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# Two New Species of Vespertilionid Bats, *Myotis* and *Murina* (Vespertilionidae: Chiroptera) from Yanbaru, Okinawa Island, Okinawa Prefecture, Japan

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**ABSTRACT**—Two new species of vespertilionid bats (Vespertilionidae: Chiroptera) were described on the basis of materials collected from Yanbaru, northern part of Okinawa Island, Okinawa Pref., Japan. These are bats of genera *Myotis* and *Murina.*

On Okinawa Island, bats of genera *Myotis* and *Murina* have been unknown (Abe *et al*., 1994). Recently we examined two bats of *Myotis* and five bats of *Murina* collected from Yanbaru, the northern part of Okinawa Island, Japan. These bats are evidently different from any described species of the genera *Myotis* and *Murina* in many characteristics. This is the descriptions of the two new forms.

The following eight external and 14 cranial dimensions were measured in mm: forearm length (FAL), tibia length (Tibia L), hind foot length without a claw (HFLsu), hind foot length with a claw (HFLcu), head and body length (HBL), tail length (Tail L), ear length (Ear L), tragus length (Tragus L), the greatest length of skull (GL), condylobasal length (CBL), the length of upper tooth row from the incisor to the third molar (UTLim), the length of the upper tooth row from the canine to the third molar (UTLcm), rostral width (RW), zygomatic width (ZW), width across upper molars (UMoW), mastoid width (MtdW), brain-case width (BCW), the height of brain-case (BCH), mandible length (MdL), and the length of the lower tooth row from the incisor to the third molar (LTL), rostral length (RL, the length of facial portion measured by Imaizumi, 1958), and brain-case length (BCL).

*Myotis yanbarensis* sp. nov.
[Japanese name: Yanbaru hôhige-kômori, new]

*Holotype*: NSMT-M31306, adult male, skin and skull, collected in a forest at the upper stream of Funga river, Aha, Kunigami-mura, Okinawa Island on 12 October, 1996 . The holotype is preserved in the National Science Museum, Tokyo (NSMT).

*Paratype*: KM (Maeda collection) 12614, adult male, the same locality and date as those of holotype.

*Distribution*: Type locality only, northern part of Okinawa Island, Japan.

*Diagnosis*: Dorsal hairs and membrane of the species from Yanbaru are black. The tip of the guard hair is not clear silver metallic luster. Size is medium among the subgenus *Selysius*, and tail is long. Brain-case is very small in length and also in width. Rostrum is long and horizontal.

*Description*: The measurements in mm of external dimensions of the holotype and the paratype are as follows: FAL 37.5 and 36.5; Tibia L 17, and16.5; HFLsu 8 and 7.5; HFLcu 10 and 9.5; HBL 43 and 41.5; Tail L 46; Ear L 14 and 14.5; and Tragus L 7 and 7, respectively.

Wing membranes attach to the base of the first toe. Anterior border of ear is turned outward, and the posterior border concave at the center. Tragus is slender and tapers gradually towards the pointed tip, and its distal third bends externally very slightly or straight.

Fur is very soft and silky. Dorsal hairs are black, and the tip of guard hair is dull silver metallic luster. Ventral hairs are black with tip of pale brown. Membranes and ear are black. Hairs on ventral surfaces of interfemoral membrane are sparse and short; the dorsal surface and endopatagium are naked.

The measurements in mm of skull dimensions of the holotype and the paratype are as follows: GL 15.1 and 14.8; CBL 14.5 and 14.2; UTLim 7.1 and 6.95; UTLcm 6.0 and 5.9; RW 3.95 and 3.75; ZW 9.55 and 9.4; UMoW 6.2 and 6.05; MtdW 7.65 and 7.4; BCW 6.75 and 6.75; BCH 6.7 and 6.65; MdL 11.95 and 11.65; and LTL 7.55 and 7.35, respectively.

Skull is larger as a whole, but the brain-case is relatively small. Relative brain-case width to condylobasal length is 0.466 in holotype and 0.475 in paratype. Relative brain-case length to condylobasal length is 0.528 in holotype and 0.542 in paratype. In the relative size of brain-case height to the width is larger (0.993 in holotype and 0.985 in paratype). Rostrum is longer and horizontal. Relative rostral length to condylobasal length is larger (0.531 in holotype and 0.535 in paratype). In relative length of rostral length to brain-case length, this spe-

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cies is conspicuously larger (holotype: 1.007, paratype: 0.987). Zygomatic arches look projecting outward, because of small brain-case. Occiput does not project backward so much.

Teeth are more massive and larger in antero-posterior diameter and also in buccal-lingual one. The second upper and lower premolars are as same in size as the third ones.

*Comparisons*: This new species show the characteristics of the subgenus *Selysius* (Tate, 1941a), and also medium size in the subgenus. Accordingly, we compare *M. yanbarensis* with the following three species which are medium in size and distributed to the vicinity of Okinawa Island: *M. mystacinus*, *M. muricola*, and *M. ikonnikovi*.

The tail (length = 46 mm) of this species is clearly longer than those (Mean = 35.24 mm, N = 74, Min = 30, Max = 40.5) of the *M. muricola*, *M. ikonnikovi*, and *M. mystacinus* (Table 1). The dorsal hairs are black, and the tip of guard hair is dull silver metallic luster. On the other hand, the hairs of *M. ikonnikovi* and *M. mystacinus* are brown, those of *M. muricola* are shiny-ochraceous rather than duller brown (Hill, 1983). The ventral hairs are black with tip of pale brown, but those of *M. ikonnikovi* and *M. mystacinus* are yellowish grey with the base of light umber, in *M. muricola* whitish rather than yellowish surface (Hill, 1983). The membranes and ear are black, however in the other three species, Vandyke brown or blackish brown, dull black brown.

The skull of this species is larger as a whole than the other three species, but the brain-case is relatively small (Fig. 1 and 2). *Myotis yanbarensis* has a relatively high brain-case as compared with the width (Fig. 3). The rostral is relatively longer than in the other three species (Fig. 4). The relative zygomatic width to condylobasal length is clearly larger than in *M. ikonnikovi* and *M. mystacinus*, but not in *M. muricola* (Fig. 5).

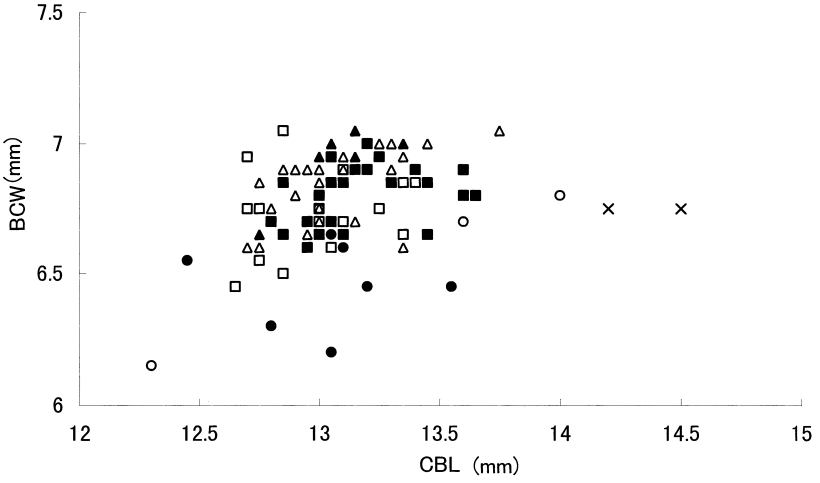



**Fig. 1.** Relative brain-case width to condylobasal length in the closely related species to *Myotis yanbarensis* (×). ○, *M. muricola*; □, *M. ikonnikovi*; △, *M. mystacinus*; Dotted symbols, male; Open symbols, female.

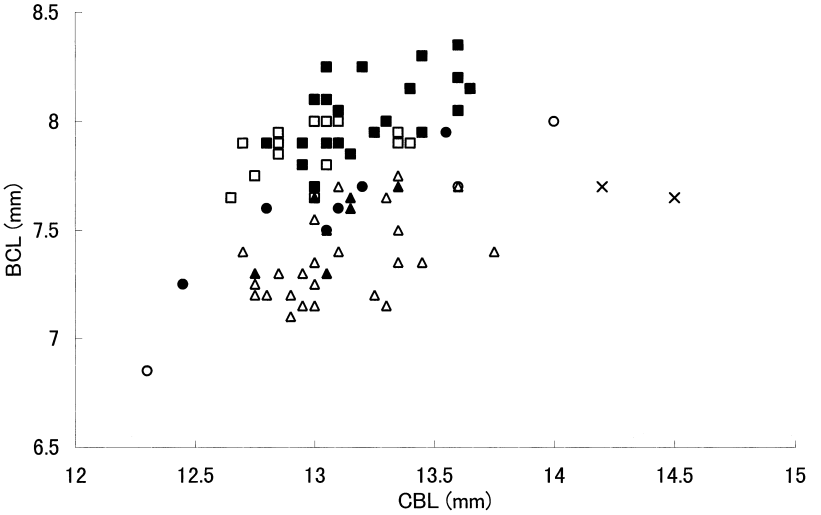



**Fig. 2.** Relative brain-case length to condylobasal length in the closely related species to *Myotis yanbarensis* (×). For symbols, see Fig. 1.

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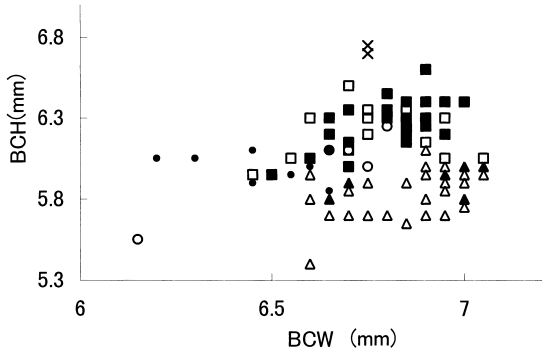



**Fig. 3.** Relative brain-case height to brain-case width in the closely related species to *Myotis yanbarensis* (×). For symbols, see Fig. 1.

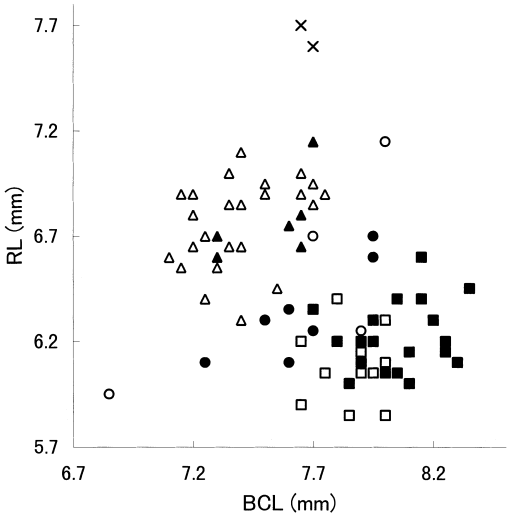



**Fig. 4.** Relative rostral length to brain-case length in the closely related species to *Myotis yanbarensis* (×). For symbols, see Fig. 1.

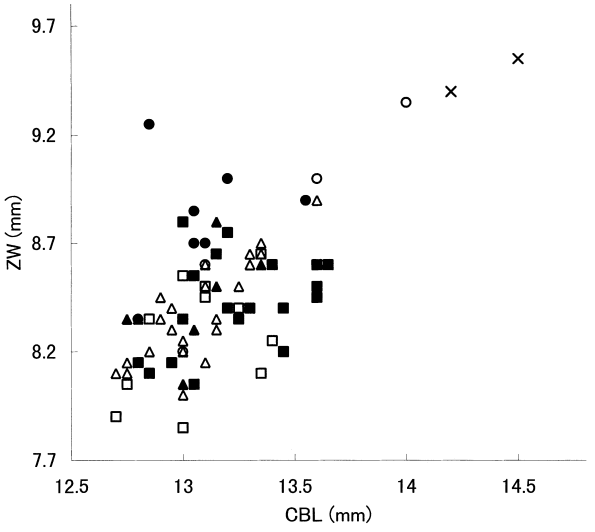



**Fig. 5.** Relative zygomatic width to condylobasal length in the closely related species to *Myotis yanbarensis* (×). For symbols, see Fig. 1.

*Murina ryukyuana* sp. nov.
[Japanese name: Ryukyu tengu-kômori, new]

*Holotype*: NSMT-M31305, adult male, skin and skull, collected in a forest at the upper stream of Funga river, Aha, Kunigami-mura, Okinawa Island on 12 October, 1996 . The holotype is preserved in the National Science Museum, Tokyo (NSMT).

*Paratype*: The following four specimens were collected at the same locality, and designated as the paratypes: KM (Maeda collection) 12612 (♀) on 12 October 1996 ; KM12629 (♀), 12630 (♂), and 12631 (♀), 24 December 1996.

*Distribution*: Type locality only, northern part of Okinawa Island, Japan.

*Diagnosis*: The new species of *Murina ryukyuana* from Yanbaru is medium in size in *M. aurata* group. The lengths of ear and tragus are conspicuously long. The brain-case is relatively slender. The upper tooth row from canine to third molar is relatively longer as compared with the greatest length of skull.

*Description*: The measurements in mm of external dimensions of the holotype are as follows: FAL 37, Tibia L 19, HFLsu 9, HFLcu 10.5, HBL 47, Tail L 45, Ear L 18.5, Tragus L 10.5. Those of the paratypes are shown in Table 1.

Wings are comparatively wide; the ratio of length of third digit to that of fifth digit is about 1.2. Wing membranes attach to the second phalange of the first toe, or the base of phalange. Tail is shorter than the head and body length, about 1 mm of its terminal portion is free from the interfemoral membrane.

Tubular nostrils are conspicuously projecting outwards about 1.5 mm from the base. Ear is ovate and rounded at the tip. Tragus is very slender, more than a half of ear in height; its anterior and posterior borders are almost straight; it tapers gradually towards the pointed tip, and its distal third bends externally.

The dorsal and ventral hairs are silky and straight, and the former is longer than the latter. Dorsal hairs are consisted of three kinds in length. The longest is guard hairs, 12–13 mm, occupied 5% of all the dorsal hairs. The tip 2–3 mm is pale brown, the lower 1 mm dark brown, the middle 5 mm pale brown, and the bottom 4 mm dark brown. Longer hairs of the remaining are occupied 50 %. The tip 1 mm is dark brown, the middle 5 mm pale brown, and the bottom 4 mm dark brown. The top 5 mm of the remaining is pale brown, the bottom 4 mm dark brown. Accordingly, the dorsal surface generally looks like pale brown phase. The dark brown phase of the bottom 4 mm is clearly demarcated from the upper part of pale brown. At the ventral side, hairs are 7–8 mm long, the top 3–4 mm is pale brown and the bottom 4 mm dark brown.

Dorsal surfaces of interfemoral membrane, hind legs, and endopatagium are thickly covered with hairs of 3–5 mm. On the ventral surface the hairs are sparse and short.

The measurements in mm of skull dimensions of the holotype are as follows: GL 18.35, CBL 17.0, UTLim 7.2, UTLcm 6.3, RW 4.25, ZW 10.0, UMoW 6.05, MtdW 8.6, BCW 8.15,

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**Table 1.** Measurements (mm) of the external and skull characters in paratypes of *Murina ryukyuana*

| | FAL | Tibia L | HFL su | HFL cu | HBL | Tail L | Ear L | Tragus L | GL | CBL | UTL im | UTL cm | RW | ZW | UMo W | Mtd W | BCW | BCH | MdL | LTL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KM 12630 ♂ | 35.5 | 19 | 9 | 10.5 | 47 | 45 | 18.5 | 10.5 | 18.3 | 16.95 | 7.2 | 6.3 | 4.4 | 9.9 | 6.1 | 8.6 | 8.05 | 8.15 | 12.9 | 7.4 |
| KM 12612 ♀ | 36.5 | 18 | 9.5 | 11 | 52 | | 19 | 10.5 | | | | | | | | | | | | |
| KM 12629 ♀ | 37 | 19 | 9 | 10.5 | 47 | 37 | 19 | 10.5 | 18.65 | 17.15 | 7.25 | 6.35 | 4.5 | 10.0 | 6.2 | 8.6 | 8.05 | 8.1 | 13.05 | 7.65 |
| KM 12631 ♀ | 37 | 19.5 | 9.5 | 11 | 50 | 38.5 | 18 | 10 | 18.55 | 17.3 | 7.35 | 6.55 | 4.5 | 10.0 | 6.35 | 8.6 | 8.15 | 8.05 | 13.3 | 7.9 |

**Table 2.** Comparisons of *Murina ryukyuana* with the closely related species in some characters (mm)

| | | FAL | | | Ear L | | | Tragus L | | | GL | | | CBL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean ± SD | N | Range | Mean ± SD | N | Range | Mean ± SD | N | Range | Mean ± SD | N | Range | Mean ± SD | N | Range |
| *M. ryukyuana* | ♂ | 36.25 | 2 | 35.5 – 37 | 18.00 | 2 | 17.5 – 18.5 | 10.00 | 2 | 9.5 – 10.5 | 18.33 | 2 | 18.3 – 18.35 | 16.98 | 2 | 16.95 – 17.0 |
| | ♀ | 36.83 | 3 | 36.5 – 37 | 18.67 | 3 | 18 – 19 | 10.33 | 3 | 10 – 10.5 | 18.60 | 2 | 18.55 – 18.65 | 17.23 | 2 | 17.15 – 17.3 |
| *M. aurata*[*1] | ♂ | 29.25 | 2 | 29 – 29.5 | 10.50 | 2 | 10.5 | 6.50 | 2 | 6.5 | 13.95 | 1 | | 12.4 | 1 | |
| *M. suilla*[*2] | ♂ | 29.55 | 2 | 29.1 – 30.0 | | | | | | | 14.90 | 2 | 14.6 – 15.2 | 13.15 | 2 | 13.1 – 13.2 |
| | ♀ | 33.0 | 1 | | | | | | | | 15.0 | 1 | | 13.4 | 1 | |
| *M. ussuriensis* | ♂ | 30.25 ± .63 | 10 | 29.5 – 31.5 | 14.28 ± .67 | 9 | 13 – 15 | 7.89 ± .55 | 9 | 7 – 9 | 15.12 ± .33 | 10 | 14.7 – 15.7 | 13.91 ± .41 | 10 | 13.3 – 14.6 |
| | ♀ | 31.63 ± .93 | 12 | 30 – 33 | 14.17 ± .81 | 12 | 13 – 15 | 7.96 ± .62 | 12 | 7 – 9 | 15.55 ± .43 | 12 | 15.1 – 16.35 | 14.22 ± .39 | 12 | 13.4 – 14.85 |
| *M. tubinaris*[*3] | | 30.8 | | | | | | | | | 15.3 | | | 13.6 | | |
| *M. florium*[*4] | ♂ | 34.5 | 1 | | | | | | | | 16.8 | 1 | | 15.25 | 1 | |
| | ♀ | 37 | 1 | | | | | | | | 16.85 | 1 | | 15.45 | 1 | |
| *M. tenebrosa*[*5] | ♀ | 34.0 | 1 | | 16.0 | 1 | | 8.5 | 1 | | 16.65 | 1 | | 15.55 | 1 | |
| *M. leucogaster* | ♂ | 43.00 ± 1.70 | 6 | 41 – 45 | 18.17 ± .26 | 6 | 18 – 18.5 | 10.17 ± .41 | 6 | 9.5 – 10.5 | 19.43 ± .41 | 6 | 18.95 – 19.95 | 18.03 ± .40 | 6 | 17.7 – 18.8 |
| | ♀ | 43.90 ± 2.19 | 5 | 41 – 46 | 18.20 ± .84 | 5 | 17 – 19 | 10.30 ± 1.1 | 5 | 9 – 12 | 19.58 ± .82 | 5 | 18.7 – 20.65 | 18.25 ± .55 | 5 | 17.65 – 19.0 |

[*1] MNHNP-CG1870–590 and 590a (the holotype and paratype) from Maeda (1980); [*2] M63.58, BM79.11.15.15–16 from Hill (1963); [*3] Mean size from Hill (1963); [*4] BM63.12.26.14 (the holotype), BM23.1.2.27; [*5] NSMT-M8812 (the holotype) from Yoshiyuki (1970).

BCH 8.25, MdL 13.1, and LTL 7.4. Those of the paratypes are shown in Table 1.

Skull is not so stout. Rostrum looks like longer. Brain-case is not so wide. The upper teeth are relatively larger, the character of which is related with the relatively longer rostrum.

*Comparisons*: The subgenus *Murina* is further divided into two groups (Tate, 1941b and Corbet and Hill, 1992). According to Corbet and Hill (1992), one which we call *aurata* group has a characteristic of maxillary tooth-rows distinctly convergent anteriorly, inner upper incisor anterior to the outer, and its postero-external face at most abutting the antero-internal face of the outer tooth with little or no overlap. Corbet and Hill (1992) stated that this group is consisted of five species, namely *M. aurata, M. leucogaster, M. florium , M. suilla*, and *M. tubinaris*. Furthermore we consider that *M. ussuriensis* and *M. tenebrosa* are also included in the *aurata* group, because *M. ussuriensis* is closely related to *M. aurata* (Maeda, 1980) and *M. tenebrosa* is similar in general aspects to *M. florium* (Yoshiyuki, 1970). *Murina ryukyuana* show the characteristics of the *aurata* group. Consequently we compare *M. ryukyuana* with the-above mentioned seven species of the *aurata* group.

The body and skull sizes of *M. ryukyuana* are smaller than those of *M. leucogaster*, but larger than in the above-mentioned other six species (Table 2). The lengths of ear and tragus are conspicuously long, and they are as long as those of *M. leucogaster*, whose body size is much larger (Table 2). The brain-case is slender than that of the other seven species (Fig. 6). The relative length of upper tooth row from canine to third molar against the greatest length of skull is larger than the other species of the *aurata* group (Fif. 7).

The dorsal hair color differs from those of *M. ussuriensis* with the surface of light greyish brown or light yellowish brown, of *M. leucogaster* with silver tip of the guard hairs, and of *M. tenebrosa* with the surface of nearly ochre. At the ventral side of the type specimen, the top of hair is pale brown, but the top is whitish beige in *M. ussuriensis*, ivory in *M. leucogaster*, and the surface looks like yellowish beige in *M. tenebrosa*.

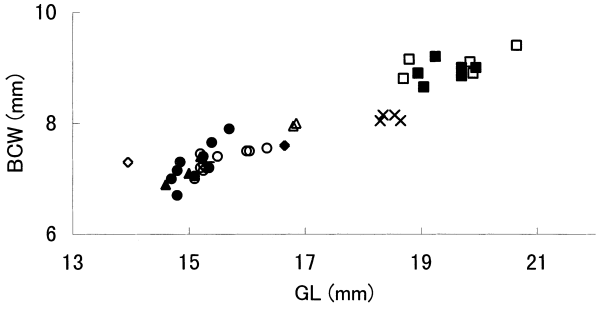



**Fig. 6.** Relative brain-case width to greatest length of skull in the closely related species to *Murina ryukyuana* (×). ○ and ●, Male and female of *M. ussuriensis*; □ and ■, male and female of *M. leucogaster*; △, *M. florium**; ▲, *M. suilla**; ◇, *M. aurata**; ◆, *M. tenebrosa**; +, *M. tubinaris**. * For examined specimens, see Table 2.

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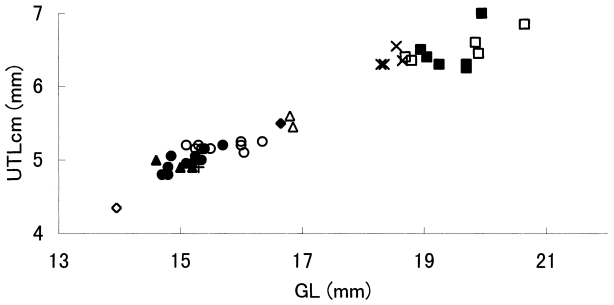



**Fig. 7.** Relative length of upper teeth row from canine to third molar to greatest length of skull in the closely related species to *Murina ryukyuana* (×). For symbols, see Fig. 6.

## ACKNOWLEDGMENTS

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## APPENDIX

*Examined specimens*: Six male and 29 female of specimens of *M. mystacinus*: KM (Maeda collection) 546–552, 554–561, Nishimemanbetu, Memanbetu-cho, Hokkaido, 25 June 1967; KM3057–3060, 3063, 3070, Memanbetu, Menanbetu-cho, Hokkaido, 25 June 1971; KM3119, 3123. 3126, 3152, 3153, 3155, Kasuga, Oketo-cho, Hokkaido, 25–27 July 1972; KM12199, 12202, 12206, 12225, 12231, 12232, Misato, Syari-cho, Hokkaido, 6–8 Aug. 1990; KM12336, 12338, Misato, Syari-cho, Hokkaido, 3 Aug. 1991. 23 male and 18 female specimens of *M. ikonnikovi*: KM2768, Foot of Mt. Fuji, Gotenba-cho, Shizuoka-Pref., 13 June 1970; KM6700, 6710–

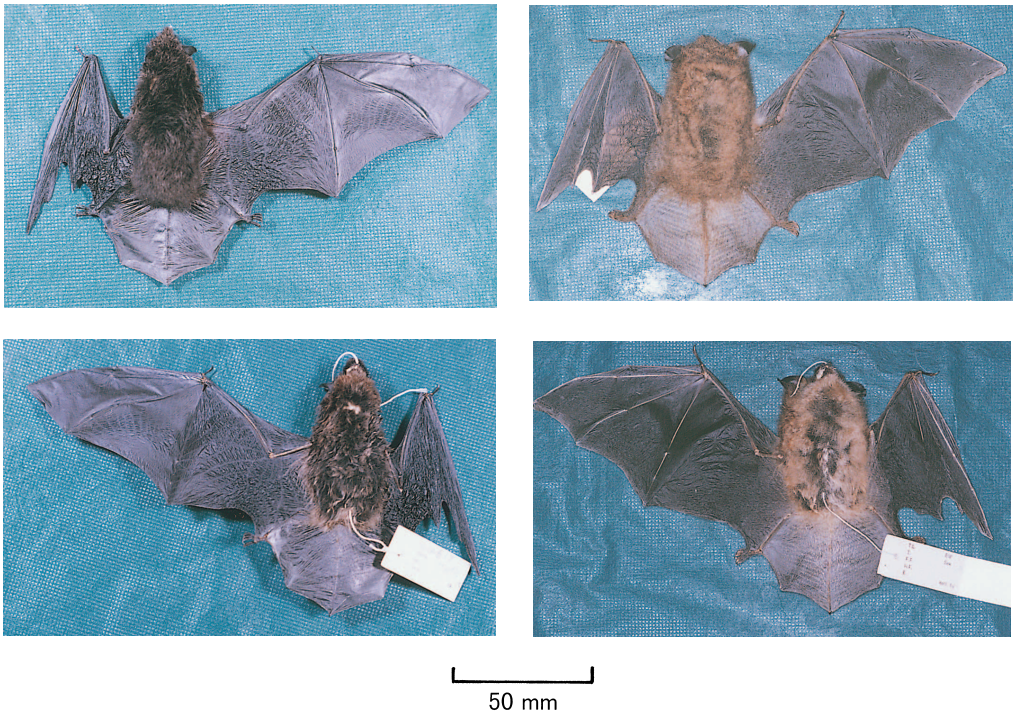



**Fig. 8.** Dorsal (upper) and ventral (lower) views of each holotype of *Myotis yanbarensis* (left side; NSMT-M31306) and *Murina ryukyuana* (right side; NSMT-M31305 ).

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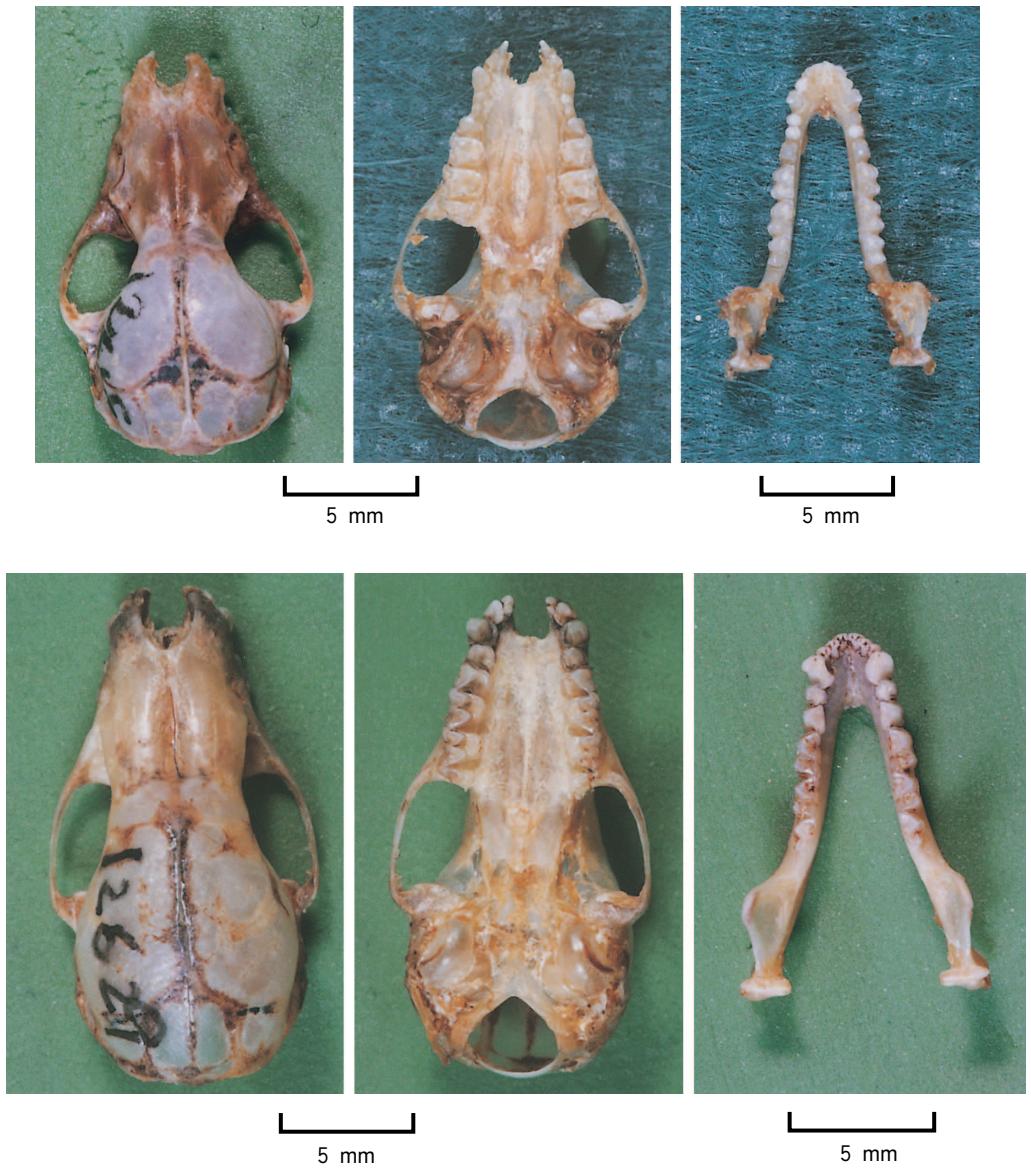



**Fig. 9.** Dorsal (left) and ventral (middle) views of skull and mandible (right) of each holotype of *Myotis yanbarensis* (upper row; NSMT-M31306) and *Murina ryukyuana* (lower row; NSMT-M31305).

6713 and 6716, 6718,6719, 6731–6733, 6735, Foot of Mt. Fuji, Narusawa-mura, Yamanashi-Pref., 20, 21 July 1981 and 24 Aug. 1981; KM12127, 12129, 12131, and 12163–12171, Kamikochi, Azumi-mura, Nagano-Pref., 26 July 1988 and 19 July 1989; KM11914, 11915 ,11926–11933, and 11938, 11939, Sinhodaka, Kamidakara-mura, Gifu-Pref., 24 May, 6 June, 5 Sept. 1987; KM2107, 2128–2130, Ohdaigahara, Kamikitayama-mura, Nara-Pref., 17, 18 Aug. 1969. Eight male and four female specimens of *M. muricola*: MNHNP (Museum National d'Histoire Naturelle de Paris) no number, Pinang, Malaysia; MNHNP-CG1895–447, Bengkalis Is., Sumatra, Indonesia; MNHNP-CG1906–96a, b, Mt. Pandan, Sumatra, Indonesia; MNHNP-CG1911–1402, Java, Indonesia; MNHNP-CG1911–596, Cochine chine, Vietnam, 31 March 1908; MNHNP-CG1877–1470, Sangihe Is., Indonesia, 1876; MNHNP-CG1959–219a-e, River Bahau, Kalimantan Timur, Indonesia, MNHNP-CG1891–95, Near Sintang, Kalimantan Barat, Indonesia. Ten male and 12 female specimes of *M. ussuriensis*: KM11324, Attoko, Hokkaido, 9 Sept. 1966; KM3211, Tottori, Kusiro, Hokkaido, 11 Dec. 1975; KM2744, Moiwa, Sapporo, Hokkaido, 5 May 1970; KM3221–3223, Takaoka, Tomakomai, Hokkaido, 31 Oct. 1977; KM12126 and 12160, Kamikochi, Azumi-mura, Nagano-Pref., 26 July 1988 and 18 July 1989; KM12173, Ohnogawa, Azumi-mura, Nagano-Pref., 31 Aug. 1988; KM12147, Fukado, Kamioka-cho, Gifu-Pref., 3 Sept. 1988; KM10971, Wakka, Tokoro-cho, Hokkaido, 3 Aug. 1984; KM3120, 3132, 3133, Oketo, Hokkaido, 26 July 1972; KM909, Biruwa, Tesikaga-cho, Hokkaido, 5 May 1968; KM3096, Simoasa, Sapporo, Hokkaido, Sept. 1971; KM3099, Sapporo, Hokkaido, April

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1971; KM12483, Takaoka, Tomakomai, Hokkaido, 18 Aug. 1996; KM12125, Kamikochi, Azumi-mura, Nagano-Pref., 26 July 1988; KM12156, 12157, Ohshirakawa, Shirakawa-mura, Gifu-Pref., 14 July 1989; KM2764, Ontake, Hidaosaka-cho, Gifu-Pref., 7 June 1970. Six male and five female specimens of *M. leucogaster*: KM3131, Oketo, Hokkaido, 26 July 1972; KM3224, 3233, Takaoka, Tomakomai, Hokkaido, 1 Sept. 1977, 8 Sept. 1978; KM12124, Kamikoti, Azumi-mura, Nagano-Pref., 26 July 1988; KM715, Kawakami-cho, Okayama-Pref., 3 April 1968; KM12146, Hukado, Kamioka-cho, Gifu-Pref., 3 Sep. 1988; KM12489, Takaoka, Tomakomai, Hokkaido, 19 Aug. 1996; KM579, 580, Higashinose, Toyono-gun, Ohsaka-Fu, 15 June 1967; KM711, 712, Yoshii-cho, Okayama-Pref., 1 April 1968.

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