rostrum. The upper tooththrow averages 5.5mm (5.4–5.7

mm). The first upper premolar (pm^2) is minute located between the cingulum of the robust canine and the anterior border of the second upper premolar (pm^4) whereby the canine and the pm^4 are not in contact. The first lower premolar (pm_2) is small, triangular in outline and measures one half of the height of the second lower premolar (pm_4). The pm_4 is about one-half to two-third the height of the tall canine. The first lower molar is subequal to slightly taller than the pm_4 while the second lower molar is equal to the height of pm_4 . The average length of the mandible is 9.9 mm (9.8–10.1 mm) while the lower tooththrow (cm_3) measures 5.58–6.0 mm. The coronoid process and the condyle of the mandible are well developed.

Echolocation calls

The echolocation calls of *H. pomona* from southern India were recorded by Wordley et al. (2014) from Valparai Plateau, Tamil Nadu where in the average frequency at maximum energy (FMAXE) of the echolocation calls produced by this species was 126.337 ± 1.25 (range: 123.7–128.2 kHz).

Ecology

All that is known about the ecology of *H. pomona* is

that it was found in an old well in Venginiserri, Thrissur District, Kerala (A. Madhavan pers. comm. October 2016), and it is found in a mixed landscape of plantations interspersed with tropical rainforest fragments, streams and riverine vegetation (Wordley et al. 2014; Juliet Vanitharani pers. comm. September 2017).

Distribution

H. pomona is known from Haleri, Coorg District, Karnataka; Venginiserri, Thrissur District, Kerala and Madhovaram in Tamil Nadu. It was recorded recently (Wordley et al. 2014) from Valparai Plateau in Tamil Nadu. It also occurs in Kalakkad-Mundhunthurai Tiger Reserve in Tamil Nadu (Juliet Vanitharani pers. comm. September 2017). Our recent surveys conducted in the 2017 in Haleri, Coorg District, Karnataka and many locations in Kerala was not successful in detecting the presence of this species. The habitat has changed over the years in the areas where this species was historically found.

Conservation status

H. pomona sensu lato, according to Bates et al. (2008) included both the taxa *pomona* and *gentilis*, was assessed as Least Concern. In the light of new information and upgradation of these taxa as distinct species, with *H. pomona* being known south of Coorg in Western Ghats and *H. gentilis* being present from Nepal, northeastern India through Myanmar to Southeast Asia, there is a need to reassess these two species.

Remarks on misidentified specimens

A specimen (ZSI No. 19450) from Macherla, Andhra Pradesh labelled as *H. pomona pomona*, collected by B. Nath in 1962 (Bates & Harrison 1997; Ghosh 2008) is hereby identified as *H. fulvus* basing on the structure of internarial septum and morphometrics. Three specimens collected by Indraneil Das from Andaman & Nicobar Islands and labelled as *H. larvatus leptophyllus* (ZSI Reg. No. 24773-75) are hereby identified as *H. gentilis* based on noseleaf structure and morphometrics.

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