Bats and Forests

R. MARK BRIGHAM AND ROBERT M. R. BARCLAY

ABSTRACT

Until recently, the majority of ecological research on microchiropteran bats, and in particular vespertilionids in temperate parts of the world, was biased towards species and situations where aggregations occurred in human-made structures (buildings and mines). However, significant progress has been made to address questions about the ecology of temperate, insect-eating bats living in more "natural" situations. Even so, our knowledge about how bats use and interact with forest ecosystems is still in its infancy.

In the last five years, intrinsic interest and concern about the impacts of timber harvest and forest management has stimulated various studies of bats in forest ecosystems. Studies of bats have also become a focus for a variety of agencies, especially those who are mandated to manage natural resources on public lands. Therefore, we felt it was appropriate to convene a symposium bringing together biologists, foresters, and land managers with an interest in bat–forest interactions to determine where we stand and to try to identify some common questions for further study. Our original idea was to have a small meeting. It quickly became apparent that there was interest from all over the continent, and indeed other parts of the world. The "small" meeting expanded to include over 100 participants and we could not accommodate everyone interested in attending. On the one hand, we were amazed and impressed by the number and diversity of people who were interested in the topic, but on the other we were disappointed that we had to turn some people away.

This volume presents the results of the symposium that took place from October 19–21, 1995 in Victoria, British Columbia, Canada. In all, 24 speakers gave presentations and there were three poster papers. We received manuscripts from the authors of almost all the papers, and they appear in this volume. In general, the presentations can be subdivided on the basis of what are acknowledged to be the two most important resources for bats: roost sites and foraging areas.

The three presentations at the beginning of the meeting were by individuals with forestry and/or wildlife expertise. These papers were designed to set the stage from a broad perspective. It became clear that forest management issues are complex and can be controversial. The message to biologists studying bats is that we have to be prepared to make recommendations about the best way to manage forests, knowing that

our understanding of the complexity of the system is incomplete and that modifications may be necessary as more information becomes available.

A recurring theme was emphasized by Brad Stelfox: bats have large home ranges for their size and travel considerable distances between roosts and foraging areas. This means that bats link habitats together, and we need to keep in mind the potential ecological and management implications of this. We need to know, for example, at what scale bats view the landscape. Our focus tends to be in terms of smaller scales, but given the movement patterns of bats they may well view things at the landscape scale, and this has important implications regarding the recommendations we make.

What follows is our impression of some of the important themes to come out of the symposium, with respect to the biology of bats in forest ecosystems, and where further work should be focused. This represents our opinions, although these were certainly modified and shaped during the excellent, two-hour discussion session at the conclusion of the formal part of the meeting. It speaks highly of the interest and dedication of those who attended this session that after eight hours of presentations and with a hot meal in the offing, most participants spent over two hours trying to bring everything together.

SPEAKING THE SAME LANGUAGE

To communicate effectively, scientists must speak the same "language," and it was evident during the meeting that even among bat biologists, some terms are used in different ways. The problem becomes worse when biologists try to use forestry terminology! We must become more aware of the correct use of "jargon," and work hard to use terms that transcend provincial, state, and national boundaries. What do we mean by "canopy" or "edge," and what attributes define "over-mature forest stands"?

ROOSTING

A large number of papers on a variety of species and geographical areas dealt with the roosting requirements of forest-dwelling bats. Two aspects in particular emerged from these talks. First, it is clear that tree-roosting bats typically select large (tall) trees in early stages of decay that are more open (uncluttered) than random (available) wildlife trees (see Betts; Crampton and Barclay; Kurta et al.; Sasse and Pekins; Vonhof). Although specific species of roost-trees differ from place to place, general attributes are similar, and one result is higher densities of roosting bats in older forest stands. Second, individual bats switch roosts on a regular basis (Betts; Crampton and Barclay; Kalcounis and Hecker; Kurta et al.; Ormsbee; Vonhof). Our concept of a "colony" may well have to change from the one we have developed by studying bats faithful to a building or cave. Although movement distances between roosts vary with the species of bat and the geographical area, individuals (including lactating females) use

several day-roosts and have larger home ranges than we would have expected. This has clear management implications and we must take a broader, landscape view of bat habitat. What is not clear is why bats switch roosts, and answering this question will be an important area for future research.

Several papers pointed out the need to understand not only the day-roost ecology of forest bats, but also the requirements for night roosts, and the use of roosts other than trees (Perlmeter; Pierson et al.). Especially in managed forests, roosts in bridges may play a key role as alternative night-roosts for bats. Information is lacking on the use of natural night-roosts and their importance.

Participants agreed that future studies of tree-roosting bats should attempt to measure the same set of roost, tree, and site characteristics so that studies will be comparable and a general picture can be developed, if it exists. At a minimum, the following should be measured: roost entrance height and aspect, tree height, DBH, decay stage, percentage of bark remaining, horizontal distance to and height of the nearest tree, horizontal distance to the nearest wildlife tree, horizontal distance to and height of the nearest tree of the same height or taller, canopy height, horizontal distance to the nearest edge (opening), horizontal distance to the nearest water, live-tree density, wildlife-tree density, and percentage of canopy closure.

FORAGING

Almost without exception, papers dealing with habitat selection by foraging bats used some type of ultrasonic detector to monitor echolocation activity. There was considerable debate as to the level of species identification that can be achieved using detection systems, and the caution must be that identification needs to take into account the natural variation of calls used by each species. Within a species, calls differ between individuals, foraging situations, and geographical areas. In particular, calls recorded from known individuals for use in identifying unknown bats must come from free-flying individuals. Calls produced by captive bats in enclosed spaces are unlikely to accurately reflect calls produced in the wild.

Various papers illustrated that bats prefer certain habitats for foraging. Edges (vertical and horizontal) seem to be important, both as commuting and foraging corridors (see Bradshaw; Grindal; Krusic and Neefus; Parker et al.), and riparian zones are areas of high bat activity (see Hayes and Adam; Parker et al.). Harvesting creates edges used by bats, but several papers indicated that bats were not abundant in large openings, including clearcuts (see Crampton and Barclay; Grindal; Hayes and Adam; Perdue et al.). Stand age also influences bat activity, with young stands usually having low activity and more heterogeneous, open, older stands having higher activity (Crampton and Barclay; Erickson), although some of this results from bats commuting from roosts in old stands.

Aside from the aspects mentioned above, several important areas for future work came to light as the meeting progressed. Not only should we experimentally test the various hypotheses to explain roost switching, we also need to consider the ecological and management consequences of switching. What is the social structure of colonial bats in the forest? Are individuals faithful to a series of roosts within and between years? Why do individuals travel as far as they do between roost sites and foraging areas, and what are the ecological consequences of this behaviour?

Information regarding the abundance and diversity of insects in different types and ages of forests or in different habitat types was lacking. We need to know not only what is available to bats in different areas, and whether this influences where they feed, but also the impact that bats have on forest pest species. Although we say that bats are the major predators of nocturnal, flying insects, and assume they have a significant impact on pests, we need hard evidence of this. Likewise we need further research on the effect that bats have on nutrient dynamics within forests. Elucidating these roles will help to place bats in perspective in forest ecosystems.

Finally, participants agreed that we need to follow up on recommendations and to monitor the effectiveness of management practices. As a greater diversity of forest harvesting regimes are used, it is essential to determine how bats respond so that we can "adaptively manage" and adjust recommendations as the gaps in our knowledge are filled. We have come a long way in a relatively short time, and with the interest shown at this meeting, progress should be rapid and we will hopefully need to meet again in a few years.

SECTION I THE BIG PICTURE