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Short Communication

Transient yellow colouration of the bat *Artibeus jamaicensis* coincides with pollen consumption

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ABSTRACT

Atypical colouration of the fur is not commonly recorded in bats. Here we report a transient yellow colouration attributed to dietary components in *Artibeus jamaicensis* in 2004 and 2005 at two localities of Yucatan, Mexico. Change in colouration was recorded in January when 62% of *A. jamaicensis* captured ($n = 50$) appeared yellow. All faecal samples collected from atypically coloured individuals consisted mainly of *Ceiba pentandra* pollen, which was also recovered from the fur. Carotenoid pigments contained in pollen ingested during peak *Ceiba* flowering appear to be incorporated into the hairs of *A. jamaicensis.* Further investigations are required to understand how pigment is transferred between the pollen and the hairs of *A. jamaicensis*.

Atypical colouration of the fur is not commonly recorded in bats, but may have many causes. Albinism is the congenital inability to produce the pigment melanin and has been reported in Old and New World bats (Gamba-Ríos 2010; Kanuch and Kristin 2003). Leucism is the expression of a recessive gene that causes loss of body pigment in the soft tissues, particularly the eyes (Boada and Titira 2010). Melanism results from excessive deposition of the black pigment melanin that causes darkening of the skin (Buchanan 1985). Although these atypical colourations are permanent, bats can also display temporary atypical colouration due to high ammonia concentrations in roosting sites (Fleming 1988), and apparently also by components of the diet. In this paper we report such atypical yellow colouration in *Artibeus jamaicensis* Leach 1821 observed while studying the vegetation around cenotes (water-filled sinkholes formed by the dissolution of limestone) as a food source for frugivorous and nectarivorous bats.

Yellow *A. jamaicensis* bats were caught at two cenotes 3.5 km apart in Buctzotz County, Yucatan, Mexico, about 100 km east of the capital Merida, where 60% of the original forest has been converted to pastureland and cattle ranches (INEGI 2006). The dry season extends from November to April and the wet season from May to October. Cenote Azul (21°13′N, 88°40′W) and Cenote Buenavista (N 21°11′N, 88°40′W) are about 40–60 m in diameter with a surrounding belt of vegetation 10–50 m in diameter. The predominant tree species are *Ficus cotinifolia* Kunth., *F. padifolia* Kunth., *F. tecolutensis* Miq. (Moraceae), *Piscidia piscipula* (L.) Sarg., *Lysiloma latisiliquum* (L.) Benth (Fabaceae), *Metopium brownei* (Jacq.) Urban (Anacardiaceae), *Manilkara zapota* (L.) van Royen (Sapotaceae), *Vitex gaumeri* Greenman (Lamiaceae), *Bursera simaruba* (L.) Sarg. (Burseraceae), and *Gymnopodium floribundum* Rolfe (Polygonaceae). One of the largest trees in the area *Ceiba pentandra* (L.) Gaertn (Malvaceae) is not present in high densities in the vegetation belt. Cenotes and their vegetation belts are islands of natural vegetation in a pastureland landscape.

We sampled bats at each location from March 2004 to April 2005. Four 12×2.6 m mist nets (AFO Mist Nets, Manomet, Inc.) were erected at ground level (0–3 m) each night, in the vegetation surrounding cenotes. Nets were set at sunset, left open for an average of seven hours and monitored every 30 min. Bats were measured and then released in the capture site. We used a fine paint brush to collect pollen from the bodies and heads of *A. jamaicensis*. Pollen was stored in Eppendorf tubes in 70% ethyl alcohol. A separate brush was used for each individual bat to avoid sample contamination. Samples were subsequently prepared according to the acetolysis method described by Erdtman (1960) and viewed with an Olympus Model Bx41 microscope (Olympus America Inc.). Four yellow individuals of *A. jamaicensis* were taken as vouchers and subsequently deposited at the Regional Zoological Museum (COZORE) at the Autonomous University of Yucatan (UADY) in Mexico.

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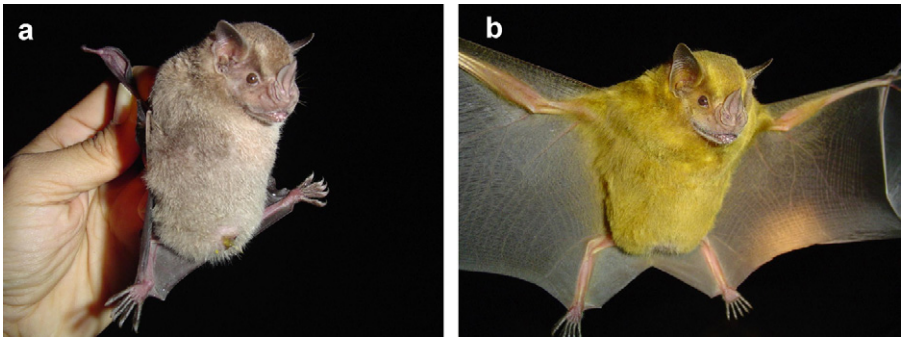

Fig. 1. Images of *Artibeus jamaicensis* fur colouration types. (a) Normal grey-brownish colouration; (b) atypical yellow colouration observed during January in the Yucatan.

The noticeable change in fur colouration of *A. jamaicensis* was observed in January when 62% of *A. jamaicensis* captured ($n = 50$) appeared yellow (Fig. 1). We recorded such colouration both in females ($n = 21$) and males ($n = 10$). The unusual colouration of the hairs observed in the majority of *A. jamaicensis* has not been reported previously in the Yucatan, but has been reported for Palo Alto and Santa Rosa, Costa Rica (Tschapka and Dressler 2002). M. Tschapka (pers. comm.) has suggested that carotenoids from *Ceiba* pollenkitt might stain the fur of the yellow bats externally. However, our observations in the field showed that all the hairs of the majority of yellow bats are evenly coloured from base to tip. In some bats, only the tips of the hairs retained the typical grey-brown colouration, and the rest was yellow. Additionally dissection of voucher specimens showed subcutaneous tissue and internal fat was also yellow-coloured.

The change in the colouration of *A. jamaicensis* coincided with the peak period of *C. pentandra* flowering. In addition, all faecal samples collected from atypically coloured individuals consisted mainly of *C. pentandra* pollen, which was also recovered from fur samples. *C. pentandra* exhibits a massive production of flowers (referred to as a "big bang" by Gentry 1974), which are visited mainly by specialized bats in the Glossophaginae (e.g. *Leptonycteris*) and by less specialized bats in the Stenodermatinae and Carollinae (von Helversen and Winter 2003). In our study sites, *Ficus* trees are important feeding resources throughout most of the year, but in January only 7% ($n = 68$) had fruits, most of which were immature and were not consumed by frugivores (Korine and Kalko 2005). In February, when most *C. pentandra* had already flowered and *A. jamaicensis* was no longer feeding mainly on pollen but on fruits (*Ficus* spp., *Spondias mombin*, *Manilkara zapota*) and leaves (MCMG unpubl. data), most of the individuals captured had the normal greyish fur colouration although a few exhibited some patches of yellow fur.

Yellow individuals of *Glossophaga soricina* Pallas, *Artibeus lituratus* Olfers, *Sturnira lilium* E. Geoffroy and, *A. phaeotis* Miller were also caught in January, but the most abundant and brightly coloured was *A. jamaicensis*. We have observed yellow colouration of nectarivorous and frugivorous bats coupled with the flowering period of *C. pentandra* for several years in the Yucatan, which suggest that it is one the most important feeding resources during the dry season for bats in this region.

Artibeus jamaicensis consumes the flowers of *C. pentandra* (Ortega and Castro-Arellano 2001). Carotenoid pigments contained in the pollen ingested during the peak *Ceiba* flowering appear to be incorporated into the hairs of *A. jamaicensis*, as has been reported in the feathers or bills of bird species which consume large quantities of pollen (Fox 1979; Klasing 1998). In a study carried out in West Africa, *C. pentandra* proved to contain the highest concentrations of alfa and beta-carotene in comparison to other edible plants (Smith et al. 1996). Change of fur colouration due to components of the diet has not been widely studied in mammals. In laboratory rats however, a diet which included a natural food colourant, beta-carotene, resulted in red colouration of the fur after a few weeks (Nabae et al. 2005).

Moulting phenology is poorly known in bats, but temperate zone species moult into new dorsal pelage once a year (Constantine 1957) and this process may take about two weeks (Cryan et al. 2004). However, in Neotropical bats, moulting may be associated with breeding periods, suggesting that it may occur in different species at different times of year (Fraser et al. 2010). Although the capture of yellow *A. jamaicensis* coincided with their breeding period, few of those caught were pregnant. To the best of our knowledge the present report is the first of colouration in the pelage of bats attributed to diet. Further investigations are required to understand the mechanisms of transfer of pigments between pollen and the hairs of *A. jamaicensis*.

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