Nyctalus (N.F.), Berlin **13** (2008), Heft 2-3, S. 122-126

Rock scree – a new habitat for bats

By Tore Christian Michaelsen, Bergen, and Karl Johan Grimstad, Hareid

With 2 figures

In Scandinavia, relatively few bats are found in caves, mines and WWII bunkers during winter. Some of these "missing" bats could be using rock scree as hibernation site. Here we present results from a study of northern bats carried out around the time the bats disappear in late autumn.

1 Introduction

Only a few hundred bats are recorded in mines and caves in Norway each winter (the Norwegian Zoological Society, unpubl.), an insignificant proportion of the different bat populations. Northern bats (*Eptesicus nilssonii*), the most common species in Norway, constitute less than one hundred of these bats. This naturally raises the question about the whereabouts of northern bats as well as other species during the time of hibernation. One explanation could be that many northern bats use buildings for hibernation as found in parts of Sweden (e. g. Rydell 1989). A few such records exist from Norway (Jeroen van der Kooij, pers. comm.). Another alternative to be considered is rock scree. Bats have previously been recorded in rock scree three times in Norway and all these observations were made during summer:

1) a northern bat left a scree when the observer accidently turned over some rocks (van der Kooij 1999)
2) a single undetermined bat emerged from a scree during daytime (unpubl.)
   and
3) several bats emerged from a scree during road construction (unpubl.).

In addition, a long-eared bat (*Plecotus auritus*) has been found in a cavity in a large rock wall covered by scree (unpubl.), suggesting that also this species will explore this habitat.

To explore the roost site selection of bats around the time when activity comes to a halt in autumn at 62°N, we fitted radio-transmitters to four northern bats in late September, between 2005 and 2007. At one location, we also tried to locate any bats emerging from scree using ultrasound detectors. The purpose was to learn more about the bats use of day roost at a time when only a few northern bats are still active at this latitude and when hibernation is imminent.

2 Study area and method

Bats were studied on two large islands in Møre og Romsdal county on the south west coast of Norway at 62°N; Location A) Hareid, Hareid municipality (62°22'N – 05°59'E) and Location B) Ellingsøy, Ålesund municipality (62°30'N – 06°30'E). Both islands have strong oceanic influence and lies within the boreonemoral vegetation zone (Moen 1998). Normal monthly temperatures for January in the lowlands are 0° to +4°C (Aune & The Norwegian Meteorological Institute 1993), thus these coastal areas are without lasting snow cover in winter. Northern bats are common in the region during summer, including the two islands studied here (Michaelsen et al. 2003b). Day roosts during summer are usually found in buildings, but northern bats will also use crevices in rock walls or hollow trees (Michaelsen et al. 2004). No bats have previously been recorded using scree as day roost in the study area, but no effort has been made to seek for bats in scree. Northern bats have been recorded active as late as mid-October, but in most years, few northern bats are still active by late

September when bats were trapped for this study (Michaelsen et al. 2003a, unpubl.). Only one northern bat has been found wintering in the study area. This hung behind a board on concrete constructions outside a WWII bunker. During the coldest periods of winter, this northern bat did not change site even though temperatures dropped below 0°C.

Northern bats were trapped around street lamps using mist nets (pole-flicking). Bats were lured down by throwing small stones into the air (northern bats commonly dive to catch the lure). Transmitters were fitted to the first bat to be trapped that evening (random selection). Two bats were fitted with transmitters in each of the two locations; in total one female and three males. We used transmitters from Titley Electronics PTY/LTD, Australia (LTM Single stage, 500 mg) and Holohil Systems Ltd., Canada (LB2N, 0.42 g). The bats were tracked using a TRX48S receiver combined with a 3-element Yagi antenna (Wildlife Materials, UK). This receiver has an attenuator switch, allowing exact positioning at short distances. A further reduction in pulse intensity could be achieved by removing the antenna. All males were banded, using rings issued by Stavanger Museum (2,9 mm Alloy) to avoid pseudoreplication. The bats were tracked during daytime and occasionally during the evening. Bats were not tracked every day, as the observers had to combine this study with other engagements.

Observations from two random points at a scree at Location B was carried out in the evening using ultrasound detectors (Pettersson D 240x and D 100), between 2 und 5 October 2007. At these points we would be able to observe and hear bats emerging up to approximately 20-30 m in one direction (upwards from the point). Due to light conditions, observations could only be made till the time around sunset. Bats emerging later would not have been seen by us, and positive confirmation of emergence would not be possible.

Temperatures are of outmost importance to bats on their hibernation site. To assess the potential of rock scree as winter habitat for bats, we measured temperatures inside and outside the scree at location B, between 25 December 2007 and 14 January 2008. One EcoLog (Fourier Systems, Ltd.) were situated 2 meters above the surface of the scree on a stick and another EcoLog 50 cm below the scree surface, just underneath a layer of soil (a northern bat

Figure 1. The emergence point of one of the northern bats (Eptesicus nilssonii) mentioned in this paper. The leaves from aspen and birch should give an impression of the size of the rocks. These leaves decay and a soil layer is formed further down in the scree. The soil layer was permeable to the bats.
Photo: Tore Chr. Michaelsen.

Table 1. The use of day-roost by the four bats fitted with transmitters. The last known roost site is indicated by a "*" if bats used more than one roost.

Bat No.	sex	Location	Period	Days in Bulding(s)	Days in Scree	Days in rock crevice	sum
1	♀	A	24. Sept. – 12. Oct. 2005	4	2*	0	6
2	♂	A	25. – 27. Sept. 2006	3	0	0	3
3	♂	B	25. – 26. Sept. 2006	0	2	0	2
4	♂	B	30. Sept. – 21. Oct. 2007	10*	0	11	21

had previously emerged from this location, Fig. 1). The loggers recorded temperatures every 30 minutes (a total of 957 parallel records per unit). Temperature data were later explored using R version 2.6.1. (R development core team 2007). The difference between inside and outside variances were tested on the sums and differences of the two dependent variables using a Pearson's product moment test.

3 Results

Two of the four northern bats fitted with radio transmitters used rock scree as day roosts, one female and one male (Tab. 1). Bat no. 1 entered the scree at the end of the battery lifetime of the transmitter, and was no longer heard after two days in the scree. Bat. No 3 was recorded hunting in the evening after spending two days in a scree. It was not heard after this evening, even though we searched for it in a radius of 30 km.

One northern bat emerged from each of the two random points in rock scree at location B (simultaneously on 5 October). None of these two bats had rings, and thus could be distinguished from the two bats fitted with transmitters at location B (bat no. 3 and 4), thus three different bats had now emerged from three different locations in this scree.

As expected, temperatures inside the scree below an insulating layer of soil varied less than on the outside (variance inside = 1.51, outside = 5.49, cor = 0.5768, df = 955 $p < 0.001$). Temperature range was +0.6 to +5.4°C (mean = 2.3°C) inside the scree and –1.4 to +9.6°C outside (mean = 3.8°C), see Fig. 2.

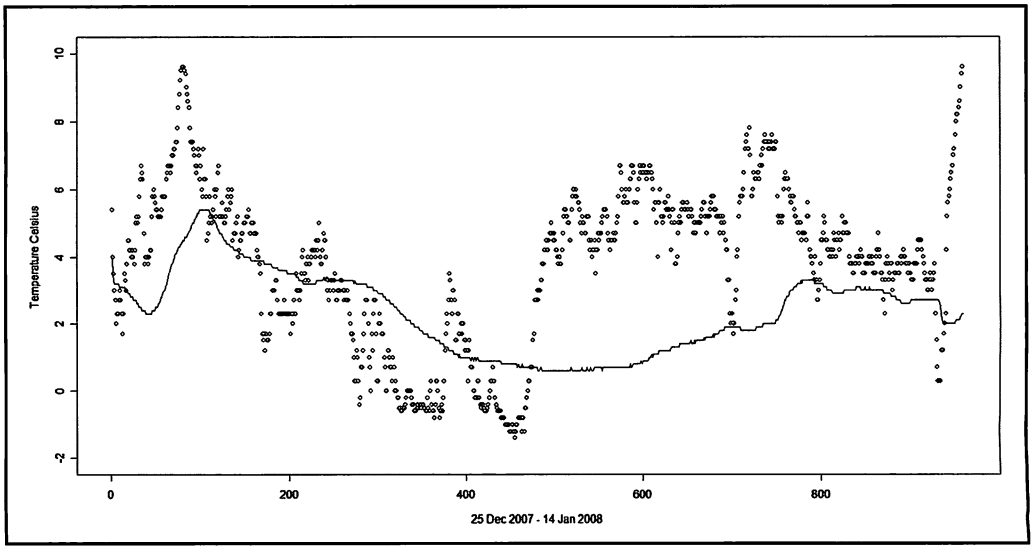

Figure 2. The parallel temperature measurements outside (dotted) and inside (line) the scree recorded every 30 minutes between 25 December 2007 and 14 January 2008. Note that inside temperatures have a delay in response to changes in outside temperatures, thus extremes are avoided in this fluctuating climate.

4 Discussion

Our unbiased method (telemetry) suggests that rock scree could be a commonly used habitat for northern bats. This is further supported by the fact that bats emerged from the scree at both the randomly selected observation points at location B. Also, the previous observations, made accidentally of bats emerging from scree, suggest that the use of this habitat is not exclusive to our two study areas. However, the number of bats tracked thus far is too small to draw any final conclusions about how frequent bats use scree. Further, our results cannot positively confirm that rock scree is a hibernation habitat for bats, but we now know that at least some bats use rock scree as roost around the time when activity comes to a halt in late autumn. It is unlikely that we would have heard telemetry bats that descended deep into the scree, thus discovering bats in scree are associated with some luck. It is quite possible that bats lost before the end of battery lifetime, actually entered rock scree without being recorded by us (e. g. bat no. 2). That being said, our telemetry bats also used buildings and a crevice in a rock wall. At least buildings are known as hibernation sites for northern bats from previous studies (RYDELL 1989).

Rock scree should provide a wide range of temperatures, varying with depth and other elements (e. g. insulating soil layers, assembly of leaves etc.). Ideal temperatures for northern bats should be in the estimate 0-5°C (GERELL & RYDELL 2001). In Finland, northern bats hibernate at relatively low temperatures (mean 2.0°C) and a large proportion of these bats are found at temperatures below 0°C (SIIVONEN & WERMUNDSEN 2008). The upper temperature limit for hibernation has been suggested to be around +8°C (MASING & LUTSAR 2007). Our temperature measurements suggest that bats may find suitable conditions in scree for hibernation, at least on the Norwegian west coast with its mild winter climate. The temperature data collected just 50 cm into the scree and just below a thin insulating layer of soil, were well within the limits for this species, even though outdoor temperatures ranged below freezing and above the suggested upper limit for hibernation. Further, inside the scree temperatures were also relatively stable as opposed to temperatures outside the scree. Above the soil layer, we expect temperatures to approximate those measured outside, and thus not provide ideal conditions for hibernating bats during much of the winter. Temperatures were measured at a site in the scree where a northern bat was observed emerging on several consecutive evenings. We found no tracks of the bat when we excavated the scree as far down as the soil layer. Our careful excavation should have revealed bat droppings at its roost site within the scree. This suggests that the bat is likely to have descended below the permeable layer of soil, where we stopped our excavation.

We assume that bats using scree would be vulnerable to predators such as weasels, but that this would manly be true when bats enter or leave the scree. Rock scree has a number of safe crevices from where small and medium sized predators are excluded. In some parts, gravel will prevent weasels to move freely about. Bats should be able to seek out such safe locations within a scree. Small mammals, such as yellow-necked mice (*Apodemus flavicollis*) could harm bats, but this would also be true in buildings. Also, buildings are subject to renovation or demolition. Thus, it is not possible to conclude that roosts in scree are associated with more risk than e. g. buildings where we know bats hibernate.

During summer, only a few northern bats are heard at Location B. In autumn the number of northern bats increase, and further, undetermined Myotis sp. and long eared bats turn up here. We have not tried to locate the day roosts of these other species using telemetry, but both long eared bats and Myotis sp. are seen and heard around the scree. Further studies will be carried out to better understand which species use scree as day roosts, and even more important, why they enter this habitat.

Aknowledgements

We are grateful to The Norwegian Directorate for Nature Management (DN) and Bat Conservation International (BCI) for funding equipment and covering expenses during this study. Also, we would like to thank Stein Eric Solevag for providing aid when fitting transmitter to the bat tracked in 2007 and to Kjell Mork Soot for assistance during fieldwork in 2005. Jeroen van der Kooij has provided us with information about hibernating bats recorded by the Norw. Zool. Soc. during winter. We would also like to thank Are Pilskog for catching emerging bats on film. All work with bats was carried out with permission from the Norwegian Directorate for Nature Management (DN) and with approval by the National Animal Research Authority.

Summary

Few bats are recorded in caves, mines and bunkers in Norway. To learn more about the whereabouts of northern bats (*Eptesicus nilssonii*) around the time bat activity comes to a halt in autumn, we fitted radio transmitters to four bats in coastal areas in western Norway at 62°N. Two of these bats used rock scree as roost, one in ultimo September and one in mid October. Bats also used buildings and rock crevices. In addition, one bat emerged from scree in each of two randomly selected observation points (October).

Our results suggest that rock scree could be a common habitat for northern bats in autumn, around the time when bat activity ends. Temperature measurements also suggest that this habitat may be suitable as winter roost for bats, but we have as of yet not been able to confirm such behaviour (unlike caves or mines, observing bats inside scree is associated with same difficulty). Other species, such as long eared bats (Plecotus auritus) and undetermined Myotis sp. are also found flying around scree in autumn, but no effort has been made to track these species. Why bats enter scree and which species use this habitat as roosts, will be further explored.

Zusammenfassung

Felsgeröll – ein neuer Lebensraum für Fledermäuse

In Norwegen werden in Höhlen, Stollen und Bunkers nur wenige Fledermäuse angetroffen. Um zu erkunden, wo Nordfledermäuse (*Eptesicus nilssonii*) während der Zeit ihrer Herbstaktivitäten Quartier beziehen, setzten wir dafür geeignete Radiosender bei 4 Fledermäusen im Küstengebiet von West-Norwegen (62°N) ein. Zwei von diesen mit Sendern ausgestatteten Fledermäusen nutzten Felsgeröll als Quartiere, die eine spät im September, die andere Mitte Oktober. Die Fledermäuse nutzten auch Gebäude und Felsspalten. An zwei zufällig gewählten Beobachtungspunkten kamen je eine Fledermaus aus dem Felsgeröll zum Vorschein.

Unsere Ergebnisse deuten darauf hin, daß im Herbst Felsgeröll ein von den Nordfledermäusen häufig genutzter Lebensraum ist, und zwar über die ganze Periode hinweg, bis die Aktivitäten der Fledermäuse im Hebst enden. Temperaturmessungen lassen darauf schließen, daß dieser Lebensraum auch als Winterquartier für die Fledermäuse geeignet sein kann, aber wir haben bis jetzt noch keinen Anhaltspunkt dafür, der dieses Verhalten bestätigt (aber im Gegensatz zu Höhlen und Stollen ist das Beobachten der Fledermäuse im Geröll mit Schwierigkeiten). Andere Arten, wie das Braune Langohr (Plecotus auritus) und eine unbestimmte Myotis-Art, sind ebenfalls dabei beobachtet, daß sie im Herbst über Geröll hinwegflogen, aber es ist noch kein Versuch gemacht worden, diese Arten im Geröll aufzuspüren. Warum die Fledermäuse in das Felsgeröll eindringen und welche Arten diesen Lebensraum als Quartier nutzen, wird weiterhin erforscht.

Literature

Aune, B., & The Norwegian Meteorological Institute (1993): National atlas of Norway: Monthly temperature. The Norwegian Mapping Authority, Hønefoss.

Gerell, R., & Rydell, J. (2001): *Eptesicus nilssonii* (Keyserling et Blasius, 1839) - Nordfledermaus, p. 561-581. In: Krapp, F. (Ed.): Handbuch der Säugetiere Europas. Bd. **4**: Fledertiere. Teil 1: Chiroptera I. Aula-Verlag. Wiebelsheim.

Kooij, J. van der (1999): Northern bat Eptesicus nilssonii found in a scree. Fauna **52**, 208-211. Oslo.

Masing, M., & Lutsar, L. (2007): Hibernation temperatures in seven species of sedentary bats (*Chiroptera*) in north eastern Europe. Acta Zool. Lituanica **17**, 47-55.

Michaelsen, T. C., Anonby, J. E., Olsen, O., Grimstad, K. J., & Soot, K. M. (2003a): Bat phenology in western Norway. Fauna **56**, 120-130. Oslo.

-, Grimstad, K. J., Soot, K. M., Heggset, J., & Jordal, J. B. (2003b): Kartlegging av flaggermus i Møre og Romsdal. Kunnskapsstatus 2002 [Bats in Møre of Romsdal county]. Report no. **10**. The Norwegian Zoological Society. Oslo.

-, -, & Anonby, J. E. (2004): Some interesting discoveries of day roosts for bats in Norway. Fauna **57**, 54-61. Oslo.

Moen, A. (1998): National atlas of Norway: Vegetation. The Norwegian mapping authority. Hønefoss.

Rydell, J. (1989): Cellars as Hibernation Sites for Bats. Fauna och Flora **84**, 49-53.

R development core team (2007): R: A Language and Environment for Statistical Computing. R. Foundation for Statistical Computing. Vienna.

Siivonen, Y., & Wermundsen, T. (2008): Characteristics of winter roosts of bat species in southern Finland. Mammalia **72**, 50-56.

Tore Chr. Michaelsen, Biological Institute, University of Bergen, NO-5007 Bergen/Norway;
E-Mail: tore.michaelsen@student.uib.no
Karl Johan Grimstad, Brandal, NO-6060 Hareid/Norway. E-Mail: karljogri@tussa.com