Emergence and Foraging Patterns of *Myotis lucifugus* and *M. yumanensis* Bats in the Southern Puget Sound Region

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Introduction

Two species of *Myotis* bats roost in a farmhouse located at The Evergreen State College in Olympia, WA. The farmhouse hosts more than 600 adult female bats in the spring and summer.

The foraging and emergence behaviors of these bats reveal important information about their metabolic abilities and habitat needs.

The interplay between abiotic influences, energetic needs, inter- and intra-species competition and predator avoidance impacts emergence and foraging behavior.

The little brown bat *Myotis lucifugus* and the Yuma myotis *M. yumanensis* were monitored for emergence patterns and foraging behaviors in 2005 and 2006.

Emergence patterns were examined for correlations with sunset, temperature, illumination and lunar phase. Emergence was most strongly correlated with time of sunset.

Two individuals were radio-tagged and tracked to document their commute distances and foraging times. Commuting distances were greater than others reported from prior studies.

Myotis lucifugus with Radiotag

The Evergreen State College Organic Farmhouse

Materials and Methods

Full spectrum echolocation calls from bats emerging from this nursery colony were recorded with a Pettersson D240x time-expansion bat detector. SonoBat software (SonoBat, Arcata, CA) was used to display and compare calls with a reference library of call samples of all species occurring in the region. The maternity roosting site was monitored on the north face of the farmhouse for one month in May of 2005.

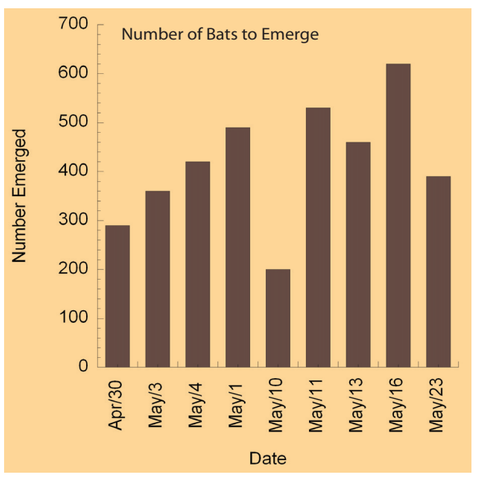
Time at initial emergence was recorded and the rate of exit was documented (time required for each 10 emergences). Emergence was declared complete after 6 minutes elapse with fewer than 5 bats exiting. Illumination was recorded in lux every 15 seconds.

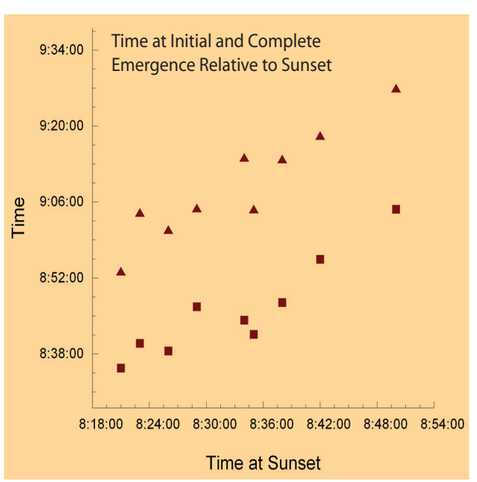
Onset of emergence and duration from initial emergence to full emergence were correlated with time of sunset, temperature, ambient light and phase of moon (quantified as percentage of moon face illuminated: 3%=new, 95%=full).

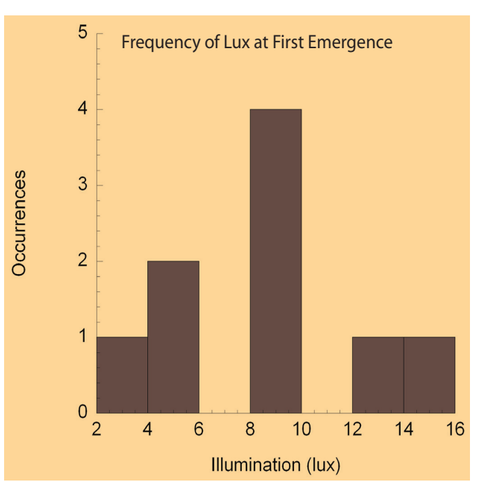
In late spring of 2006, two adult female little brown bats associated with this maternity roost were captured with mist nets, radio-tagged and tracked.

The bats were monitored continuously most nights from emergence to return to day roost to obtain detailed commuting and foraging data.

A radio-equipped vehicle with a non-directional antenna was used for tracking large movements when searching for a lost signal, and a Telonics TR-2 receiver with a custom 3-element Yagi-Uda antenna was used for close-in tracking and directional information.







Results

More than 600 bats were counted exiting one face of the farmhouse in May 2005. The number of bats present increased from ~200 in late April.

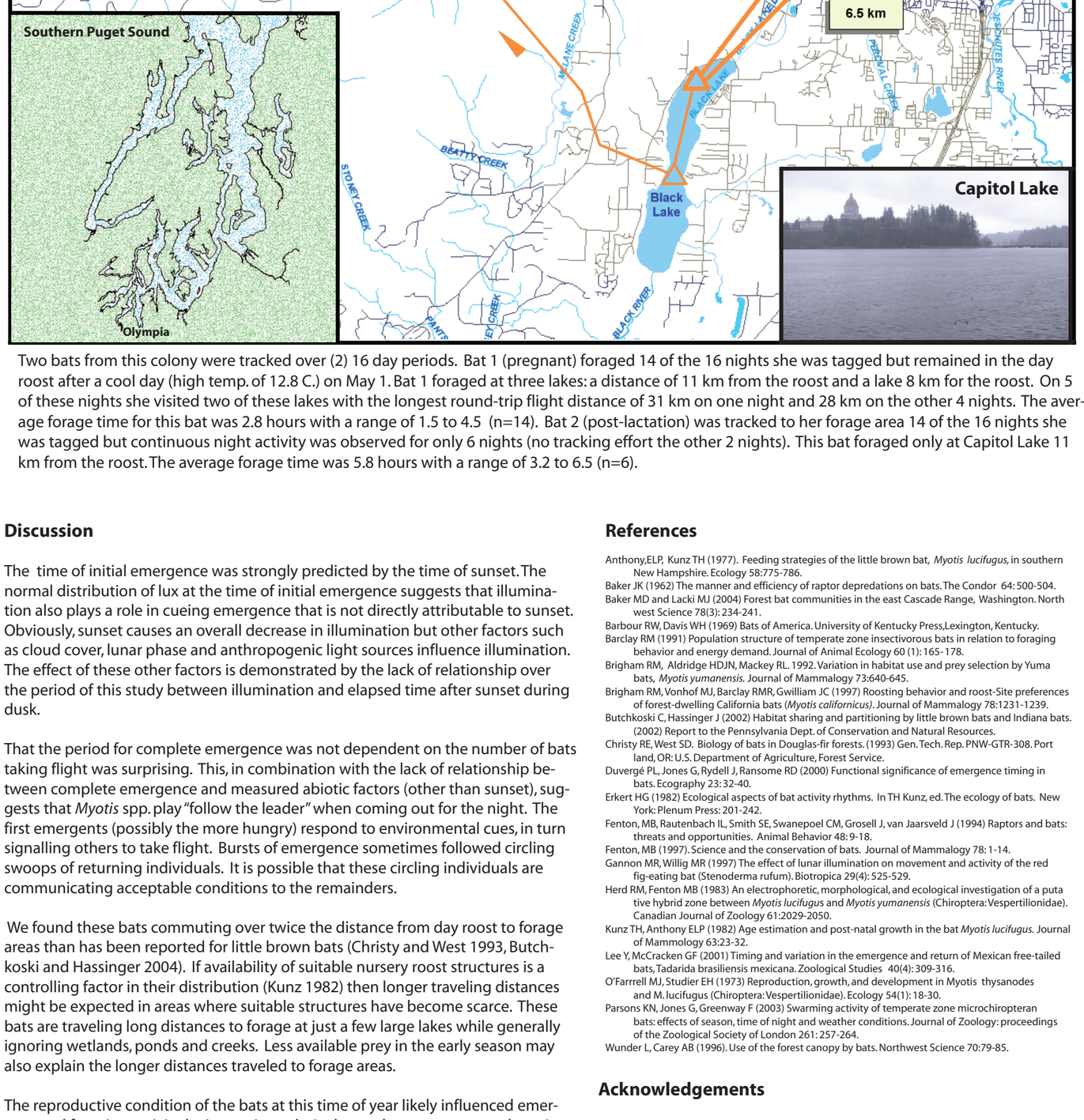
Physical features and call characteristics were used to identify the bats that were captured and radio-tagged. Both Yuma myotis and little brown bat calls were detected at the colony. Morphology of the bats was consistent with call features, as was ecological indicators.

The time of the first emergence was predictable by the time of sunset with the first bat exiting the colony 12.2 minutes after sunset (r^2=0.86, $p<0.001$). Illumination during dusk was not dependent on time of sunset.

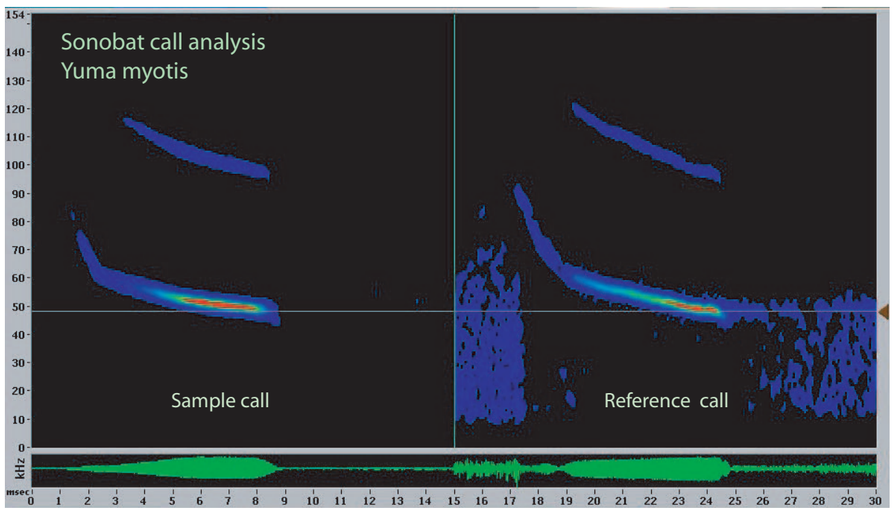
Illumination at initial emergence was normally distributed with emergences most commonly occurring between 6 and 8 lux, and ranging from 15.7 to 3.1 lux.

Complete emergence occurred 35.2 minutes after sunset and was not related to the number of bats emerging.

Temperatures ranged from 13.0 to 18.0˚ C at initial emergence and lunar illumination varied from 3% to 99%. No correlation was found between initial emergence and temperature or moon phase. Lux, temperature and moon phase were not predictive of time to complete emergence ($p>0.05$ in every case).



Two bats from this colony were tracked over (2) 16 day periods. Bat 1 (pregnant) foraged 14 of the 16 nights she was tagged but remained in the day roost after a cool day (high temp. of 12.8 C.) on May 1. Bat 1 foraged at three lakes: a distance of 11 km from the roost and a lake 8 km for the roost. On 5 of these nights she visited two of these lakes with the longest round-trip flight distance of 31 km on one night and 28 km on the other 4 nights. The average forage time for this bat was 2.8 hours with a range of 1.5 to 4.5 (n=14). Bat 2 (post-lactation) was tracked to her forage area 14 of the 16 nights she was tagged but continuous night activity was observed for only 6 nights (no tracking effort the other 2 nights). This bat foraged only at Capitol Lake 11 km from the roost. The average forage time was 5.8 hours with a range of 3.2 to 6.5 (n=6).



Discussion

The time of initial emergence was strongly predicted by the time of sunset. The normal distribution of lux at the time of initial emergence suggests that illumination also plays a role in cueing emergence that is not directly attributable to sunset. Obviously, sunset causes an overall decrease in illumination but other factors such as cloud cover, lunar phase and anthropogenic light sources influence illumination. The effect of these other factors is demonstrated by the lack of relationship over the period of this study between illumination and elapsed time after sunset during dusk.

That the period for complete emergence was not dependent on the number of bats taking flight was surprising. This, in combination with the lack of relationship between complete emergence and measured abiotic factors (other than sunset), suggests that *Myotis* spp. play "follow the leader" when coming out for the night. The first emergents (possibly the more hungry) respond to environmental cues, in turn signalling others to take flight. Bursts of emergence sometimes followed circling swoops of returning individuals. It is possible that these circling individuals are communicating acceptable conditions to the remainders.

We found these bats commuting over twice the distance from day roost to forage areas than has been reported for little brown bats (Christy and West 1993, Butchkoski and Hassinger 2004). If availability of suitable nursery roost structures is a controlling factor in their distribution (Kunz 1982) then longer traveling distances might be expected in areas where suitable structures have become scarce. These bats are traveling long distances to forage at just a few large lakes while generally ignoring wetlands, ponds and creeks. Less available prey in the early season may also explain the longer distances traveled to forage areas.

The reproductive condition of the bats at this time of year likely influenced emergent and foraging activity by increasing caloric demands on pregnant and nursing females. More in-depth studies on the impact of parturition and lactation on emergence and foraging patterns would be an interesting follow-up to this study.

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