



Short Note

Frequent melanism in Geoffroy's bat (*Myotis emarginatus*, Geoffroy 1806)

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Abstract

Melanistic, or otherwise atypically coloured bats, are rarely observed. Here we report on a survey of melanistic individuals of *Myotis emarginatus* (Geoffroy's bat) in the Northwestern edge of its distribution. Across the sampled region, 31 sites and over 3000 individuals of *M. emarginatus* were observed. Overall, melanism was found in approximately 2–4% of the populations. To our knowledge this is the highest proportion of melanistic individuals recorded in any bat species thus far. Such large levels of melanism may indicate a recent bottleneck in the population. Further research on the genetic structure and behaviour of this population may help identify the possible causes and consequences of this peculiarity.

Melanism, defined as the excessive deposition of the pigment melanin resulting in an atypically dark individual (Kettlewell, 1973), is traditionally considered to be quite rare in bats (Krapp, 2011) although it can be quite common in other mammals (Caro, 2005). Melanistic individuals have been reported in North America for *Myotis lucifugus* (Trapido and Crowe, 1942; Buchanan, 1985) and *Perimyotis subflavus* (*Pipistrellus subflavus obscurus*; Osgood 1938). In Europe, cases of melanism in bats are rare and poorly described; dark individuals have been noted in *Eptesicus serotinus* and *Pipistrellus pipistrellus* (Krapp, 2011), and several photos of apparent melanistic individuals appear in the literature (*R. hipposideros*, Meschede and Rudolph 2004, p.389; *M. emarginatus*, Arthur and Lemaire 2009, p. 488; *M. alcaethoe*, Dietz et al. 2007, p. 230s). It is important to note that for vespertilionid species juvenile individuals are darker in pelage (Dietz and von Helversen, 2004), however this phenomenon is clearly different from melanism.

The Geoffroy's bat (*Myotis emarginatus*, Geoffroy, 1806) is a bright reddish-brown coloured bat, which is found across Europe and Northern Africa. Here we present data on a survey of *Myotis emarginatus* in the Northwestern edge of its distribution, and document the presence of substantial numbers of melanistic individuals throughout this region (Fig. 1). Between 2007 and 2012, a total of 31 unique maternity colonies, swarming sites and hibernacula (16, 8 and 7 respectively) in the Netherlands, Belgium and Germany were monitored to gather census data on *M. emarginatus* ($n = 3019$ bats). Additional sites where less than 10 individuals were observed have been omitted from this report. Eight maternity colonies were visited in multiple years (up to 4), in which case the sample with the largest number of total bats was taken for this analysis. For swarming sites, multiple sampling events within one season were pooled.

A total of 16 maternity colonies were surveyed in July for the presence of melanistic individuals, of which 8 were surveyed in 2 or more years. In total, 41 melanists were found (Fig. 2a), representing 1.9% of all *M. emarginatus* present. Additionally, 8 swarming sites and 7 hibernacula in the region were surveyed, resulting in 32 melanistic individuals, representing 3.7% (swarming) and 3.4% (hibernation) of the total sample (Fig. 2b). At both summer colonies and swarming/hibernation sites, the number of melanistic individuals was consistent throughout the region, and no distinct geographical pattern could be discerned.

At the swarming sites surveyed, all 13 of the captured melanistic individuals were male (Tab. 1). Of these 13, 1 was identified as a juvenile (based on epiphyseal plates and secondary sexual characteristics), and the rest were sexually active adults with swollen testes and/or epididymides. Four of the individuals had considerable dental wear and dental plaque, suggesting that melanistic individuals can reach an advanced age. When compared to adult normally coloured individuals, the mean forearm length of adult melanistic individuals was not significantly different (Wilcoxon ranked sign test, $p = 0.21$), nor was mean mass (Wilcoxon ranked sign test, $p = 0.65$).

No melanistic females were caught during the swarming survey, however the sex ratio at these sites was strongly male biased (79.6%).



Figure 1 – A melanistic *Myotis emarginatus* surrounded by normally coloured adults and juvenile individuals at a maternity roost. Photo: René Janssen.

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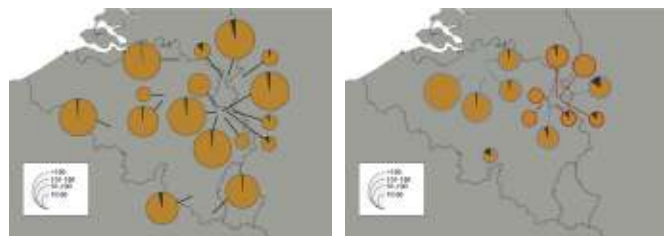


Figure 2 – (left) proportion of melanistic individuals (black) to normally coloured individuals (orange) per observed summer colony; (right) proportions observed at swarming sites (red outline) and hibernation sites (blue outline) sites. The size of the circle is proportional to the total number of individuals observed, for sites that were surveyed in multiple years the sample with the largest total number of bats was taken.

An adult melanistic female that had lactated in a previous year was caught on 2/6/2010 in the Vijlenerbosch (50.766° N, 5.946° E) in the Netherlands. Additionally, as maternity colonies are strongly female biased (Krapp, 2011) and many of the monitored colonies yielded very similar numbers of melanistic individuals across years, it is likely that most of the melanists observed at these colonies are adult females. It is therefore unlikely that there is truly a sex bias of melanism in this system.

Having consulted several colleagues on the issue we have found that the melanistic form of *M. emarginatus* is also present outside of the current study area, albeit probably to a lesser degree. In mainland France cases of melanism have been observed in several departments in the north, east and centre of the country (Eure: V. Culicchi; Oise: S. Declercq; Meuse and Meurthe-et-Moselle: D. Jouan; Cher: L. Arthur; Ain: C. Schönbacher & R. Letscher; Savoy: S. Laguet; all personal communications). On the islands of Corsica and Sardinia, individuals of *M. emarginatus* have been described to be greyer (Courtois et al., 2011) and darker brown (Dietz and von Helversen, 2004) respectively, however it is unclear whether these colour aberrations are related to the melanistic form described here. Finally, in the southern parts of the distribution, melanistic individuals have not been noted despite the observation of large numbers of *M. emarginatus* (Portugal: P. Barros; Bulgaria: I. Borissov; Greece: S. Puechmaille; all personal communications; Tunisia: Puechmaille et al. 2012).

In conclusion, here we report frequent population-wide melanism for the first time in a European bat species. The proportion of melanists found in the Belgian and Dutch population of *M. emarginatus* (between 1.9 - 3.7%), is larger than thus far reported for any other bat species. Due to the nocturnal nature of bats, melanism itself is likely inconsequential for fitness in terms of sexual selection or predation (Buchanan 1985, but see Voigt and Lewanzik 2011). Nevertheless, as melanism has been found to be a recessive trait in several other mammals (eg. Robinson 1970; Rieder et al. 2001; Kingsley et al. 2009), the comparatively high number of melanists observed here may indicate that this population is genetically depauperate and has experienced a recent bottleneck event. Future studies investigating the population genetic structure and phylogeographic history of *M. emarginatus* across Europe may therefore be highly interesting.

References

Arthur L., Lemaire M., 2009. Les chauves-souris de France, Belgique, Luxembourg et Suisse, Biotope, Mèze; Muséum national d'Histoire naturelle, Paris. [in French]
 Buchanan G.D., 1985. Comments on the frequency of melanism in *Myotis lucifugus*. J. Mammal. 66(1): 178.
 Caro T., 2005. The adaptive significance of coloration in mammals. Bioscience 55(2): 125–136.
 Courtois J.-Y., Rist D., Beuneux G., 2011. Les chauves-souris de Corse, Albiana, Gémenos. [in French]
 Dietz C., von Helversen O., 2004. Illustrated identification key to the bats of Europe. Electronic publication, version 1. Available from: <http://www.fledermaus-dietz.de/publications/publications.html> [11 September 2013]
 Dietz C., von Helversen O., Nill D., 2007. Handbuch der Fledermäuse Europas und Nordwestafrikas, Kosmos, Stuttgart. [in German]
 Kettlewell H.B.D., 1973. The evolution of melanism: the study of a recurring necessity, Clarendon Press, Oxford.
 Kingsley E.P., Manceau M., Wiley C.D., Hoekstra H.E., 2009. Melanism in *Peromyscus* is Caused by Independent Mutations in Agouti. PLoS ONE 4(7): e6435. doi:10.1371/journal.pone.0006435
 Krapp F. (Ed.) 2011. Die Fledermäuse Europas. Ein umfassendes Handbuch zur Biologie, Verbreitung und Bestimmung, Aula-Verlag, Wiebelsheim. [in German]
 Meschede A., Rudolph B.-U., 2004. Fledermäuse in Bayern, Ulmer-Verlag, Stuttgart. [in German]
 Osgood F.L., 1938. The Mammals of Vermont. J. Mammal. 19(4): 435–441.
 Puechmaille S.J., Hizem W.M., Allegrini B., Abiadh A., 2012. Bat fauna of Tunisia: review of records and new records, morphometrics and echolocation data. Vespertilio 16: 211–239.
 Rieder S., Taurit S., Mariat D., Langlois B., Guerin G., 2001. Mutations in the agouti (ASIP), the extension (MC1R), and the brown (TYRP1) loci and their association to coat color phenotypes in horses (*Equus caballus*). Mamm. Genome 12(6): 450–455.
 Robinson R., 1970. Inheritance of black form of the leopard *Panthera pardus*. Genetica 41(1): 190–197.
 Trapido H., Crowe P.E., 1942. Color abnormalities in three genera of Northeastern cave bats. J. Mammal. 23(3): 303–305.
 Voigt C.C., Lewanzik D., 2011 Trapped in the darkness of the night: thermal and energetic constraints of daylight flight in bats. Proc. R. Soc. B. 278(1716): 2311–2317.

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Table 1 – Measurements, age and sex of the melanistic individuals caught at swarming sites as well as the average of all “normally coloured” individuals caught. FA = forearm length.

Sample date	Location	Sex	FA (mm)	Mass (g)	Age
16-08-2008	Koelenbosch groeve (50.852° N, 5.775° E)	male	38.7	7.1	adult
29-08-2008	Groeve de Hel (50.798° N, 5.745° E)	male	38.1	7.6	adult
29-08-2008	Groeve de Hel (50.798° N, 5.745° E)	male	39.1	8.4	adult
30-08-2008	Koelenbosch groeve (50.852° N, 5.775° E)	male	38.6	7.9	adult
27-09-2008	Groeve de Hel (50.798° N, 5.745° E)	male	35.2	7.0	juvenile
27-09-2008	Koelenbosch groeve (50.852° N, 5.775° E)	male	39.5	9.1	adult
08-08-2009	Vallenberg groeve (50.851° N, 5.836° E)	male	39.1	8.5	adult
19-09-2009	Vallenberg groeve (50.851° N, 5.836° E)	male	37.5	7.5	adult
01-09-2011	Vallenberg groeve (50.851° N, 5.836° E)	male	37.6	-	adult
18-09-2011	Vallenberg groeve (50.851° N, 5.836° E)	male	39.2	7.8	adult
18-09-2011	Vallenberg groeve (50.851° N, 5.836° E)	male	39.8	8.7	adult
18-09-2011	Vallenberg groeve (50.851° N, 5.836° E)	male	-	7.5	adult
18-09-2011	Vallenberg groeve (50.851° N, 5.836° E)	male	38.7	8.2	adult
Average of normally coloured individuals (n = 294)		79.6% male	39.4	8.4	