

- ROBB, J. R., M. S. CRAMER, A. R. PARKER, AND R. P. URBANEK. 1996. Use of tree cavities by fox squirrels and raccoons in Indiana. *Journal of Mammalogy*, 77: 1017-1027.
- SASSE, D. B., AND P. J. PEKINS. 1996. Summer roosting ecology of northern long-eared bats (*Myotis septentrionalis*) in the White Mountain National Forest. Pp. 91-101, in *Bats and forests* (R. M. R. Barclay and R. M. Brigham, eds.). Research Branch, Ministry of Forests, Victoria, British Columbia, Canada.
- SPARLING, D. W., AND G. L. KRAPU. 1994. Communal roosting and foraging behavior of staging sandhill cranes. *The Wilson Bulletin*, 106:62-77.
- TAYLOR, R. J., AND N. M. SAVVA. 1988. Use of roost sites by four species of bats in state forest in south-eastern Tasmania. *Australian Wildlife Research*, 15: 637-645.
- TIDEMANN, C. R., AND S. C. FLAVEL. 1987. Factors affecting choice of diurnal roost site by tree-hole bats (Microchiroptera) in south-eastern Australia. *Australian Wildlife Research*, 14:459-473.
- TUTTLE, M. D., AND D. L. HENSLEY. 1993. The bat house builder's handbook. Bat Conservation International, Austin, Texas.
- TUTTLE, M. D., AND D. STEVENSON. 1982. Growth and survival of bats. Pp. 105-150, in *Ecology of bats* (T. H. Kunz, ed.). Plenum Press, New York.
- VAN HEERDT, P. F., AND J. W. SLUJTER. 1965. Notes on the distribution and behaviour of the noctule bat (*Nyctalus noctula*) in the Netherlands. *Mammalia*, 29:463-477.
- VONHOF, M. J. 1996. Roost-site preferences of big brown bats (*Eptesicus fuscus*) and silver-haired bats (*Lasionycteris noctivagans*) in the Pend d'Oreille Valley in southern British Columbia. Pp. 62-80, in *Bats and forests* (R. M. R. Barclay and R. M. Brigham, eds.). Research Branch, Ministry of Forests, Victoria, British Columbia, Canada.
- VONHOF, M. J., AND R. M. R. BARCLAY. 1996. Roost-site selection and roosting ecology of forest-dwelling bats in southern British Columbia. *Canadian Journal of Zoology*, 74:1797-1805.
- WILKINSON, G. S. 1992. Information transfer at evening bat colonies. *Animal Behaviour*, 44:501-518.

Submitted 25 March 1998. Accepted 23 June 1998.

Associate Editor was C. Renn Tumlison.

Aspen

BAT ACTIVITY IN THE BOREAL FOREST: IMPORTANCE OF STAND TYPE AND VERTICAL STRATA

M. C. KALCOUNIS, K. A. HOBSON, R. M. BRIGHAM, AND K. R. HECKER

Department of Biology, University of Regina, Regina, Saskatchewan, Canada, S4S 0A2 (MCK, RMB, KRH)

Environment Canada, Canadian Wildlife Service, Prairie and Northern Region, 115 Perimeter Road, Saskatoon, Saskatchewan, Canada, S7N 0X4 (KAH)

Present address of MCK: Department of Zoology, University of Western Ontario, London, Ontario, Canada, N6A 5B7

Present address of KRH: Department of Biology, Carleton University, Ottawa, Ontario, Canada, K1S 5B6

1999

We examined habitat use by bats in the boreal forest of central Saskatchewan during summer 1995 by monitoring echolocation calls across forest types and through the canopy of mature forest. We sampled bat activity in mature aspen (*Populus tremuloides*)-white spruce (*Picea glauca*) mixedwood, aspen, and jack pine (*Pinus banksiana*) stands and recorded passes from little brown (*Myotis lucifugus*), northern long-eared (*M. septentrionalis*), big brown (*Eptesicus fuscus*) or silver-haired bats (*Lasionycteris noctivagans*), and hoary (*Lasiurus cinereus*) bats. There were significantly more bat passes per night in the aspen-white spruce mixedwood forest than in aspen or jack pine forest. There was no difference in the proportion of feeding buzzes recorded from aspen-white spruce mixedwood and aspen forest. In aspen forest, mean number of hoary bat calls per night was higher above than below the canopy, whereas number of *Myotis* calls was higher within and above the canopy than below the canopy. There was no difference in the number of feeding buzzes recorded among the three canopy heights. Bat activity peaked toward sunset below the canopy but was more uniform within and above the canopy. Our results highlight the importance of mature aspen-white spruce mixedwood and aspen forest as habitat for boreal forest-dwelling bats and demonstrate for the first time that insectivorous bats are active both within and above canopy levels of the boreal forest.

Key words: Anabat, bats, bat detector, boreal forest, echolocation, habitat-use, foraging, forest type, forest canopy

Several studies have examined habitat use, in particular foraging activity, by bats in high-latitude temperate forests of North America (Grindal and Brigham, in press; Kalcounis and Brigham, 1995; Thomas, 1988). However, to our knowledge, only one previous study has been conducted on bats in boreal forest (Crampton and Barclay, in press). Those authors determined the relationship between habitat use by bats and stand age in aspen-dominated mixedwood forest and found that foraging activity was most intense in mature stands and bats roosted exclusively in old stands. Crampton

and Barclay (in press) hypothesized that key structural attributes of older stands included presence of old trees and gaps in the canopy, which provided roost sites and foraging locations, respectively. Although evidence that bats prefer older stands is convincing, it is not clear how bats respond to structure and vegetative composition among different types of mature boreal forest stands.

The influence of habitat structure on animals has long interested ecologists (e.g., MacArthur, 1958). Heterogeneity is an intrinsically important and defining attribute