

Tail defects in two Daubenton's bats (*Myotis daubentonii*)

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Abstract: Two Daubenton's bats (*Myotis daubentonii*) with tail defects were caught in mist-nets in front of the entrances of two neighbouring cellars at Klein Heidekamp, a military base which is part of the Oranjekazerne in Schaarsbergen, province of Gelderland, the Netherlands. The anomalies are described and the possible etiology of the malformations is discussed. In the first case an accident, predation or frostbite is proposed, for the second bat a congenital malformation is among the plausible causes.

Keywords: tail defects, teratology, malformation, Daubenton's bat, *Myotis daubentonii*.

Introduction

The hidden lifestyle of bats prevents large-scale, detailed, close-up examination. Animals available for detailed study, either as single specimens or in low numbers at most, may either be dead museum specimens or may have ended up in health care. Catching bats alive can enlarge these numbers. Mist-netting bats is used for several reasons and gives insight in, for example, species composition, relative species abundance and bats' reproductive cycle.

In the Netherlands a mixed group of professionals and volunteers active in bat research founded a system in order to regulate catching bats, a 'bat-catching system' ('Vleermuisvang-systeem', see: www.vleermuisvang.nl). Together these bat workers form a sounding board. A limited number of them participate as trainers and committee members. Members of this sounding board catch swarming bats on a yearly base just prior to the hibernation period at two particular cellars next to each other known to contain large numbers of bats

in winter. In this short note we report on the tail defects that we found in two of the Daubenton's bats (*Myotis daubentonii*) caught at this location.

Even with mist-netting, relatively few bats are checked at close distance and consequently anomalies are rarely encountered and reported. We consider it important to notice and describe these tail defects to understand the natural variation and incidence of anomalies. The information could also be used in decisions to be made regarding the release of injured bats from health care.

Materials and methods

On the evening of 15 October 2016 bats were caught in front of the entrances of two cellars at the Oranjekazerne military base in Schaarsbergen, province of Gelderland, the Netherlands, also known as Klein Heidekamp (52°01'35.3" N, 005°53'39.2" E). Forty meters of hair nets (Solida, Germany) were put in position near the entrances of the two cellars. Additionally, a harp trap was placed in front of both doors, not totally blocking the way in or out.

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Figure 1. Ventral side of bat number 1, showing a shortened tail with a knob-like thickening. *Photo: Frans Bosch.*



Figure 2. Ventral side of bat number 2. The tail of this bat was unusually short. *Photo: John Mulder.*



Figure 3. Dorsal side of bat number 2, showing the very short tail ending in a small 'curl'. *Photo: Jan Boshamer.*

Each bat caught was examined, i.e. its left forearm length and body mass were measured using a caliper and a spring balance. Sexual status (condition of nipples, testes and epididymides) was checked as described in Haarsma (2008).

All contributors had been vaccinated against rabies and trained and licensed to catch and handle bats. Bats were temporarily marked on the toenails using non-toxic nail polish to exclude recaptured individuals. Bat captures were carried out under license from the Dutch Ministry of Economic Affairs (permit FF/75A/2012/037a), and with the permission of the Oranjekazerne. Each bat was released within half an hour after its capture.

Results

We caught 49 individual bats, there were no recaptures. Among these bats there were 17 Daubenton's bats. While handling the bats we noticed tail defects in two of these Daubenton's bats. Hereafter we refer to these two individuals as bat number 1 and 2.

Bat number 1

The first animal, a male, showed a remarkable shortening of the tail. The tail vertebrae column missed several parts and ended in a knob-like thicker part, probably indicating a healed state after an inflammatory response. An estimated number of three vertebrae (of the usual ten) were still present. Stretching the uropatagium from feet to the remaining vertebra resulted in a upside down V-shape (figure 1). Only minor remnants of the calcars were seen near the ankles. The rim of the uropatagium showed slight irregularities. The left forearm length was 39.3 mm and the body mass was 12.6 g. The forearm length fitted well into the reported range for Daubenton's bat (Dietz & Kiefer 2015), while the bat's body mass was normal for the end of the season. Sexual condition characteristics (colour, fill-

ing and length of epididymides) showed that the bat had been sexually active during the past mating season. The chin spot suggested an age older than three years (Haarsma 2008).

Bat number 2

The second animal was also a male showing a short tail (figure 2). A smaller part of the tail seemed to be missing than in bat number 1. The overall view of the tail of this bat gave the impression of a proportionally shortened tail (figures 2 and 3). Both calcars were present and robustly built, but were connecting to a point more or less halfway the normal tail length (the end of the estimated fourth tail vertebra). The tail vertebrae column ended abruptly. A close-up view showed a small 'curl' on the dorsal side possibly presenting a vestigial tail tip (figure 3). The animal also showed a distorted orientation of the uropatagium with a massive wrinkle in the distal part at the right side. The forearm was remarkably short (left 34.8mm, right 35.1mm). This value is within the range reported for Daubenton's bat (33.1-42.0mm: Dietz & Kiefer 2015), but for the Dutch situation it is extremely low (A.-J. Haarsma, unpublished data).

Discussion

Bat tails are complex organs consisting of ten caudal vertebrae, the tail membrane or uropatagium, a pair of calcars and several structures forming a so-called venation pattern, a characteristic feature, which is thought to relate to a species' feeding strategy (Dokuchaev 2015). The tail is said to play a major role in the maneuverability of bats during flight (Vaughan 1959, 1970, Schmieder et al. 2014) and presumably also in feeding (Webster 1962).

Both caught bats seemed to be in good condition according to the amount of body fat, which was as much as can be expected for

Daubenton's bats prior to hibernation. The malformations did not seem to adversely affect their ability to fly or to take part in reproduction. The bats had just passed the peak of the male sexual cycle. Both had clearly been sexually active in the weeks prior to capture.

The aberration in bat number 1 obviously was an acquired state and the result of some amputation incident. The remaining tissue looked as if a rupture of the vertebrae along with the surrounding uropatagium had occurred. Possibly this was the result of the animal being stuck somewhere or flying across a thorn bush or barbed wire. The latter is known to cause extensive damage to wing membranes (Hinkel & Rackow 1994). Hooks belonging to fishing tackle left behind in the water could also be a serious threat to trawling bats.

One of the alternative explanations is predation by leopard slugs (*Limax maximus*). This ubiquitous, partly carnivorous slug can be found in moist subterranean places where bats hibernate, as well as in tree cavities where Daubenton's bats stay in summer. Bats in torpor may not be able to react in time on an attack by this predator. We suspect gnawing by leopard slugs to be one of the main causes of missing parts of the outer ears we regularly see in bats.

Frostbite has to be taken into consideration as a cause of the missing part of the tail too, although the ears are probably more sensitive to frostbite. Both bats had flawless ears.

In the past a high predation rate caused by wood mice (*Apodemus sylvaticus*) has been observed in subterranean hibernation sites (Haarsma & Kaal 2016) and also in the cellars of the study site, but wood mice attacks often seem to result in the death and almost total predation of their victims. Apart from wood mice, greater white-toothed shrews (*Crocidura russula*) are suspected of causing casualties among bats. Nowadays wood mice and other small mammals do not have free entrance to these cellars due to precautions taken some years ago.

Even small injuries can cause severe tissue loss due to inflammation. In bats this seems to be restricted by higher body temperatures (febrile situation) caused by a high metabolism rate during flight (O'Shea 2014).

Also worth bearing in mind are the possible effects of White-nose syndrome, a fungal disease which can have profound implications like scarring and necrosis on the wing membrane in the little brown bat (*Myotis lucifugus*) in North America (Reichard & Kunz 2009) and which may have lasting consequences for flight (Voigt 2013).

As for now the etiology of this defect in bat number 1 cannot be reconstructed, but extra attention is recommended to document and publish any future incident with for instance barbed wire, slugs, frostbite or mice.

For bat number 2 a congenital malformation seems to be a more logical explanation, though an acquired anomaly cannot be ruled out. Some sort of developmental disorder may have caused the long limb bones to reach a shorter length than normal and the distal part of the tail to be malformed. Also in this bat we can only guess for its etiology. Both prenatal exposure to teratogenic chemicals and inbreeding are known to be able to cause congenital deformations (Kunz & Chase 1983).

Tail defects in bats are very rarely reported. Constantine (1958) mentioned some deformations in two seminole bats (*Lasiurus seminolus*). Mitchell & Smith (1966) reported only two tail anomalies found in 150,000 banded Mexican free-tailed bats (*Tadarida brasiliensis*). Those defects were clearly different from the ones described here. The incidence of, especially congenital, anomalies is, however, much higher when immature bats prior to weaning age are included (Kunz & Chase 1983), due to the detrimental effect on survival of the more severe anomalies.

Several European researchers known to have caught a lot of *Myotis* species were inquired about their experiences. Summer mist-net captures above water in the Netherlands between 2008 en 2011 resulted in a

total of 715 Daubenton's bats (A.-J. Haarsma, unpublished results). A total of 572 of these bats were checked and described in detail. During this research one Daubenton's bat was found with a broken, dislocated tail curling in a dorsal direction, much like the cases in Mitchell & Smith (1966); two other bats showed inflammation of a tail joint. None of those Daubenton's bats had injuries resembling the ones in this study, which indicates a low incidence (A.-J. Haarsma, personal communication). In Germany several Natterer's bats (*Myotis nattereri*), a species with a gleaning feeding strategy, were found with lost tail membranes (C. Dietz, personal communication). One Geoffroy's bat (*Myotis emarginatus*) caught during the swarming period in the Netherlands had lost a part of the tail membrane and even some tail vertebrae, but the calcars were still present (J. van Schaik, personal communication). In England, several, mainly unilaterally, injured bat tails were seen in for instance three (among 793) long-eared bats (*Plecotus auritus*), at least one (among 991) Natterer's bat (*Myotis nattereri*) and eleven (among 2276) Daubenton's bats. In just two cases, of a Daubenton's bat and a long-eared bat, the injury resembled that of bat number 1. The Daubenton's bat was recaptured after three years and the long-eared bat after one year at which moment it was lactating (D. Linton, personal communication).

Given the low incidence of bats lacking both calcars and most of the uropatagium this can be seen as a rare state. Though only anecdotal information is available, such animals seem to handle their handicap surprisingly well. Bats in health care can, even if missing a major part of their tail, be released without problems after healing of the wounds.

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Samenvatting

Staartdefecten bij twee watervleermuizen (*Myotis daubentonii*)

Twee watervleermuizen (*Myotis daubentonii*) met staartdefecten werden met mistnetten gevangen voor de ingang van twee bunkers in Klein Heidekamp (Oranjekazerne, Schaarsbergen) tijdens een vangavond door mensen uit de klankbordgroep van het Vleermuisvangsysteem. De afwijkingen worden beschreven en mogelijke oorzaken worden opgesomd. In het eerste geval kan zowel een ongeluk (met bijvoorbeeld prikkeldraad) alsook predatie door muizen of tijgerslakken (*Limax maximus*) of bevroering de reden van het staartdefect zijn geweest. In het tweede geval wordt een aangeboren afwijking als plausibel verondersteld.

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