

Adit Surveys 2014-2016, the story so far.

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Introduction

Hibernation surveys within lead mine adits in Cumbria began in January 2014.

The surveys are based around Nenthead in Cumbria. This area was a centre for lead mining and there are many remaining adits that are open and safe to access. Adits, or levels, were the main horse access routes into the lead mines, used to bring the ore to the surface for processing. The adits are level tunnels between 1-2m wide and from 1.5-2.5m high with small stone blocks used to construct the walls and arched roof. The arching provides many crevices for bats to hide within, and no doubt there are many more crevices behind these which we cannot see. There are some short sections of rock cut and shale cut tunnel between sections of arching that are included within the survey area. The majority of the adits we survey still lead into extensive mine systems.

Bats have been found in some, but not all, of the adits checked and several of the sites are now registered with the Bat Conservation Trust's National Bat Monitoring Programme. The surveys are undertaken by members of Northumberland and Cumberland bat groups.

Methodology

The adits are searched systematically working inwards, until either the end of the stone arching is reached, the adit is blocked or fallen or it looks too unsafe to continue.

The temperature and humidity at each adit entrance is recorded. When a bat is found, the species is identified (if possible) and the temperature and humidity recorded from a spot below where the bat is roosting. The distance the bat is from the adit entrance is also measured to the nearest 50mm. Each team is led by a licenced surveyor and the recording of the bat and its location are done quickly and efficiently to prevent any undue disturbance to the bat.

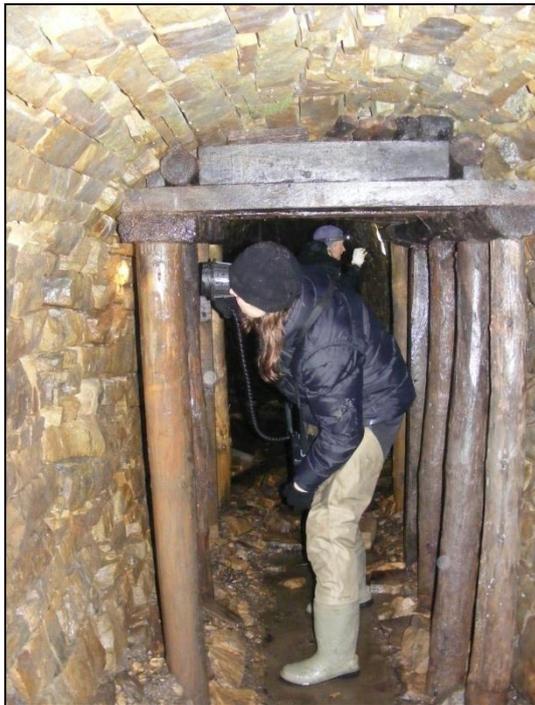
The temperature in the adits is variable; however further in the mines maintain a steady temperature of 11°C. The mines themselves are not searched for hibernating bats as it is assumed (possibly in error) that the internal temperature is too high for bats to maintain themselves in torpor.

Results

This data has been collected for twenty three bats found between January 2014 and February 2015. The species found hibernating in the adits are whiskered/Brandt's' bat *Myotis mystacinus/brandtii*, Daubenton's bat *M. daubentonii*,



Natterer's bat *M. nattereri* and brown long-eared bat *Plecotus auritus*.



Our results have shown that the temperature at which the bats have been found is variable, ranging from 0.5°C to 8.7°C. Dietz and Kiefer (2016) describe *Plecotus* species bats as cold hardy, tolerant of hibernation temperatures as low as 0°C and the small *Myotis* species, defined as whiskered bats, Daubenton's bats and Natterer's bats, as requiring temperatures between 4-8°C.

The data show a strong correlation between the external temperature and the internal temperature within the adit. The lower the temperature outside, the lower the temperature it is within the adit (see Figure 1).

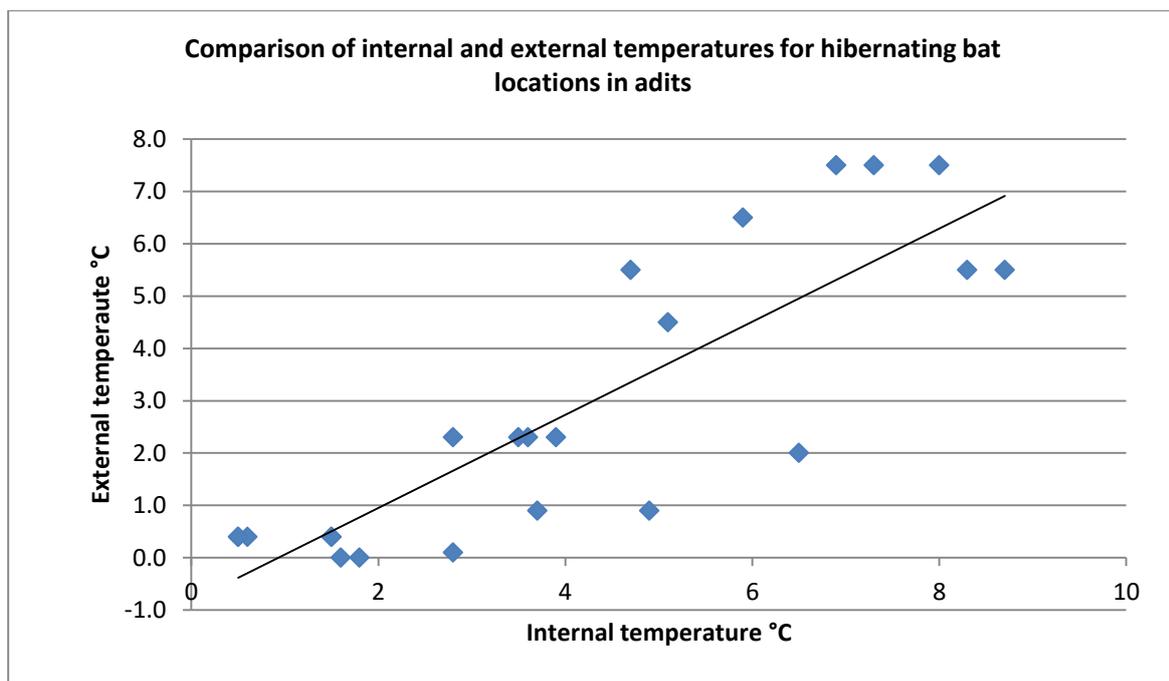


Figure 1 Comparison of internal and external temperatures for hibernating bat locations in adits.

There is also a direct relationship between the internal temperature and the distance from the entrance of the adit, the further the bat was in the adit the higher the temperature (see Figure 2).

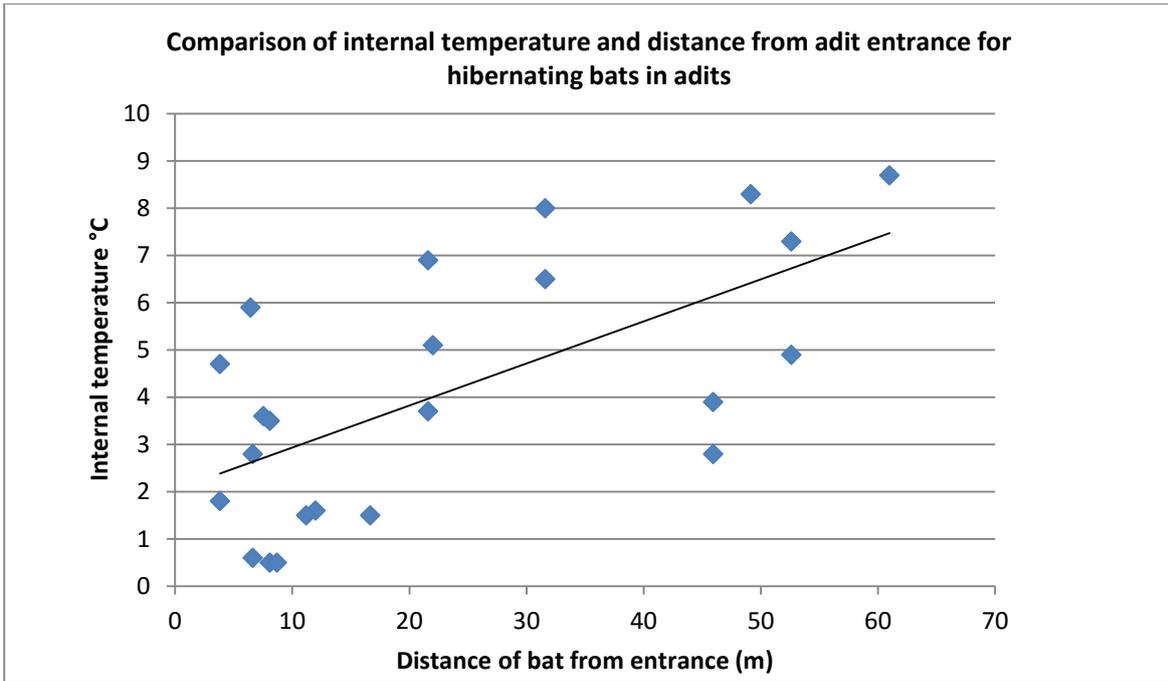


Figure 2 Comparison of internal temperature and distance from adit entrance for hibernating bats in adits.

Combining this data for all 23 bats shows the relationship between the internal and external temperature for each recording point and also shows the variation in temperature with distance into the adit (see Figure 3).

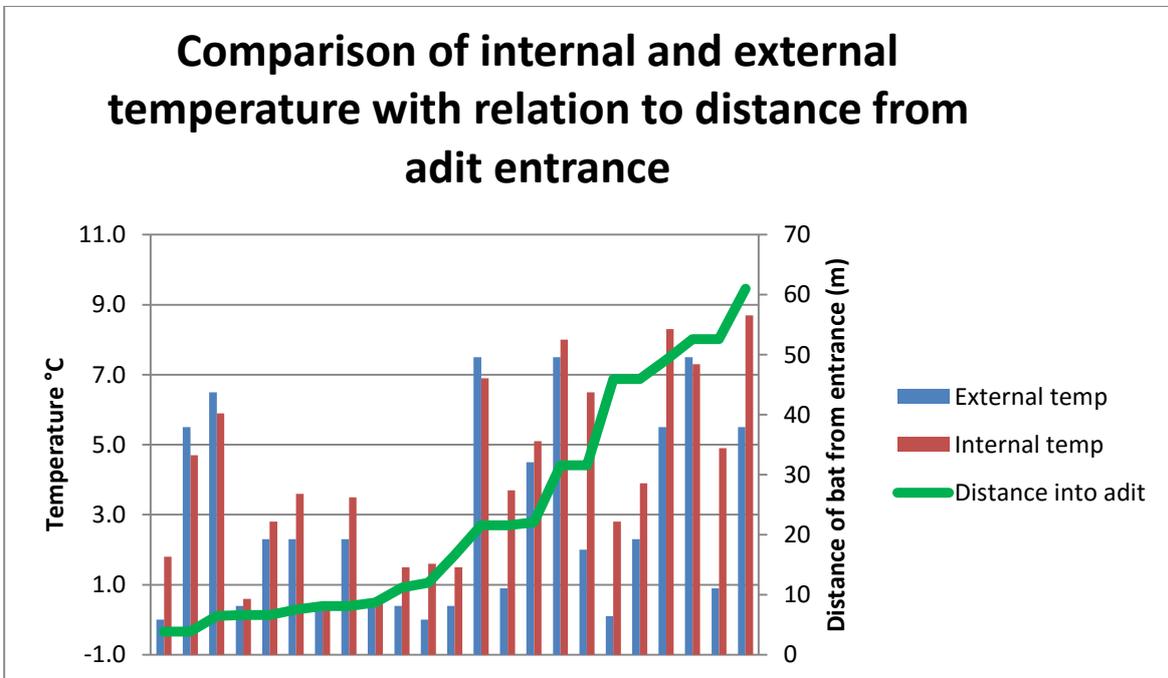


Figure 3 Comparison of internal and external temperature with relation to distance from adit entrance.

During the survey period seven individual bats have been refound in consecutive months. These bats have not changed their hibernation position and yet the internal and external temperatures have changed around them. This temperature change does not seem to have influenced the bat enough to have aroused and changed roost location (see Figure 4).

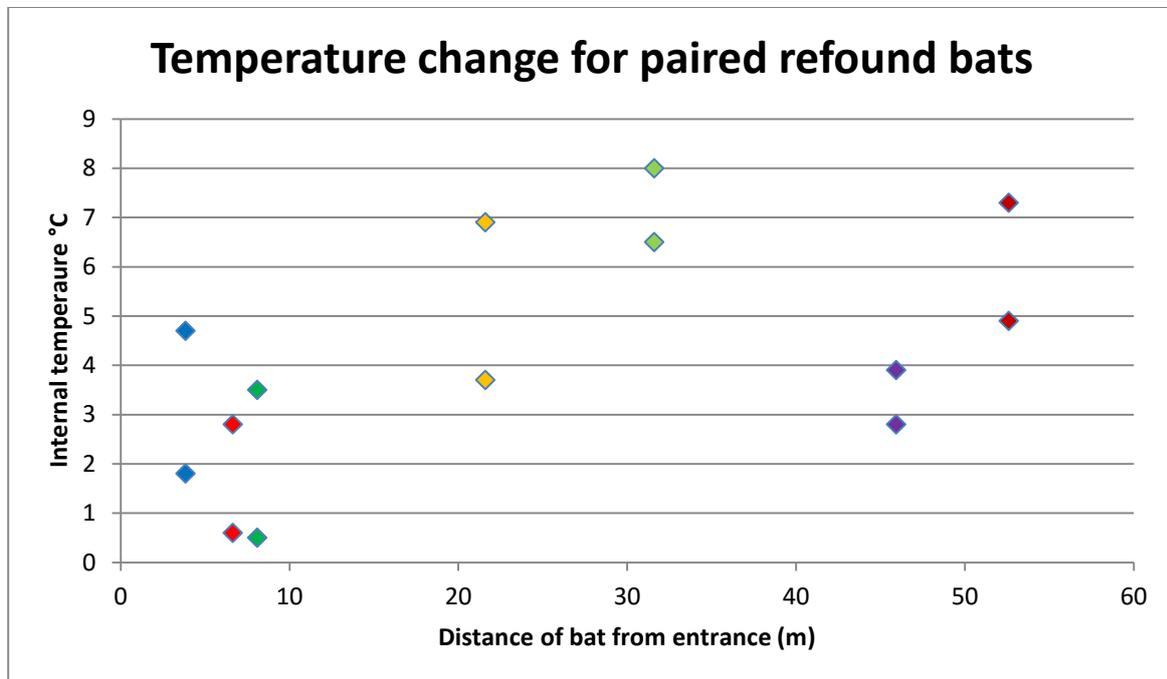


Figure 4 Temperature change for paired refound bats.

The temperature at which each bat is hibernating has varied between surveys. This is to be expected as the external temperature has changed between surveys and the internal temperature in the adit has changed as a result of the relationships shown in Figures 1 and 2.

Of the seven refound bats, three were first recorded on 17/12/2014 and were refound on 31/01/2015. The remaining four were found on 31/01/2015 and refound on 21/02/2015. None of the bats refound on 31/01/2015 were recorded again on 21/02/2015.

The temperature at which the three bats, two Daubenton's bats and a brown long-eared bat, recorded in December 2014 were hibernating at fell by an average of 2.4°C by January 2015. On this survey visit snow was lying up to 1m deep in places.

The remaining four bats, a Daubenton's bat and three Natterer's bats, all experienced a temperature rise of an average of 2.3°C between the surveys in January and February 2015. The second visit was undertaken in milder conditions, some pockets of snow remained but the temperature was higher during this survey than in January.

The changes in temperatures at which individual bats were refound varied; the smallest variation was +1.1°C and the largest variation was -3.2°C. The variation in temperature compared to the distance from the adit entrance can be seen in Figure 5. It can be seen that

the three bats closest to the entrance experienced a similar increase in temperature; these three bats were all in the same adit.

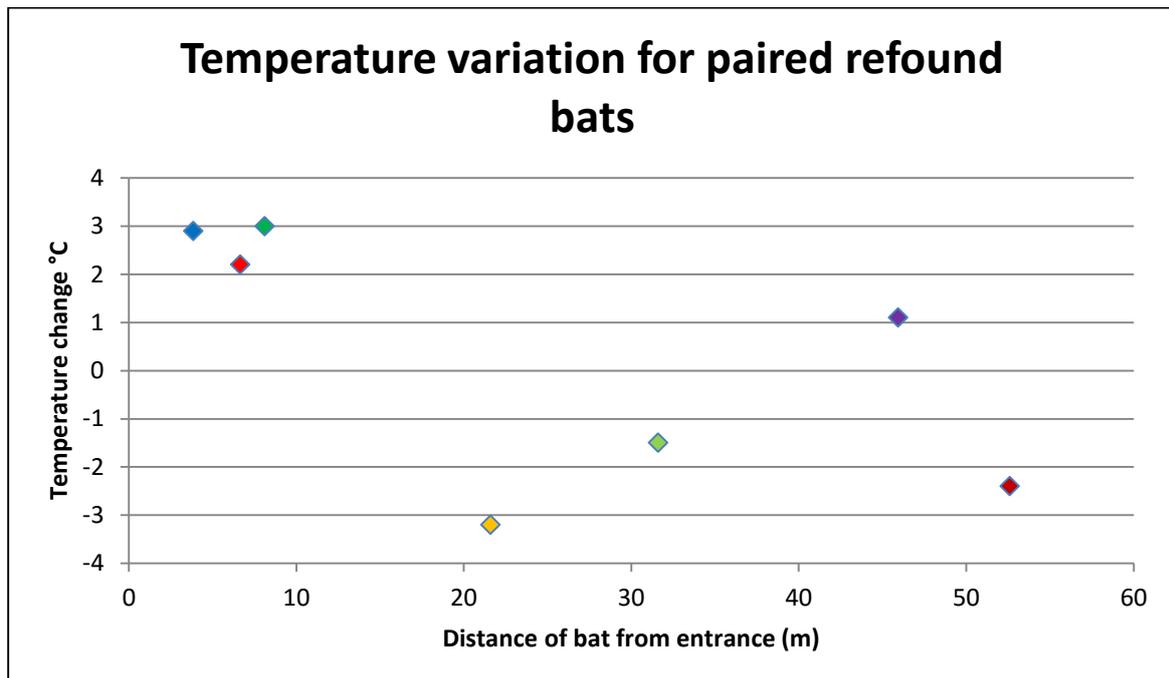


Figure 5 Temperature variation for paired refund bats.

Discussion

Hibernating bats have been found in surveys undertaken in December, January and February. Seven bats have been refound in consecutive surveys.

This data does confirm expected theories; the colder it is outside, the further the cold penetrates into the adit. This has a greater impact closer to the entrance.

This data is best illustrated by the paired bats; these bats have chosen to remain in the same location although the temperature at that point in the adit has changed. Three of the paired bats were first found in December 2014 and refound in January 2015, the average temperature change between these two surveys was -2.4°C . The other four paired bats were first seen in January 2015 and refound in February 2015, in this case the average temperature change was $+2.3^{\circ}\text{C}$. This fits the expected temperature change over the winter months with January being coldest month.

Interestingly, four bats found in January 2015 were not present in the same locations in February 2015. Is it possible that the temperature change was too great for these animals causing them to rouse and move between survey visits? The overall condition of each bat will also affect whether a bat rouses; an individual may be low on resources and need to forage when conditions are suitable in an effort to survive the winter period.

This data has a very small sample size and none of the results are statistically robust, however this subject is one for further research.

Acknowledgements

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References

Dietz, C., Kiefer, A. (2016) Bats of Britain and Europe. London.