First Records of the Northern Myotis (*Myotis septentrionalis*) from Labrador and Summer Distribution Records and Biology of Little Brown Bats (*Myotis lucifugus*) in Southern Labrador

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We conducted the first regional survey of bats in Labrador (Newfoundland and Labrador) to provide information on the distribution and biology of bats in this region. Our approach was to locate maternity roosts of *Myotis lucifugus* (Little Brown Bat) via word of mouth and then capture Little Brown Bats as they emerged from their day-roosts. We also surveyed for free-flying forest-dwelling bats using mist nets and a harp trap along forested trails and roads in southern Labrador. We captured 355 *M. lucifugus* at nine maternity roosts and one non-reproductive adult female *M. lucifugus* at a forested site. We captured two adult male *Myotis septentrionalis* (Northern Myotis) at two of the three forested sites (Gull Island and Grand Lake Road). These are the first confirmed records of this species from Labrador. Maternity roosts of *M. lucifugus* often had several hundred individuals. The proportion of female *M. lucifugus* captured at a roost that were either pregnant or lactating ranged from 35% to 96%; the estimated average date of parturition in 2012 was 10 July.

Key Words: Little Brown Bat; *Myotis lucifugus*; Northern Myotis; *Myotis septentrionalis*; parturition; Labrador; Newfoundland and Labrador

There is little information on the biology and distribution of bats in Labrador (Newfoundland and Labrador). Accounts of bats date back to the late 19th century, when naturalist excursions were made to the Labrador Peninsula. Low (1897) reported observing bats over the Hamilton River (now Churchill River) that he presumed were Little Brown Bats (*Myotis lucifugus*), and Bangs (1898) cited the observations of Low in his corrected list of the mammals of Labrador. Strong (1930) documented traditional ecological knowledge of bats as far north in Labrador as Davis Inlet from local Innu First Nations people. Eidmann (1935) reported records of *Myotis lucifugus* in Makkovik, and Nadin-Davis *et al.* (2008) reported the species from a rabies-positive bat submitted from Cartwright, Labrador.

Both Low (1897) and Bangs (1898) also reported a second species from the Labrador Peninsula by citing the observations of Stearns (1883) of a bat taken at Natashquan on the North Shore of Quebec. This bat is listed by Stearns (1883) as "*Vespertilio subulatus,* Little Brown Bat", although a later classification reports this species as *Myotis subulatus*, a synonym for the current species name *M. septentrionalis* (Northern Myotis). Although the true identification of the bat listed by Stearns (1883) cannot be verified, van Zyll de Jong (1985), presumably referring to the report in Stearns (1883), included *M. septentrionalis* from Natashquan, Quebec.

Regardless of the ambiguity of the report by Stearns, *Myotis septentrionalis* occurs in all adjacent jurisdictions (van Zyll de Jong 1985; Broders *et al*. 2003; Henderson *et al.* 2009; Park and Broders 2012), and we expect that the distribution of *M. septentrionalis* might extend into Labrador. However, since no known systematic survey for bats has been conducted in Labrador, an understanding of their distribution and basic biology is lacking for the jurisdiction.

Given the paucity of information on bats in Labrador and the impending threats to their populations posed by white-nose syndrome (*Pseudogymnoascus destructans,* formerly *Geomyces destructans*) (Frick *et al.* 2010a), our goal was to collect baseline information on bats from the region. Specifically, our objectives were first to locate and survey maternity roosts of *Myotis lucifugus* to characterize distribution and reproductive biology (e.g., timing of parturition, reproductive rate) and second to determine whether the distribution of *M. septentrionalis* extends into Labrador.

Study Area and Methods

The study area was within the taiga shield and boreal shield ecozones (Ecological Stratification Working Group 1995). Generally, these areas were comprised of black spruce forest matrix with abundant bogs and stands of white birch, trembling aspen, balsam poplar, balsam fir, white spruce, eastern larch, and Jack pine (Roberts et al. 2006). Climatically, the average annual temperature is about 0°C and annual precipitation ranges from 900-1300 mm and snow persists for 6-8 months per year. Summers are short and cool with brief periods of higher temperatures (+25°C). Forest fires occur regularly (Wiken 1986; Roberts et al. 2006).

We collected reports from the public of nine *Myotis lucifugus* colonies in southern Labrador that were using buildings as maternity roosts (Figure 1). Following initial visual assessments of where the Little Brown Bats were potentially roosting in each building, we set various configurations of mist nets (Avinet Inc., Dryden, New York) and a harp trap (Austbat Research Equipment, Lower Plenty, Victoria, Australia) prior to sunset to capture Little Brown Bats as they emerged from the roost. Traps and nets were left open for between 30 and 180 minutes, with a goal of capturing 40–50 bats per roost. Trapping took place between 23 June and 28 July in 2011, 2012, and 2013.

To determine whether the distribution of *Myotis septentrionalis* extends into Labrador, we set two or three mist nets and a harp trap across forested roads and trails during one night of sampling at each of four candidate sites (Figure 1). We targeted mature forests as trapping areas, because this species typically roosts in decaying live trees or snags associated with such stands (Jung *et al.* 1999; Broders and Forbes 2004; Garroway and Broders 2008; Park and Broders 2012).

Captured bats were held in individual bags until they were processed. Bats were identified to species, gender, and age class (juvenile or adult). Also, where possible, reproductive condition of females (pregnant, lactating, non-reproductive) was determined by gentle palpation of the abdomen and examination of the condition of nipples (Racey 1988). Damage to wing membranes was scored according to Reichard and Kunz (2009) as an indicator of the presence of white-nose syndrome. Any ectoparasites observed on the bats were noted and were sub-sampled opportunistically. All bats were released at the site of capture.

Colony size was crudely estimated by considering the number of bats captured, the number seen emerging from the roost that were not trapped, and a rough estimation of the number of bats left inside the roost, based on the noise generated by the bats within the roost once the traps were closed.

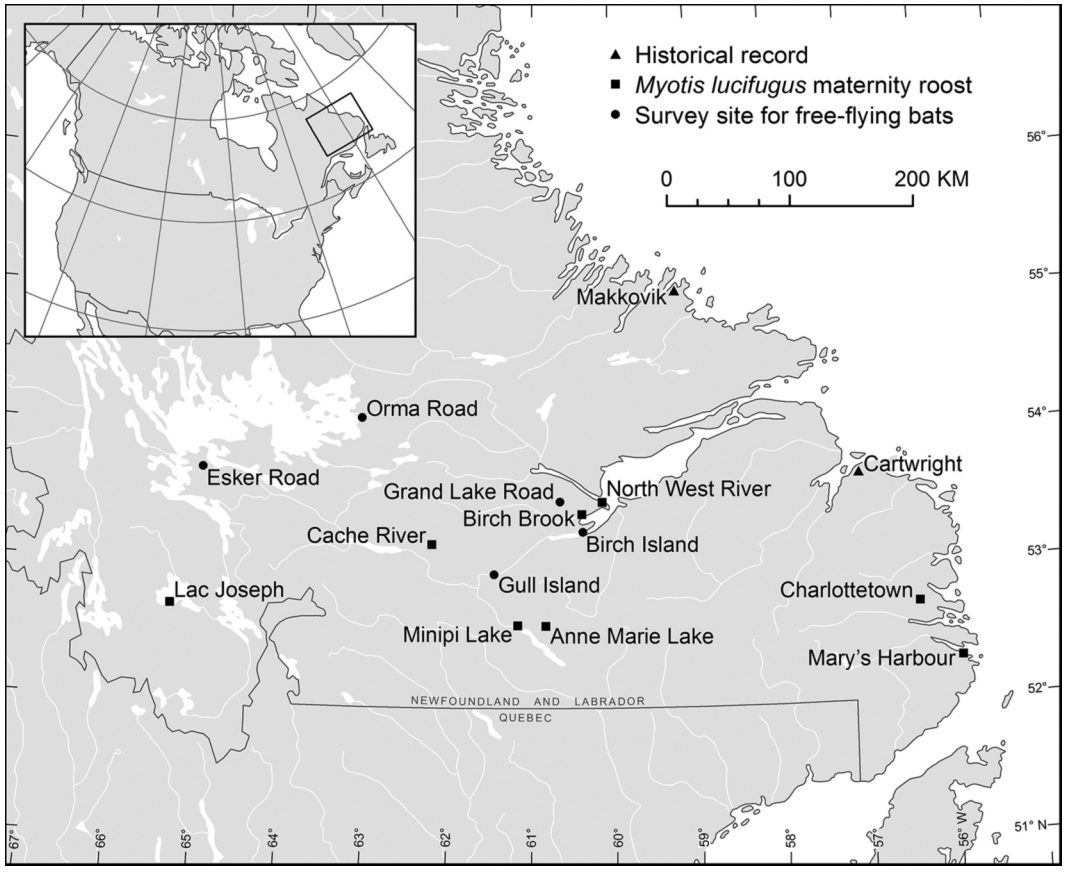

FIGURE 1. Locations of historical records and trapping survey sites for bats (*Myotis* spp.) in Labrador, 23 June to 28 July, 2011 to 2013. At *Myotis lucifugus* maternity roosts, we captured bats as they emerged at sunset. At free-flying capture sites, we used mist nets and a harp trap to capture commuting and foraging bats. At the Grand Lake Road site, we trapped at both the roost and the adjacent forest and have labelled it as a maternity roost.

This work was conducted under permits from the Newfoundland and Labrador Department of Environment and Conservation (Wildlife Division) and the Saint Mary's University Animal Care Committee. To minimize the risk of spread of pathogens (e.g., *Pseudogymnoascus destructans*), we ensured that none of the equipment and clothing used as part of these studies had been used outside Labrador.

Results

During the summers of 2011–2013, we live-trapped 355 *Myotis lucifugus* (329 adult females, 22 adult males, and 4 of undetermined gender) at nine maternity roosts in southern Labrador. Of these roosts, three were in abandoned cabins in remote areas (Lac Joseph, Cache River, and Charlottetown), two were in unoccupied buildings (in Birch Brook and Mary's Harbour), one was in an inhabited home (North West River), and the remaining three sites (Anne Marie Lake, Minipi Lake, and Grand Lake Road) were in seasonal buildings used during the summer.

Precise and accurate estimates of numbers of Little Brown Bats at each roost could not be made. However, on the nights of our surveys, it was clear that the roosts at each of Lac Joe, Cache River, Minipi Lake, and Anne Marie Lake consisted of >100 Little Brown Bats. The number of Little Brown Bats at each of the North West River, Birch Brook, Grand Lake Road, Mary's Harbour, and Charlottetown sites was probably fewer than 100.

We captured both lactating and pregnant Little Brown Bats on 9 and 12 July 2012 at Minipi Lake and at Cache River, respectively. We therefore estimate that the parturition date for Little Brown Bats in Labrador is approximately 10 July, but we are unable to make inference on variability in parturition date. When/where reproductive condition could be reliably determined, we estimated that the proportion of Little Brown Bats that were reproductive within a maternity roost was 35% (18/52) at Cache River in 2012, 36% (17/47) at Minipi Lake in 2012, 50% (13/26) at North West River in 2011, 73% (8/11) at Birch Brook in 2011, 89% (8/9) at Grand Lake Road in 2013, and 96% (47/49) at Lac Joe in 2011, assuming our sample of Little Brown Bats captured was not biased.

We did not systematically collect data on ectoparasites but, minimally, noted the presence of the Eastern Bat Bug (*Cimex adjunctus*), Bat Flea (*Myodopsylla insignis*), and mites (*Spinturnix* spp. and *Leptotrombidium myotis*). Anecdotally, it seemed that the prevalence and intensity of ectoparasites on *Myotis lucifugus* in maternity roosts in Labrador was greater than in other similar roosts in Nova Scotia and Newfoundland (HGB, unpublished data). Based only on examination of wing membranes of the bats (Reichard and Kunz 2009), there was no evidence that white-nose syndrome had reached Labrador at the time of our surveys.

During our free-flying capture surveys we captured an adult female *M. lucifugus* at Gull Island and seven pregnant female *Myotis lucifugus* at Esker Road suggesting there was a maternity roost nearby. During these surveys we also captured one adult male *Myotis septentrionalis* at each of Gull Island and in the forest adjacent to the *M. lucifugus* maternity roost at Grand Lake Road. No bats were captured at either Birch Island or Orma Road. The captures of *M. septentrionalis* at Gull Island and Grand Lake Road are the first confirmed records of this species in Labrador. This extends the range northward from the observation by Stearns (1883) in Natashquan, Quebec, by >350 km.

Discussion

There are a number of maternity colonies of *Myotis lucifugus* (Little Brown Bats) in southern Labrador, and these bats use human-built dwellings as roosts. In this study, we have added 11 additional capture localities for the region, 9 of which are maternity roosts. Based on these results, we anticipate that there are a number of other maternity colonies in buildings in the region that were not sampled. It is not known if any natural structures (e.g., trees) were being used as maternity roosts. Little Brown Bats captured in the forest adjacent to Esker Road may have been using trees as roosts, since they were not observed coming from the cabin located at this site.

We confirmed the presence of *Myotis septentrionalis* in Labrador, and existing distribution maps should be updated (e.g., Naughton 2012). However, we still do not have a suitable characterization of the species' distribution or biology in Labrador. A systematic survey using similar live-trapping methods, mist nets, and harp traps of areas with mature forest and large trees is required to make inference of their distribution in the region.

The distribution of *Myotis septentrionalis* may be patchy. The presence of males at each of Gull Island and Grand Lake Road does not necessarily mean that reproductive females are also present, although they may be. Ideally, trapping surveys should be complemented by radio-telemetry surveys to locate maternity roosts and characterize colony dynamics. As further development affecting the extent and structure of forests occurs in the region, such work may be of conservation importance for the protection of this species, which is restricted to forested areas.

The average parturition date of 10 July for *Myotis lucifugus* in Labrador is among the latest recorded for the species, although individual parturition dates can vary by more than four weeks at any given location (Davis and Hitchcock 1965; Broders *et al*. 2006; Frick *et al*. 2010b). Despite this, the proportion of females that was pregnant in some roosts was quite high (up to 96%). It is possible that our sample was biased, as it consisted of the first animals captured. If there was a temporal bias in the emergence order of bats in relation to reproductive condition or if reproductive bats were

more or less capable of eluding capture, these data may not be representative of the colony.

Only ≈10% of the forests in the region were classed as productive forests with commercial value (Wilton 1964), suggesting that trees of a diameter sufficiently large to support bat colonies are likely rare. Therefore, it seems possible that *Myotis lucifugus* relies heavily on buildings for maternity roosts, and we hypothesize that human dwellings facilitate the occurrence of the species in Labrador, which may be a limiting factor. Anecdotal evidence suggests that many local people have a low tolerance of bats inhabiting buildings. For this reason, an increase in education and outreach efforts regarding bat ecology and the value of roosts established in Labrador is recommended.

Identifying and monitoring any hibernacula within Labrador is of particular importance, given the recent emergence of white-nose syndrome, which can have severe population-level effects. At this point, there are no known overwintering sites for either *Myotis lucifugus* or *M. septentrionalis* in Labrador. Therefore, potential locations, such as the abandoned mine shafts in the Makkovik–Postville area, should be surveyed for overwintering bats.

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