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Balionycteris maculata.

By Robert Hodgkison and Thomas H. Kunz

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Balionycteris (Matschie, 1899)

Cynopterus Thomas, 1893:341. Part, not *Cynopterus* Cuvier, 1824.
Balionycteris Matschie, 1899:80. Type species *Cynopterus maculatus* Thomas, 1893, by monotypy.

CONTEXT AND CONTENT. Order Chiroptera, family Pteropodidae, subfamily Pteropodinae, tribe Cynopterini, subtribe Cynopterina, genus *Balionycteris*. *Balionycteris* is monotypic (Corbet and Hill 1992; Koopman 1993).

Balionycteris maculata (Thomas, 1893)

Spotted-winged Fruit Bat

Cynopterus maculatus Thomas, 1893:341. Type locality "Sarawak," Borneo.
Balionycteris maculata: Matschie, 1899:80. First use of current name combination.
Balionycteris maculata seimundi Kloss, 1921:229. Type locality "junction of Tahan and Teku rivers, foot of Gunung Tahan," Pahang, Malay Peninsula.

CONTEXT AND CONTENT. Context as above. *B. maculata* is monotypic.

DIAGNOSIS. *Balionycteris maculata* (Fig. 1) can be readily distinguished from other small species of Pteropodidae by a single pair of lower incisors, 2 pairs of upper molars, and by characteristic pale spots on wing membranes, particularly on joints of digits (Lekagul and McNeely 1977; Medway 1983; Payne et al. 1985). Among similar species and genera, *Chironax melanocephalus* and *Cynopterus* have 2 pairs of lower incisors, 1 pair of upper molars, and plain wing membranes, with no pale spots; *Aethalops alecto* has 1 pair of upper molars, a thickly furred interfemoral membrane, and no wing markings (Lekagul and McNeely 1977; Medway 1983; Payne et al. 1985).

GENERAL CHARACTERS. *Balionycteris maculata* is a small fruit bat with large eyes, simple ears, and no tail. Dorsal parts of body, including head, are blackish brown and thickly furred, whereas ventral parts are pale gray-brown. Pelage is soft and fine. Wing membranes are dark brown and sparsely covered with pale cream spots, particularly on joints of digits. Cream spots on wing membranes vary among individuals, whereas those on joints of digits are less variable (Hodgkison et al. 2003a). Thumb and forefinger have claws. Single pale spots are present on anterior edge of ears and in front of eyes. Nostrils are elongated and widely divergent (Kloss 1921; Lekagul and McNeely 1977; Medway 1983; Payne et al. 1985; Thomas 1893).

Skull of *Balionycteris* (Fig. 2) is elongated with 2 pairs of upper molars and 1 pair of lower incisors. Upper incisors are close together and angled inwards (Payne et al. 1985). Canine has a deep vertical groove on anterior edge (Lekagul and McNeely 1977; Payne et al. 1985).

External and cranial measurements (mean ± 1 *SD* and range in parentheses, in mm—R. Hodgkison, in litt.) of dry skins and skulls of male and female *B. maculata* collected from the Malay Peninsula, southern Thailand, and northern and northwestern Borneo, are: length of head and body, 61.0 ± 4.4 (56.0–66.0, $n = 7$); length of 1st digit, 13.1 ± 0.6 (12.2–14.0, $n = 9$); length of 2nd metacarpal, 19.6 ± 0.7 (18.0–20.1, $n = 9$); length of 3rd metacarpal, 28.3 ± 0.7 (27.0–29.7, $n = 9$); length of 4th metacarpal, 27.9 ± 0.7 (26.7–29.2, $n = 9$); length of 5th metacarpal, 28.3 ± 0.6 (27.6–29.9, $n = 9$); length of 1st phalanx of 3rd digit, 20.2 ± 0.6 (19.3–21.1, $n = 9$); length of 2nd phalanx of 3rd digit, 24.9 ± 0.5 (24.4–25.7, $n = 8$); length of 1st phalanx of 4th digit, 15.7 ± 0.2 (15.3–16.0, $n = 7$); length of 2nd phalanx of 4th digit, 15.4 ± 0.3 (15.0–15.7, $n = 6$); length of 1st phalanx of 5th digit, 13.3 ± 0.4 (12.9–13.9, $n = 6$); length of 2nd phalanx of 5th digit, 12.9 ± 0.2 (12.5–13.2, $n = 6$); length of tibia, 12.3 ± 0.6 (11.5–13.0, $n = 5$); length of hind foot, 7.3 ± 0.4 (6.3–7.5, $n = 10$); length of ear, 10.5 ± 0.7 (10.0–11.0, $n = 2$); greatest length of skull, 21.7 ± 0.4 (20.8–22.5, $n = 19$); condylobasal length, 20.5 ± 0.6 (19.4–21.5, $n = 19$); condylocanine length, 20.0 ± 0.6 (18.8–21.1, $n = 19$); interorbital breadth, 4.7 ± 0.2 (4.3–5.1, $n = 19$); length of maxillary toothrow, 7.2 ± 0.2 (6.7–7.4, $n = 19$); width across outside molars, M–M, 5.9 ± 0.2 (5.4–6.4, $n = 19$); width across outside canines, C–C, 4.7 ± 0.2 (4.2–5.1, $n = 19$); breadth of braincase, 9.8 ± 0.2 (9.5–10.3, $n = 19$); depth of braincase, 8.2 ± 0.3 (7.9–9.1, $n = 19$); zygomatic breadth, 14.5 ± 0.5 (13.3–15.5, $n = 16$); mandibular length, 16.2 ± 0.5 (15.0–16.8, $n = 19$); length of lower toothrow, 7.6 ± 0.2 (7.2–7.8, $n = 19$). On the Malay Peninsula, adult males are significantly smaller than adult females with respect to length of forearm but not body mass. Length of forearm of adult males and females (mean ± *SD*) is 40.9 ± 0.7 mm ($n = 21$) and 41.9 ± 1.1 mm ($n = 49$), respectively; body mass of adult males and nonpregnant adult females is 13.3 ± 0.8 g ($n = 21$) and 13.5 ± 1.0 g ($n = 35$), respectively (Hodgkison et al. 2003a).

FIG. 1. Female *Balionycteris maculata* from the Krau Wildlife Reserve, Pahang, Malay Peninsula. Note ectoparasite adjacent to right ear. Photograph by R. Hodgkison.

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of an adult female *Balionycteris maculata* (NHM [Natural History Museum, London, United Kingdom] 60.743) from Selangor, Malay Peninsula. Greatest length of skull is 21.8 mm. Photograph by R. Hodgkison; ©The Natural History Museum, London.

External and cranial measurements of 4 (1 male and 3 female) *B. maculata* from Sumatra are as follows (mean ± *SD* and range in parentheses, in mm): length of forearm, 39.9 ± 1.3 (38.6–41.7); condylobasal length, 19.6 ± 0.7 (19.0–20.7); zygomatic breadth, 13.9 ± 0.5 (13.3–14.5); breadth of mastoid, 9.4 ± 0.3 (9.1–9.9); palatal length, 10.2 ± 0.6 (9.6–10.9); length of maxillary toothrow, 6.7 ± 0.2 (6.5–6.9); width across outside molars, M1–M1, 5.4 ± 0.2 (5.2–5.7—Danielsen et al. 1997). Additional morphological data for *B. maculata* are available (Andersen 1912).

DISTRIBUTION. *Balionycteris maculata* occurs throughout the Malay Peninsula, northern and western Borneo (Brunei, West Kalimantan, Sabah, and Sarawak), the Riau Archipelago (on the islands of Durian and Galang), and southern Thailand (Fig. 3). In Thailand, *B. maculata* is known only from Khao Phu Pah, in Trang Province (Corbet and Hill 1992; Lekagul and McNeely 1977). *B. maculata* also has been recorded in the Tigapuluh Hills on the island of Sumatra, Indonesia, on the Riau–Jambi provincial border (Danielsen et al. 1997). No fossils are known.

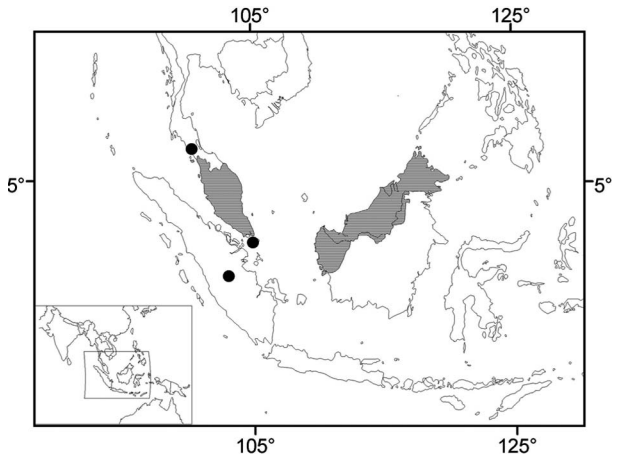

FIG. 3. Geographic distribution of *Balionycteris maculata* redrawn from Corbet and Hill (1992), with modifications according to Danielsen et al. (1997). Shaded area shows the general distribution of *B. maculata* on the Malay Peninsula and northern and western Borneo; circles show isolated populations in southern Thailand, the Riau Archipelago, and Sumatra.

FORM AND FUNCTION. *Balionycteris maculata* has short, broad wings and highly maneuverable flight. Some measurements pertaining to wing morphology and flight are: wing span, ca. 0.28 m; wing area, ca. 0.014 m^2; aspect ratio, ca. 5.8; wing loading, ca. 9.51 N/m2 (Hodgkison et al. 2004a). Reproductively mature males have scrotal testes and a dermal glandular structure on lower throat (Hodgkison 2001). Dental formula of *B. maculata* is i 2/1, c 1/1, p 3/3, m 2/2, total 30 (Thomas 1893).

ONTOGENY AND REPRODUCTION. Gestation lasts for ca. 135 days, and pups are nourished by their mother's milk for 40–80 days (Hodgkison 2001). In Peninsular Malaysia, individual female *B. maculata* give birth to 1 pup up to twice a year, with most births occurring between June and January. Pups are born with eyes and ears closed, minimum body mass of ca. 3.5 g, and length of forearm of 18.8 mm. The smallest free-flying juveniles have a body mass of a least 8.0 g and length of forearm of at least 36.3 mm. Female *B. maculata* may produce their 1st litters after 10 months (Hodgkison 2001).

ECOLOGY. *Balionycteris maculata* is strongly associated with old-growth forest, from sea level to ca. 1,500 m and is also found in mangroves (Francis 1990, 1994; Lim 1966; Medway and Wells 1971; Zubaid 1993, 1994). In lowland rain forest, on the Malay Peninsula, *B. maculata* is the only species of fruit bat strongly associated with forest understory (<10 m—Hodgkison et al. 2004a).

In Peninsular Malaysia, the spotted-winged fruit bat is an important seed disperser (Hodgkison et al. 2003b) and feeds on fruits of at least 22 species of plants from 9 families, including Annonaceae (*Cyathocalyx scortechinii*, *Polyalthia obliqua*, and *Pseuduvaria setosa*), Ebenaceae (*Diospyros sumatrana*), Loganiaceae (*Fagraea racemosa* and *Strychnos axillaris*), Melastomataceae (*Memecylon megacarpum* and *Pternandra echinata*), Moraceae (*Ficus fistulosa*, *F. globosa*, *F. scortechinii*, and *F. sundaica*), Myrtaceae (*Eugenia griffithii*), Rhizophoraceae (*Pellacalyx saccardianus*), Rubiaceae (*Diplospora malaccensis* and *Nauclea officinalis*), and Theaceae (*Adinandra sarosanthera*). These fruits are generally small (ca. 0.5–4.5 g) and inconspicuous in color (green or yellow-green—Hodgkison et al. 2003b). Stomach contents of 50 specimens from the Cameron Highlands, on Peninsular Malaysia, revealed remains of insects (Orthopteroidea, crickets and grasshoppers) and spiders (Araneae—Lim 1973). *B. maculata* never congregates in large numbers to feed, even when food resource is very large (Hodgkison 2001). On the Malay Peninsula, *B. maculata* is resident in old-growth lowland rain forest throughout the year (Hodgkison et al. 2004b).

In Borneo, the Horsfield's tarsier (*Tarsius bancanus*) preyed on spotted-winged fruit bats tangled in mist nets (Niemitz 1984). Spotted-winged fruit bats have a minimum life expectancy in the wild of at least 4 years (Hodgkison 2001).

Ectoparasites (Fig. 1) from the families Nycteribiidae and Streblidae have been recorded from *B. maculata* on the Malay Peninsula (Lim 1973), with infestation rates of 28% and 16%, respectively (n = 50 specimens). Blood parasites (*Hepatocystis*) and intestinal nematodes also have been recorded, with infestation rates of 40% and 10%, respectively (n = 40 and 50 specimens—Lim 1973).

BEHAVIOR. *Balionycteris maculata* inhabits small cavities, but rarely cave entrances (Medway 1983), and roosts singly, or in small groups. Each group consists of a single adult male accompanied by up to 9 adult females and their dependent young (Hodgkison et al. 2003a). Single roosting spotted-winged fruit bats are always male. Sex ratio of free-flying adults is significantly female-biased (1:2.15—Hodgkison et al. 2003a).

Male and female spotted-winged fruit bats forage locally, within ca. 1 km of their day roosts (Hodgkison et al. 2003a). However, in contrast to females, which remain away from their roost sites throughout the night, adult males divide their nightly activity between foraging and returning to their day roosts. Individual females roost sequentially with different males (Hodgkison et al. 2003a).

Roost cavities occupied by male *B. maculata* occur within a number of different forest structures, including ant nests (*Crematogaster ebinina*), termite nests (*Bulbitermes*), and the root masses of epiphytic ferns (*Asplenium nidus*, Aspleniaceae) and a single species of epiphytic ginger (*Hedychium longicornutum*, Zingiberaceae). The consistent shape and position of cavities, along with a single observation of roost cavity enlargement by an adult male, suggest that *B. maculata* plays an active role in creation of roost cavities (Hodgkison et al. 2003a).

Balionycteris maculata produces audible social calls (a high-pitched "peep") when foraging and when leaving the roost at dusk (Hodgkison et al. 2003a). Male *B. maculata* also produce more complex social calls (a rapid series of ascending "peeps"—Hodgkison et al. 2003a).

CONSERVATION STATUS. *Balionycteris maculata* is locally threatened throughout much of its distribution by deforestation. Scattered populations in southern Thailand, Sumatra, and the Riau Archipelago may be particularly vulnerable. On the Malay Peninsula and Borneo (Sabah, Sarawak, Brunei, and western Kalimantan), this species occurs within several reserves and protected areas, including production forests. On a global scale, *B. maculata* is not considered threatened (Davison 1992).

REMARKS. *Balionycteris maculata* is vulnerable to high levels of mortality during sampling, if subjected to excessive handling or prolonged periods of exposure (>30 min) in mist nets or harp traps. The spotted-winged fruit bat also is extremely sensitive to several standard methods of marking bats in capture–mark–recapture studies, particularly stainless steel ball-chain necklaces, which cause severe injury and death (Hodgkison et al. 2003a).

The generic name of the spotted-winged fruit bat is derived from the Greek words *balio*, meaning "spotted," and *nukteris*, meaning "bat." The specific name is Latin in origin, and also means "spotted." The Malay name for this species, cecadu sayap bertitik (Medway 1983), is a direct translation of the English spotted-winged fruit bat. This name is not widely recognized on the Malay Peninsula, where most small species of Megachiroptera and Microchiroptera are generally known as kelawar.

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Associate editors of this account were Kristofer Helgen, Betty McGuire, and Pamela Owen. Editor was Virginia Hayssen.

R. Hodgkison and T. H. Kunz, Department of Biology, Boston University, Boston, Massachusetts 02215.