

Pelage patterns and crypsis in roosting bats: *Taphozous mauritanus* and *Epomophorus* species

M. BROCK FENTON

Fenton, M. Brock. 1992. Pelage patterns and crypsis in roosting bats: *Taphozous mauritanus* and *Epomophorus* species. *Koedoe* 35(2): 49-55. Pretoria. ISSN 0075-6458.

The grizzled dorsal pelage of *Taphozous mauritanus* (Emballonuridae) contributes to the camouflage of these bats when they are roosting on natural surfaces. The white ear spots of *Epomophorus* spp. (Pteropodidae) represent disruptive patterns contributing to the cryptic appearance of these bats when they are roosting in foliage.

Key words: crypsis, disruptive patterns, *Taphozous*, *Epomophorus*.

M. Brock Fenton, Department of Biology, York University, North York, Ontario, Canada M3J 1P3.

Introduction

Pelage and wing patterns are thought to contribute to the cryptic appearance of some species of bats that roost in the open, whereas species roosting in crevices or hollows tend to be more uniformly coloured (Kunz 1982). In some cases, a cryptic effect appears to be enhanced by grizzled dorsal colour patterns such as those of the neotropical *Rhynonycteris naso* (Wied-Neweid, 1820) (Goodwin & Greenhall 1961; Bradbury & Emmons 1974) or the new world *Lasiurus cinereus* (Beauvois, 1796) (Kunz 1982). In many other species, contrasting patches or stripes are presumed to lend a concealing effect (megachiropterans, Novick 1977; *Saccopteryx bilineata* (Temminck, 1838), Bradbury & Emmons 1974; *Scotomanes ornatus* (Blyth, 1851), Walker 1975; stenodermine phyllostomids, Goodwin & Greenhall 1961; Foster and Timm 1976; Morrison 1980). It is easy to overlook roosting bats because most are small and usually motionless. The difficulty of finding roosting lasiurine bats (e.g., Constantine 1966) illustrates this point, even when radio transmitters permit location of the specific tree in which a *Lasiurus borealis* (Muller, 1776) (Hickey & Fenton 1990) or a *L. cinereus* (M.B.C. Hickey pers. comm.) is roosting. The same situation applies to larger bats such as *Epomophorus wahlbergi* (Sundevall, 1846) (Fenton *et al.* 1985). The effectiveness of an overall cryptic appearance may explain why so little is known about the roost-

ing habits of most species of bats that roost in the open.

The purpose of this paper is to consider two variations in bat pelage patterns that contribute to their cryptic appearance when roosting. The first variation is the proposal that the grizzled pelage patterns contribute to an overall cryptic effect of bats roosting in the open. The second variation is the suggestion that the white ear spots of epomophorine bats represent disruptive colouration. In both cases the data come from general observations which support, but do not prove, the proposed functions.

Materials and methods

Roosting *Taphozous mauritanus* E. Geoffroy, 1818 and *Epomophorus* Bennett, 1836 species were observed and photographed at different locations in the Kruger National Park at different times in 1984, 1985, 1988 and 1992. The 1984 observations were of *Epomophorus wahlbergi* as the animals had been captured, examined (Fenton *et al.* 1985) and fitted with radio transmitters. The other observations could have involved either *Epomophorus wahlbergi* or *Epomophorus gambianus crypturus* Peters, 1852, species distinguishable only by examination of palatal ridges (Bergmans 1988). In addition to these observations, study skins of bats in the Royal Ontario Museum (Toronto, Canada) were examined to assess prevalence of pelage patterns observed in the field.

Results and discussion

Taphozous mauritanus is one of the more familiar insectivorous African bats (Kingdon 1974) because of its propensity to roost on the

walls of buildings and scuttle away when approached. Still, these bats are easy to overlook, particularly when they are roosting on more natural backgrounds (Fig. 1a). In this photograph, taken in the Skukuza staff vil-

lage in March 1992, the bat was roosting on a tree trunk to which it had flown when disturbed on the wall of the church. Through 400 mm of lens the animal is easy to spot, partly because the eye reflects the flashes used to

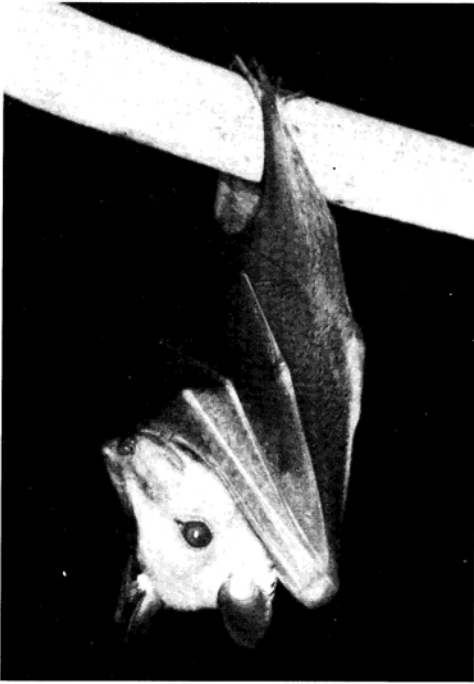


(a)

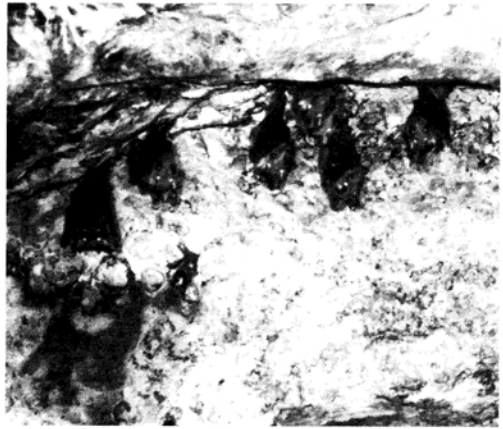
Fig. 1. A *Taphozous mauritanus* roosting (a) on the trunk of a tree in the Skukuza staff village near the church. The striking white venter obvious in a portrait of a hand-held bat (b) is almost completely concealed when the bat is roosting.



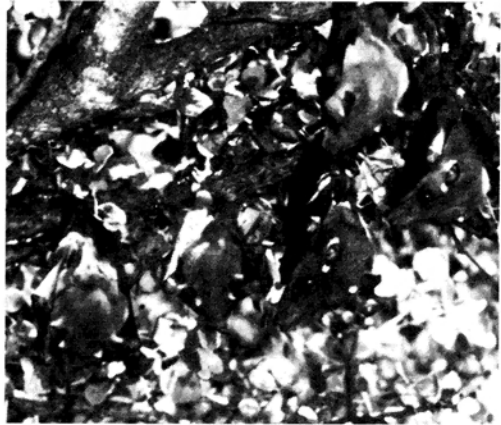
(b)



(a)



(c)



(d)



(b)

Fig. 2. When an *Epomophorus wahlbergi* roosts against a black background (a), its white ear spots are conspicuous (bat photographed in Harare, Zimbabwe). When *Epomophorus* spp. roost in a tree (b), the white ear spots disrupt the general appearance of the bats (photographed in Lower Sabie in the Kruger National Park). When *Epomophorus wahlbergi* roost in a shelter cave (c), the white spots are more conspicuous (photographed about 7 km south of the Luvuvhu River in Kruger National Park; Fenton *et al.* 1985). The ear spots contribute to disruptive patterns even when *Epomophorus* species are viewed more closely; (d) same group of bats as in (b).

illuminate the scene. The grizzled dorsal fur makes the animal cryptic in a natural roost. Note that, except for an area near the shoulder, the striking white venter (Fig. 1b) of this roosting *T. mauritanus* is entirely concealed. All of the 50 study skins of *T. mauritanus* I examined in the ROM collections showed similar patterns of dorsal pelage. The observations and the photograph support the suggestion that the grizzled dorsal pelage contributes to the cryptic nature of *T. mauritanus*.

Grizzled dorsal pelage pattern may contribute to a cryptic effect in a variety of other species such as *Rhynonycteris naso* (Goodwin & Greenhall 1961) and lasiurine bats whose roosting habits are generally known (Kunz 1982). It is not clear if generalisations about pelage colour apply to species whose roosting habits remain unknown or poorly known. Does the grizzled appearance of *Hipposideros cyclops* Temminck, 1843 or species in the genus *Kerivoula*, for example relate to their roosting habits?

White ear spots are characteristic of male and female epomophorine bats (family Pteropodidae). These ear spots are conspicuous when an animal is seen against a dark background (Fig. 2a), and although the prevalence of these features has been noted by many authors (e.g., Rosevear 1965; Kingdon 1974), I found no suggestions about their function. Unlike the shoulder epaulettes of male epomophorines, the hairs comprising the white ear spots are similar except in colour to body hairs (Hickey & Fenton 1987). The eversible epaulettes are used in advertisement displays by male epomophorine bats (Rosevear 1965; Kingdon 1974; Bradbury 1977; Wickler & Seibt 1976).

When viewed from below, *Epomophorus* species roosting in trees (Fig. 2b) are difficult to see against the dappled background of sunlight coming through foliage. The general lighting situation involves intense illumination in some areas and deep shade in others (see Owen 1980). In this situation the ear spots disrupt the outlines of the bats' heads. A clear illustration of the disruptive function

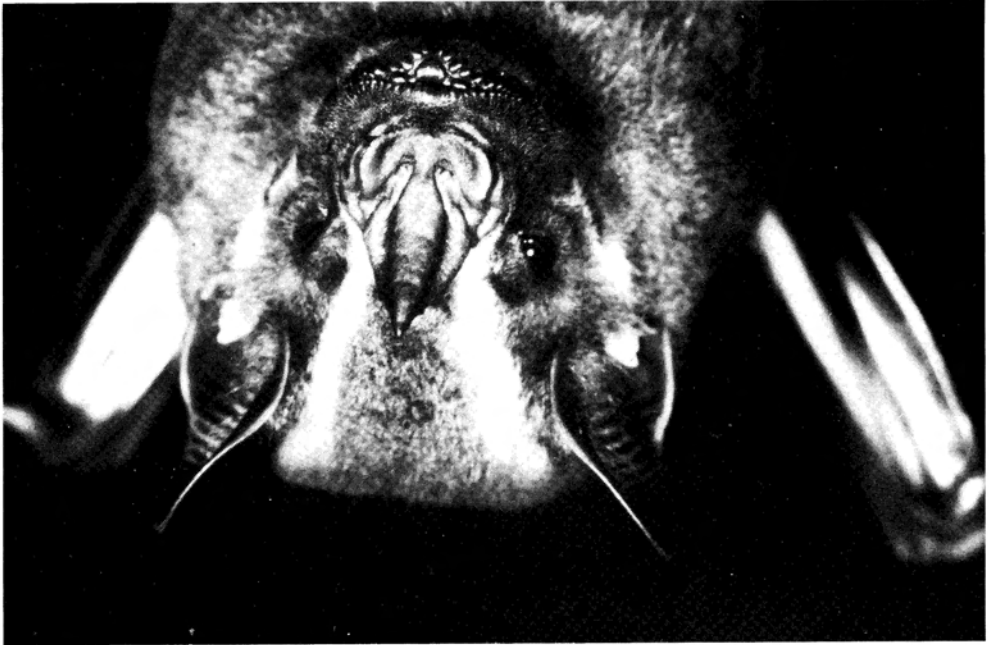
of the ear spots is provided by comparing the photograph of bats in foliage with one of *Epomophorus wahlbergi* roosting in a shelter cave (Fig. 2c). Quite simply, the ear spots disrupt the outlines of the bats roosting in foliage, but make the cave-roosting animals more conspicuous. In both Figs 2b and 2c the bats are more conspicuous because their eyes reflect the flashes used in taking the photographs. Even in close-up views when bats fill more of the frame (Fig. 2d) different body positions relative to the camera and the ear spots disrupt the bats' outlines, contributing to a camouflage effect.

Ear spots were conspicuous in study skins of

- five species of *Epomophorus* :
E. anurus Heuglin, 1864, 2;
E. gambianus (Ogilby, 1835), 38;
E. gambianus crypturus, 6;
E. labiatus (Temminck, 1837), 51;
E. wahlbergi, 45,
- two species of *Epomops*
E. dobsoni (Bocage, 1899), 1;
E. franqueti (Tomes, 1860), 40,
- *Hypsignathus monstrosus* H. Allen 1861 (40),
- *Micropteropus pusillus* (Peters, 1867) (40) and
- *Nannonycteris veldkampii* (Jentink, 1888) (13),

species representing a wide range of sizes (forearms from 48 mm, *Micropteropus*, to 140 mm, *Hypsignathus*).

The photographic evidence supports the proposal that the white ear spots of epomophorine bats represent disruptive colouration and specifically extends the suggestion of Novick (1977) about countershading effects in megachiropteran bats that roost in foliage. This raises questions about other white markings on bats, stripes being among the most common. The white dorsal stripes of *Saccopteryx bilineata* and *Saccopteryx leptura* (Schreber, 1774) have been proposed as contributing to the cryptic appearance of these bats when they are roosting in the trunks of trees (e.g., Goodwin & Greenhall 1961; Bradbury & Emmons 1974), presumably disrupting the outline of the bat. It is likely that the comparable stripes of *Chalinolobus egeria* (Thomas, 1913) serve the same function, although nothing is known of the roosting habits of these small African vespertilionids.



(a)



(b)

Fig. 3. White facial stripes in *Artibeus lituratus* (Olfers, 1818) (a) may represent disruptive patterns (bat photographed near Akumal, Quintana Roo, Mexico). The same may be true of the white ear margins and digit outlines in *Cynopterus sphinx* (b) (photographed near Madurai in southern India).

The white facial stripes of many species of stenodermine (e.g. Fig. 3a) Phyllostomidae are thought to contribute to the cryptic appearance of these bats when they are roosting, particularly in tents made from leaves (Goodwin & Greenhall 1961; Walker 1975; Foster & Timm 1976; Morrison 1980), perhaps because they disrupt the outline of the bats. The same may prove true of the white markings on *Cynopterus sphinx* (Vahl, 1797)(Fig. 3b) which sometimes roosts in tents (Goodwin 1979; Kunz 1982). In this species, the anterior edge of the ear is white as is the skin over the metacarpals (Fig. 3b). Study skins of *Cynopterus sphinx* (2), *Cynopterus brachyotis* (Muller, 1838) (50) and *Cynopterus horsfieldi* Gray, 1843 (29) in the ROM consistently showed these patterns.

White shoulder spots occur in several species of bats and as noted above, often are sexually dimorphic. The function of the dramatic white spots in the dorsal pelage of the vespertilionids *Chalinolobus superba* (Hayman, 1939), *Scotomanes ornatus* or *Euderma maculatum* (J.A. Allen, 1891) remains unclear. There is no obvious association of pelage pattern and roosting in *E. maculatum* where strong circumstantial evidence suggests roosting in rock crevices (e.g., Watkins 1977; Waiping & Fenton 1989). The roosting habits of the other two species remain unknown.

Other patterns in bats that have been related to roosting may or may not apply. For example, the variegated wings of *Chalinolobus variegatus* (Tomes, 1861) are supposed to help conceal these bats as they roost (e.g., Kunz 1982), but when roosting these bats do not always envelop themselves in their wings (Obrist *et al.* 1989; Fenton 1992). The translucent areas in the wing membranes of *Centurio senex* Gray, 1842 may be related to vigilance when roosting (Vaughan 1970), but these sections of the wings and the stripes on the wings are most conspicuous when back-lighted (Fenton 1992). White or translucent wings occur in a variety of African bats (species in the Emballonuridae, Vespertilionidae and Molossidae), but their role is not obvious. Recent work with bats and raptors (MBF

unpublished results) makes it plausible that white or translucent wings lend a counter-shading effect (as outlined in Edmunds 1974) when the bat is flying, perhaps making it less conspicuous to bat hawks.

Acknowledgements

I thank I.L. Rautenbach for providing logistical assistance and the Executive Director: Kruger National Park for permitting me to study bats there. I also thank R.M. Bringham, A.M. Mills, S.E. Smith, C.M. Swanepoel and K. Viljoen for assistance in the field. L. Acharya, D. Audet and D. Pearl read earlier drafts of the manuscript and made useful suggestions about it. My work on bats has been supported by the Natural Sciences and Engineering Research Council of Canada and York University.

References

- BERGMANS, W. 1988. Taxonomy and biogeography of African fruit bats (Mammalia, Megachiroptera). 1. General introduction, material and methods, results: the genus *Epomophorus* Bennett, 1836. *Beaufortia* 38: 75-146.
- BRADBURY, J.W. 1977. Lek mating behavior in the hammer-headed bat. *Zeitschrift für Tierpsychologie* 45: 225-255.
- BRADBURY, J.W. and L.H. EMMONS. 1974. Social organization of some Trinidad bats. I. Emballonuridae. *Zeitschrift für Tierpsychologie* 36: 137-183.
- CONSTANTINE, D.G. 1966. Ecological observations on lasiurine bats in Iowa. *Journal of Mammalogy* 47: 34-41.
- EDMUNDS, M. 1974. *Defence in Animals*. London: Longmans.
- FENTON, M.B. 1992. *Bats*. New York: Facts on File Inc.
- FENTON, M.B., R.M. BRIGHAM, A.M. MILLS and I.L. RAUTENBACH. 1985. The roosting and foraging areas of *Epomophorus wahlbergi* (Pteropodidae) and *Scotophilus viridis* (Vespertilionidae) in Kruger National Park, South Africa. *Journal of Mammalogy* 66: 461-468.
- FOSTER, M.S. and R.M. TIMM. 1976. Tent-making by *Artibeus jamaicensis* (Chiroptera: Phyllostomatidae) with comments on plants used by bats for tents. *Biotropica* 8: 265-269.
- GOODWIN, G.G. 1979. The bats of Timor: systematics and ecology. *Bulletin of the American Museum of Natural History* 163: 73-122.
- GOODWIN, G.G. and A.M. GREENHALL. 1961. A review of the bats of Trinidad and Tobago. *Bulletin of the American Museum of Natural History* 163: 187-302.
- HICKEY, M.B.C. and M.B. FENTON. 1987. Scent-dispersing hairs (osmetrichia) in some Pteropodidae and Molossidae (Chiroptera). *Journal of Mammalogy* 68: 376-384.

- HICKEY, M.B.C. and M.B. FENTON. 1990. Foraging by red bats (*Lasiurus borealis*): do intraspecific chases mean territoriality? *Canadian Journal of Zoology* 68: 2477-2482.
- KINGDON, J. 1974. *East African Mammals, an Atlas of Evolution. Vol. IIA. Insectivores and Bats*. New York: Academic Press.
- KUNZ, T.H. 1982. Roosting ecology of bats. Pp. 1-55. In: KUNZ, T.H. (ed.). *Ecology of Bats*. New York: Prenum Press.
- MORRISON, E.W. 1980. Foraging and day-roosting dynamics of canopy fruit bats in Panama. *Journal of Mammalogy* 61: 20-29.
- NOVICK, A. 1977. Acoustic orientation. Pp. 74-287. In: WIMSATT, W.A. (ed.). *Biology of Bats*. Vol. 3. New York: Academic Press.
- OBRIST, M., H.D.J.N. ALDRIDGE and M.B. FENTON. 1989. Roosting and echolocation behavior of the African bat, *Chalinolobus variegatus*. *Journal of Mammalogy* 70: 828-833.
- OWEN, D. 1980. *Survival in the Wild. Camouflage and Mimicry*. Chicago: University of Chicago Press.
- ROSEVEAR, D.R. 1965. *The Bats of West Africa*. London: British Museum (Natural History).
- VAUGHAN, T.A. 1970. The transparent dactylopatagium minus in phyllostomatid bats. *Journal of Mammalogy* 51: 142-145.
- WAIPING, V. and M.B. FENTON. 1989. Ecology of spotted bat (*Euderma maculatum*): roosting and foraging behavior. *Journal of Mammalogy* 70: 617-622.
- WATKINS, L.C. 1977. *Euderma maculatum*. *Mammalian Species* 77: 1-4.
- WALKER, E.P. 1975. *Mammals of the World*. Vol. 1. Baltimore: John Hopkins University Press.
- WICKLER W. and U. SEIBT. 1976. Field studies of the African fruit bat, *Epomophorus wahlbergi* (Sundevall), with special reference to male calling. *Zeitschrift für Tierpsychologie* 40: 345-376.