

Do Large Colonies Create Long Commutes? Examining *Myotis* Bat Foraging Distance and Duration

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Introduction

Each spring and summer the largest known bat colony in Washington state, a mixed-species maternity colony of Little brown and Yuma bats (*Myotis lucifugus* and *M. yumanensis*, or "MYLUYU") roost in an abandoned railroad pier near Olympia, Washington (Fig. 1). The bats begin arriving in April, have their young in early June. After the young disperse within a few days, the colony declines as the bats disperse only a few remain by September. Based on examination of bats in the hand, it appears that nearly all of the bats roosting in the pier are Yuma bats or Little brown bats (Gaspari 1994) by examining the skulls of specimens (Schiato 2003, pers. comm.) and in 2004 by the author collecting time-of-day (TOD) data (for bats foraging) and using a genetic detector and analyzing the calls with SonoBat software (Pettersson Elektronik, Sweden & SonoBat, Arcadia, CA). In the coastal Pacific Northwest these 2 species are extremely difficult to distinguish by morphological features (Harris 1974) and identification between these two in the hand is unreliable without the aid of genetic analysis or DNA barcoding (for bats foraging, pers. comm.). Both species are considered to be insectivorous, aquatic emergent insects (Birgman et al. 1992); and this study supports earlier reports that these two species will use similar resources for maternity roosts (Nagorski & Birgman 1993).

The roost area is bordered by saltwater inlets of Puget Sound to the north and east, semi-rural open and wooded land to the south and west which then transitions into urban areas 6-10 km from the maternity roost. We identified 15 foraging areas foraging areas, 10 wetlands located 2 and 6 km to the south of the roost and for their nightly activity alternate between bouts of foraging and periods of night roosting. This nightly pattern is widely reported for insectivorous bats. Both of these assumptions generally proved to be wrong for this group.



Figure 3. Capitol Lake, Olympia, Washington. One of the distant feeding areas for the bats from the maternity roost. Bats roosted continuously for nearly 6 hours before returning to a day roost, with no rest breaks or night roosting.

Methods

We monitored the maternity colony population with (emergence) counts per night from late March to early October, 2003 and 2004. We captured bats leaving the pier with mist nets on 16 nights between mid-April and late August both years. We used SkinBond adhesive to attach radio-tags with a 12-day battery life (36 gram LB-2N, Hoholi Systems) to 4 pregnant and 6 post-lactating bats (Fig. 2). We gathered an average of over 8 nights of foraging and night roosting behavior per radio-tagged bat. To permit intensive monitoring of the subjects' activities on a single night, the capture and handling of radio-tagged bats was limited to 15 minutes. We used a Yaesu FT-817 ham radio (VeriEx-Standard, Cypress, CA), omni-directional gain antenna, low-noise preamplifier, and digital audio processor (to reduce ignition noise). The observer then switched to a portable telemetry receiver and used either a 3 or 4-element handheld Yagi antenna to obtain directional information and "walk-in" locations on the bat. When a tagged bat's signal was lost or cut off by a tree, a search pattern was initiated from its last known position. Bats were tracked until the following day. Large movements such as switching day roosts separated by 19 km were successfully tracked, and a single bat crossing 2 Puget Sound inlets (in succession) were successfully tracked.

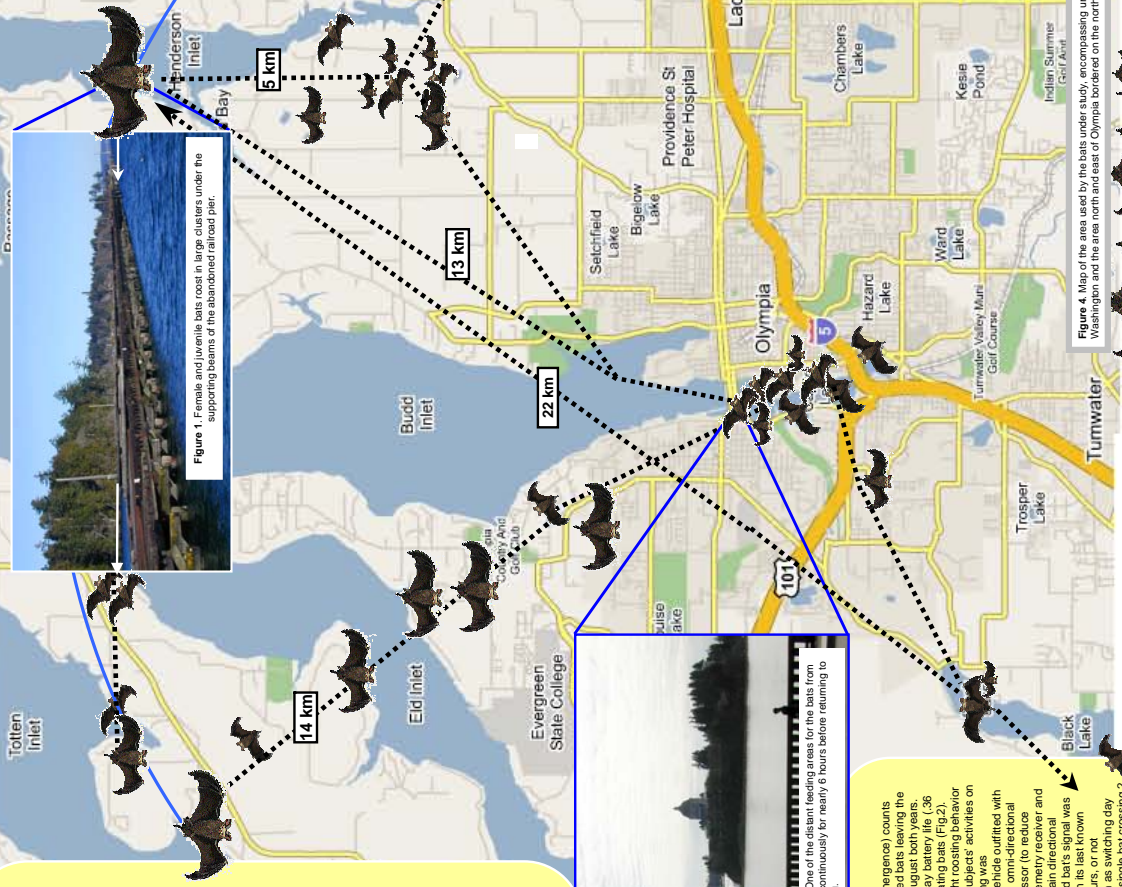


Figure 4. Map of the area used by the bats under study, encompassing urban Olympia, Washington and the area north and east of Olympia bordered on the north by Puget Sound.

BAT KEY

- Large Maternity Roost
- Small/Med. Roost
- Night Roost
- Non-Wooded Bay Myotis Foraging Area
- Wooded Bay Myotis Foraging Area



Figure 1. Female and juvenile bats roost in large clusters under the supporting beams of the abandoned railroad pier.

Results

Three of the 10 radio-tagged bats foraged for long periods with no night roosting observed, 3 others night roosted only when it started raining while they were involved in foraging, emerging shortly after the rain abated to continue foraging. The remaining 4 routinely roosted 2, or 3 times nightly, close to the feeding area (in cases a lake, large pond or open wetland) for between 1 and 3 hours. The day roost was located greater than 12 km. Five of the bats tagged at the large Woodard Bay colony commuted to a 250-acre urban lake (Fig. 3) a distance over 13 km from the capture location. Two of these bats were tracked to this distant lake on 6 consecutive nights each (one in July and one in August), and one of these travelled directly to the lake from the day roost, foraged non-stop for 5.75 hours, then travelled back to the roost for a total of 6.75 continuous hours "on the wing."

Discussion

These one-way commute distances ranging between 10 and 15 km are considerably greater than previously reported; studies and surveys for these 2 species indicate distances of <1 km to 8 km between day roosts and foraging areas (Barbour and Davis 1989; Barclay, pers. comm.; Henry et al. 2002; Johnson 2002). The non-stop flying for up to 6.75 hours was also unusual. Chruszcz & Barclay (2003) first reported insectivorous bats (Long-eared myotis, *Myotis evotis*) spending 90% of their out-of-roost time foraging. They felt this might be related to the species being near the edge of its range, exercising a flexible feeding strategy as they glean insects from surfaces as well as taking prey aerially. This would allow them to take advantage of the period between midnight and shortly before dawn when aerial insect counts are lower (Anthony et al. 1977), but insects on surfaces are still available for gleaning. However, since Little brown and Yuma bats are thought to be exclusively hawking (aerial) feeders, we expect that emergent aquatic insects are available all night at Capitol Lake during the summer months. Additionally, foraging in this region is not unusual, as the bats are found at that abundance range. The low prey density relative to the large roosts suggests that the bats need to feed over 5.5 hours should be enough time for a Little brown bat to fill its stomach several times (Barclay, pers. comm.). A recent hypothesis predicts that the relatively cool temperature of the Woodard Bay pier roost increases the energy requirement for bats foraging long forage the time. These bats in our study that night-roosted regularly (including nights with no precipitation) did so for only 10 to 40 minutes at a time, and rarely more than twice a night. Three bats were never observed night roosting when away from the day roost. It is also unknown why these bats regularly forage at greater distances than previously reported for Little brown or Yuma myotis. Possible explanations offered here included: greater competition for resources by a larger colony; the distant lake offers a superior forage opportunities; that the scale monitoring of individual bats reveals behavior that might be missed by less intensive methods.



Figure 2. *Myotis lucifugus* with 37 mm radio tag, ready for release at capture site (in this case the foraging area).

Conclusion

Our results suggest that aspects of the reported foraging behavior for small myotis bats is not applicable to this landscape, and that these small bats have the metabolic capacity and endurance to regularly make long commutes to feeding areas. Many forage long hours interrupted by little or no night roosting, then commute back to a distant day roost. The hypothesis made in 2003 that the large colony size at Woodard Bay forced these long distances in order to disperse over a larger feeding area was not supported by the 2004 data obtained from "MYLUYU" bats tagged at Capitol Lake which commuted just as far (up to 15 km) to small maternity roosts in entirely different areas (Figure 4). Whether the behavior of these bats is exceptional or if the methods employed facilitated more remote observations that might have been otherwise missed cannot be inferred from this general study, but tracking bats using the methods described here is a novel approach. The use of radio tags and the development methods for studies with larger sampling effort. Certainly the observation that the "signal was lost" should flag the need to reevaluate the assumptions regarding the range.

Because of our experience with a defective tag, we recommend performing distance tests on all radio tags prior to deployment on study subjects. We continue to investigate bat utilization at Capitol Lake using time expansion acoustic sampling methods to better identify the species and spatial distribution at this large foraging aggregation.

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