Notes

Collapsing Burrow Causes Death of a Eurasian Beaver, *Castor fiber*

LIAT R. THOMSEN[1], FIONA SHARPE[2], and FRANK ROSELL[3]

[1] Department of Zoology, University of Aarhus, Denmark
[2] School of Biology, University of St Andrews, Fife, Scotland
[3] Faculty of Arts and Sciences, Department of Environmental and Health Studies, Telemark University College, N-3800 Bø i Telemark, Norway

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The death of a Eurasian Beaver *Castor fiber* caused by a collapsing burrow in southeast Norway is reported. Two days of heavy rainfall had presumably caused the burrow to collapse, suffocating the animal.

Key Words: Beaver, *Castor fiber*, collapsing burrow, southeast Norway.

Several causes of death have been reported for Eurasian Beavers (*Castor fiber*) (Rosell et al. 1996; Nolet et al. 1997), but to our knowledge this is the first report of a beaver killed due to a collapsing burrow. The beaver was an adult solitary male (21.5 kg and 5 years old; age was determined by examining annual cementum and dentine layers of the first molar (van Nostrand and Stephenson 1964)). His mate died two months earlier, probably due to old age (18 years old). The animal was one of several radio tagged beavers that were followed during a field study in spring and summer 2000 in Telemark County, southeast Norway (59°25'N, 09°03'E) (see Campbell 2000). On the evening of 14 July 2000 it was noted that the pulse interval of the radio signal had increased. The signal is inversely related to the body temperature of the animal (Alterra 1999), thus a higher pulse interval indicated that the beaver had died. The dead beaver was located in the main part of a partly collapsed burrow (assessed to be relatively new), which was excavated four days later in order to find and retrieve the carcass (Figure 1).

Beavers dig burrows where banks are sufficiently high (Wilsson 1971; Żurowski 1992). A burrow usually consists of a single living chamber, a water basin, and a tunnel with exit below the water level (Wilsson 1971). The beaver was lying in the chamber (1 m long and 70 cm wide) of the collapsed burrow, facing towards the exit. The chamber was situated 210 cm from the water's edge, 80 cm below the surface of the riverbank, and 60 cm above the current water level. Apparently the ceiling of the chamber had collapsed on top of the beaver causing the death of the animal, presumably by suffocation. There was loose sand along the flanks of and underneath the body of the dead beaver. The last 10 cm of the beaver's tail was bent downwards into the sand and the right hind foot was crouched as if the beaver had been attempting to dig with it. The beaver had no external injuries and seemed to be in good condition.

FIGURE 1. The dead solitary adult beaver located in the chamber of a partly collapsed burrow.

The burrow was dug in sandy soil. In the week prior to the discovery of the beaver there had been two days with heavy rainfall in the area with 30.8 mm and 24.6 mm of rain, respectively (data from the Norwegian Meteorological Institute).

We conclude that the combination of heavy rainfall and a sandy soil had caused the burrow to collapse, therefore causing the death of the beaver. How prevalent this cause of death is in beavers is unknown. However, we expect that more field studies using radio telemetry, in areas where beavers dig burrows, could clarify this issue.

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Literature Cited

Alterra. 1999. Alterra (IBN/DLO) P.O. Box 23. 6700 AA Wageningen. Netherlands.

Campbell, R. D. 2000. Territoriality in the European Beaver, *Castor fiber*. MSc thesis, School of Biological Sciences, University of East Anglia, Norwich, England.

Nolet, B. A., S. Broekhuizen, G. M. Dorrestein, and **K. M. Rienks.** 1997. Infectious diseases as main factors of mortality to beavers *Castor fiber* after translocation to the Netherlands. Journal of Zoology, London 241: 35-42.

Rosell, F., H. Parker, and **N. B. Kile.** 1996. Causes of mortality in beaver (*Castor fiber & canadensis*). Fauna 49: 34-46 [In Norwegian with English summary].

van Nostrand, F. C., and **A. B. Stephenson.** 1964. Age determination for beavers by tooth development. Journal of Wildlife Management 28: 430-434.

Wilsson, L. 1971. Observations and experiments on the ethology of the European beaver *(Castor fiber* L.). Viltrevy 8: 1-266.

Żurowski, W. 1992. Building activity of beavers. Acta Theriologica 37: 403-411.

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Frequency of Tail Breakage of the Northern Watersnake, *Nerodia sipedon sipedon*

KENNETH D. BOWEN[1, 2]

[1]Department of Biology, Central Michigan University, Mt. Pleasant, MI 48859 USA
[2]Present Address: 709 Ringold Street, Boone, Iowa 50036 USA

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I noted the frequency of broken tails of Northern Watersnakes, *Nerodia sipedon sipedon*, in the Beaver Archipelago of Northeastern Lake Michigan. Overall, 10% (22 of 220) of captured snakes had broken tails. This value is similar to published values for closely related snakes but is smaller than those reported for another *Nerodia sipedon sipedon* population. Unlike some previously published studies, the frequency of injured tails was not greater for females or lesser for first-year snakes. The mechanism behind the injury frequency observed here and the reason for differences between this and other studies are unknown.

Key Words: Beaver Archipelago, *Nerodia sipedon sipedon*, Northern Watersnake, tail breakage, Michigan.

The frequency of tail injuries in a lizard or snake population was at one time considered to be a useful index of the predation pressure on that population because tail autotomy and breakage (Mendelson 1992) are thought to be important defense mechanisms (reviewed in Arnold 1988). More recently, theoretical and empirical tests of this hypothesis have led to the assertion that loss or injury of the tail may instead be related to predator inefficiency or alternative sources of mortality and that careful investigation must be undertaken to determine the mechanism behind observed injury frequencies (Schoener 1979; Medel et al. 1988). While such data must indeed be interpreted with caution, reporting the frequency of tail injury in study populations can be useful when combined with demographic data (Arnold 1988), for example in forming hypotheses regarding sex or size-based differences in anti-predator mechanisms (Fitch 2003).

Several researchers have reported the frequency of tail injuries in populations of snakes. Fitch (1999) found that the frequency of tail breakage increased with the age/size of individuals in a Kansas population of *Nerodia s. sipedon,* the Northern Watersnake. More specifically, the frequency of female tail breakage ranged from 21.2 to 44.5%, and the frequency of male tail breakage ranged from 6.5 to 25% in increasing body size categories. Willis et al. (1982) reported that female Eastern Garter Snakes (*Thamnophis sirtalis*) and Northern Ribbon Snakes (*Thamnophis sauritus*) had a higher incidence of tail loss than males (13% versus 6%, and 12% versus 7%, respectively) and that tail loss was more prevalent in larger size classes. However, neither trend was statistically significant in populations of Butler's Garter Snake (*Thamnophis butleri*). Fitch (2003) found that tail breakage was more common for female *T. sirtalis* (16.7%) than for males (10.3%) and more common for large snakes (13.7%) than for first-year snakes (2.42%). In general, females and larger snakes appear more likely to have broken tails.

I studied the frequency of broken tails of the Northern Watersnake in the Beaver Archipelago of northeastern Lake Michigan during the summers of 2000 and 2001. I captured snakes from Beaver Island (45°41.26'N, 85°30.34'W), Garden Island (45°48.28'N, 85°29.41'W), High Island (45°43.88'N, 85°39.54'W), and Hog Island (45°48.39'N, 85°22.15'W). Upon cap-