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Hide and Seek: In Search of Forest Bats
The difficult job of tracking bats through forests pays off when researchers get to observe their roosts and foraging behavior . . .
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By Robert M. R. Barclay and R. Mark Brigham

It was humid and hot--95 degrees Fahrenheit--in the southern interior of British Columbia, Canada. For more than 20 minutes we had been scrambling up a steep, forested slope, stumbling over hidden logs, sweat streaming off our foreheads. We were determined, however, to locate the tree roost of the California myotis (*Myotis californicus*) we were tracking. We had put a radio transmitter on the tiny bat the night before, and the beeping signal coming from the telemetry receiver was getting stronger--an encouraging sign that our goal was just a little farther up the hill.

Until our research team undertook this study in British Columbia's West Arm Demonstration Forest (WADF), almost nothing was known about the roosting ecology or behavior of the California myotis, one of the smallest bats in North America (weighing only four grams, or about one-seventh of an ounce). Indeed, until the last five years or so, the ecology of bats living in temperate forests had been relatively unstudied. After all, it's much easier to study the larger numbers of bats that congregate in buildings, mines, and caves.

In fact, interest in small, forest-dwelling animals of any kind has always been low. Most forestry-related studies concentrate on bears, wolves, and ungulates (deer, elk, moose). This is not the case in the WADF, however--a forest set aside specifically for experimental research by the British Columbia Ministry of Forests. Here there are ongoing studies of small mammals, songbirds, woodpeckers, and beetles, as well as other studies investigating climate, erosion, water quality, and silvicultural methods--all focused on the impact forestry operations have on different flora and fauna.

With heaving lungs and aching legs, we finally located the tree where the California myotis carrying the transmitter was spending the day. As it turned out, the bat's chosen tree was typical of more than a dozen roost sites we located over the next two weeks: a recently dead, tall, western white pine with loose bark peeling from the trunk, which provided a secure and dry roost for a colony of 52 pregnant females. Indeed, our study revealed that these bats prefer roosting under loose bark, while others, such as the silver-haired bat (*Lasionycteris noctivagans*), are often found in abandoned woodpecker holes or other narrow crevices. From a conservation perspective, the temporary nature of exfoliating bark means that bats using these cavities as roosts must continually search for new sites.

The common feature of the roosts chosen by these species of bats in B.C. (and other bats in forests all over North America), seems to be that they are located in large-diameter, tall trees that rise above the forest canopy in the open or on the edge of forest clearings; also, the trees are relatively early in the decay process. Such trees are probably most likely to have spaces to hold many individuals--spaces that receive warmth from the sun and are safe from terrestrial predators, yet are easily located and accessible for clumsy juveniles when they start to fly. Trees of this type, however, are not always abundant. In a study of little brown bats (*Myotis lucifugus*) in the boreal forest in northern Alberta, graduate student Lisa Crampton found that suitable roost trees were only available in old-growth forest stands. Five hundred miles southeast, in the mixed coniferous-deciduous forest of the Cypress Hills, Matina Kalcounis, another graduate student, found that big brown bats (*Eptesicus fuscus*) selected the same attributes. In fact, every suitable tree Kalcounis checked had evidence of use by bats.

Harvesting old-growth stands may also have negative impacts on foraging by bats. There is mounting evidence, exemplified by Lisa Crampton's work, that bats spend more time foraging in gaps in old growth forests than they do in younger forests, perhaps because insects are more abundant in these locations. Paul Bradshaw's University of Regina study in three different old-growth forest stands on Vancouver Island added a further element to the complexity of how bats use forest habitats. Bradshaw regularly detected bats foraging near the tops of old growth trees--some of which tower more than 320 feet above the forest floor.

The problem is that old stands, which contain large trees, are the most desirable for forest harvesting. The effects of harvesting on animals seem to be, to a large degree, specific to the type of animal. Some species benefit, while others are negatively affected. The challenge is to integrate what we learn about the different animals to develop long-term plans. At a recent workshop for WADF researchers, participants concluded that no one system of harvesting (for example, clear-cutting or partial thinning) should be applied everywhere. To minimize negative effects and maintain healthy, productive forests, it is likely that a variety of systems will be required. In fact, even old fashioned horse logging has recently been used in this forest.

Our next day of tracking was as steamy as the first, and the sun's hitting the south-facing slope only added to the heat. But we moved purposefully up the hill, knowing the route and anticipating that the radio-tagged female would be in the same location. To our surprise, however, she had moved to another large, dead tree several hundred yards away from the first roost; this time a ponderosa pine. When we watched the tree from a distance that evening, only 32 bats exited from beneath some loose bark.

The frequency of movement between roosts, and the apparent lack of cohesiveness in "colonies" has probably been the biggest surprise we have encountered in our work to date. Roost-switching represents behavior opposite to the high degree of site fidelity exhibited by bats roosting in buildings or caves. Without any human disturbance, individuals move between tree roosts on a regular basis, sometimes to a site only yards away, but in other cases to trees nearly a mile away. Females will move even while nursing their dependent young, presumably carrying the pup from one tree to the next during the night. Why they do this is a fascinating question that current research is attempting to answer. Perhaps bats move to confuse potential predators such as weasels and squirrels. Perhaps moving reduces the load of parasites such as ticks, fleas, and mites that can build up in roosts. Or perhaps different trees offer appropriate microclimates, depending on whether it is sunny and hot or cool and wet. Whatever the reason, the bats' willingness to move in spite of the cost indicates that it is an important behavior for the well-being of the bats.

From a conservation perspective, the fact that each individual bat uses several suitable roost trees in its home range--rather than just one that houses a large, stable colony--means that we must view both the forest and bat populations from a larger, landscape scale when making recommendations on how to protect critical bat habitat. We cannot simply save particular trees; significant areas of forest with appropriate types of trees must be preserved.

After the female California myotis emerged from her tree, we tried to follow her to find out where she fed and how important the forest was to her as a feeding area. She had a distinct advantage--the ability to fly downhill while we stumbled through the darkness, trying to keep up with the rapidly fading radio signal and struggling not to break anything valuable, such as the telemetry equipment . . . or our legs!

Various studies are showing that different species of bats prefer certain features of the forest as feeding areas. Graduate student Scott Grindal used bat detectors to find that bats in the WADF, including California myotis, feed in clearings, such as avalanche chutes or gaps created by fallen trees in older forest stands. Relatively little feeding activity occurs in dense forest. In areas where logging has occurred, by far the greatest bat activity occurs along the "edge," between intact forest and the cut areas--rarely in the middle of the clearcuts. Such large, open areas seem to be avoided by all but the largest and fastest flying bats, such as hoary bats (*Lasiurus cinereus*).

Forest managers thus have a problem if they wish to incorporate bat habitat concerns into an overall management

scheme. Maintaining edges such as those found associated with old stands, or creating them by harvesting in small patches, may increase bat foraging opportunities, while larger-scale harvesting may reduce not only foraging habitat, but roosting areas as well. Currently, large-scale experiments are investigating the ecological impacts of different harvesting designs, and bats are an integral part of the study. Given that bats are key predators of nocturnal flying insects, and thus may be important predators of forest pests, forest managers have a strong incentive to understand more fully the interaction between bats and the forest ecosystem.

Some bats, such as little browns and Yuma bats (*Myotis yumanensis*), regularly feed near or over bodies of water. John Hayes, a bat researcher at the Hatfield Marine Science Center in Portland, Oregon, found that along riparian areas in western Oregon, bat activity was up to eight times higher in forested parts of streams than in areas that had been logged. This activity was related to greater insect abundance in the wooded sections--a relationship that reinforces the need to maintain natural habitats within forested landscapes, not just the trees themselves.

Over the next two weeks, the female California myotis we were tracking used four different roost trees--some that she returned to several times and others that she used for only one night each. The number of bats with which she roosted changed from night to night. Unfortunately we had only a small window of time during which we could follow her behavior because the transmitter eventually fell off. Thus we do not know whether she lived with an extended colony of bats. It is possible that a large group of individuals occupies an area of forest using many roosts, rather than a single, more permanent site. This will be a challenging question to answer with future research.

Insights into the use bats make of forests will help forest managers integrate features that bats require into forest management plans. Attitudes and interest in bats have already changed dramatically among forestry professionals. At the October 1995 Bat-Forest Symposium we organized in British Columbia, more than 100 university and government scientists, wildlife managers, foresters, and forest industry personnel from as far away as England convened to talk about recent findings concerning the important roles bats play in forest ecosystems and how best to preserve bat populations in forested areas. Interest was so great that we reluctantly had to turn people away. The conference room was simply too small.

British Columbia forester Larry Price is charged with the task of integrating the data collected in the WADF into forest management plans being produced for decades to come. He uses powerful computer modeling techniques that allow inclusion of information from a wide variety of sources. Simulations can then be run to make predictions about how forests will look centuries from now.

For bats, some crucial features seem similar from forest to forest and species to species; older forests seem particularly important, especially for roosting. In other respects, each species of bat is unique and some, such as the western long-eared bat (*Myotis evotis*) studied by graduate student Maarten Vonhof, seem particularly flexible in their roost selection. Vonhof and others have followed tagged individuals to roosts in old trees, rock crevices, and even short stumps left after logging operations. As Rachel Krusic's work in the White Mountain National Forest in New Hampshire indicated, a landscape with a matrix of habitats that includes different forest ages, gaps, and bodies of water may fulfill the requirements for all bats in an area.

Bat researchers and forest managers must determine the extent of differences between species and make recommendations that will preserve the diversity of forest features required by the entire bat community in an area. It is a daunting task, but one that promises to be exciting, and one that must be accepted now. It is our plan to continue this work, but as we age, perhaps we should be looking for a flatter study site!

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Robert M. R. Barclay is a professor of Biological Sciences at the University of Calgary in Alberta. He has been studying the ecology and behavior of bats for over twenty years but still has more questions than answers.

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Copies of the Proceedings of the Bat-Forest Symposium, which provide a more comprehensive review of current research, are available free of charge by writing to the British Columbia Ministry of Forests, Forestry Division Services Branch, Production Resources, 595 Pandora Ave., Victoria, BC V8W 3E7 Canada. (Working Paper 23/1996, 292 pp., Barclay, R.M.R., and R.M. Brigham, editors).

For Further Reading

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Author Robert Barclay and son Graham listen for transmitter signals from a radio-tagged bat. Tracking a bat

involves following it wherever it goes, whether that means pursuing in a truck as it flies, or climbing to find the exact tree in a forest where the bat has chosen to roost.

The California myotis is one of North America's smallest bats, weighing less than a nickel. It is quite a feat to find such a tiny bat concealed in a roost crevice amidst acres of forest.

(From left) Barclay, son Graham, and author Mark Brigham take a break during tracking.

Researcher Matina Kalcounis scales an old-growth aspen tree, which she discovered to be a preferred roost of big brown bats in the Cypress Hills in Saskatchewan.

The authors' research revealed that, in their study area, the California myotis favored trees such as this one, which rises above the forest canopy (left) and has peeling bark under which the bats can roost (right, close-up view).

This clearcut in the West Arm Demonstration Forest has left an edge on the forest, where researchers are finding some bats prefer to feed. The large opening that is left, however, is of little use.

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