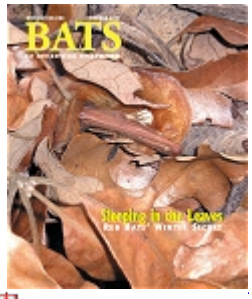

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Hibernation: Red Bats do it in the Dirt
Brad Mormann et al

Take a winter walk through the deciduous forests of the eastern United States. Notice the countless, colorful leaves scattered like a carpet beneath your feet. Reach for one as you imagine its long fall from the canopy to the windswept forest floor. At that point, you just might notice your leaf has a rather shaggy outline and what looks very much like an ear. You would probably take a surprised step backward if your oak leaf suddenly spread its wings and flew off into the dwindling evening light.

We have found that at least some eastern red bats (Lasiurus borealis), though they often migrate long distances to avoid severe northern winters, may nonetheless hibernate in cool climates and survive by snuggling into the leaf litter of the forest floor.

The eastern red bat is a relatively abundant species that, during the summer, roosts in foliage throughout the eastern United States and much of Canada. Because it does not hibernate in caves, it has been assumed that most red bats migrated to areas that are warm enough for them to remain active and find food.

Yet wildlife and forest managers from many parts of North America have noted over the years that these bats are sometimes seen flying out of leaf litter ahead of winter burns used in forest management. These observations, along with our recent research, confirm that red bats do enter and leave leaf litter on the floors of forests during winter.

The specific environmental conditions that cause red bats to move from tree roosts to the ground, however, and what's needed for leaf-litter roosts to provide adequate winter protection have remained mostly unknown. Also unclear are the physical abilities that allow this species to withstand extended periods of subfreezing weather conditions with limited and unpredictable opportunities to forage for insects.

Our lab at Southwest Missouri State University in Springfield explored these open questions by capturing and tracking red bats in southern Missouri and studying roost selection and roosting behavior. We also examined the eastern red bat's thermoregulatory abilities and behavior under simulated winter conditions in the lab.

During a series of warm December days, we captured a male red bat and tagged it with a tiny radio transmitter. Tracking this bat showed it foraging for insects each night and roosting by day in cedar trees. When a cold spell drove temperatures below freezing, however, the radiotracking signal came not from the previous day's roost, but from somewhere on the ground nearby. Following the signal through the forest, we repeatedly circled a small area without finding the source of the signal. We finally pinpointed a spot beneath a small cedar tree. Upon removing a few fallen leaves, we found our bat deep in torpor.

Torpor is a state, similar to hibernation, in which an animal's pulse, respiration and overall metabolism are drastically reduced, with a corresponding reduction in energy needs.

We tracked this red bat and five others (all males) throughout the winter to a variety of oak-dominated leaf litter. The depths and conditions of this litter changed daily as wind, rain, snow and ice shifted and packed the leaves. Some bats became totally exposed to the environment and potential predation, but no mortality occurred – perhaps because of their strikingly effective camouflage coloring.

During warmer periods, the bats would emerge from their ground roosts, forage for insects and spend their days in tree roosts of eastern red cedar or red or white oaks with a few persistent dead leaves. Videos of this behavior show the bats slowly emerging from beneath the leaves and, after a visual and acoustic perusal of their immediate environment, launching themselves into the air.

Movement of red bats from a tree roost into the leaf litter usually occurred when temperatures dropped below freezing. As temperatures warmed again, some bats would return to tree roosts while others remained under the leaf litter. Interestingly, all of the 13 leaf-litter roosts we examined were located on exposed southern slopes with similar ecological conditions.

In the laboratory, we analyzed the physiological and behavioral responses of several captive red bats to simulated winter conditions, including unpredictable food supplies. (These bats were evenly divided between males and females and behaved in similar fashion.) We found that, when exposed to cold temperatures, the bats periodically and spontaneously aroused from torpor, and their body temperatures fluctuated accordingly. These arousals may provide the bat with an opportunity for feeding and/or routine maintenance.

Our data also suggest that the duration and frequency of these arousals is highly dependent on temperature. As the mimicked winter season progressed and temperatures fell within each individual's enclosure, the activity level of each bat decreased. When temperatures reached their lowest, all bats dropped into the leaf litter at the bottom of each enclosure. Bats that consumed larger amounts of their food rations (mealworms) stayed in the leaf litter longer than those that ate less food.

The idea of bats roosting in leaf litter is hardly a mind-boggling notion when you consider the numerous species of wildlife – from eastern box turtles to sage grouse – that directly or indirectly use leaf litter as a barrier against harsh climatic conditions. Leaf litter provides a buffer that reduces heat loss and offers shelter from the chilling wind. As a result, such roosts in our research area effectively buffered bats from low ambient temperatures and rarely dropped below freezing, even when covered by snow and ice.

These red bats feasted on the insect flights of warm, winter evenings, when few other bats were around to compete. (Some evening bats [Nycticeius humeralis] were also captured and tracked during the winter.) Among future research plans, we hope to study the bats' response to controlled fires, which disrupt winter torpor, eliminate roosting habitat and sometimes prove fatal to individuals that are too deep in torpor to escape.

The next time you find yourself hiking through the woods on a warm winter evening, keep your eyes peeled for a leaf that suddenly flies away – demonstrating a remarkable adaptation to an environment that had been considered out of bounds for winter bats.

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