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RESEARCH NOTE

BAT ACTIVITY IN CENTRAL APPALACHIAN WETLANDS

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ABSTRACT

We conducted acoustical bat surveys at 14 high-elevation wetlands in West Virginia, using the Anabat II detection system. In two survey periods (June and August 2002), we recorded seven bat species. Little brown bats (*Myotis lucifugus*) dominated the surveys, constituting 73.6% of all identifiable calls. Big Run Bog, which contains a 2-ha beaver pond with the most structurally "open" habitat in our study, accounted for 71.8% of all identifiable calls, nearly all identified as little brown bats. Observations of note were one Indiana bat (*M. sodalis*), an endangered species that is present but locally rare, recorded at Big Run Bog, and the evening bat (*Nycticeius humeralis*) at North Bog, considered an accidental migrant in the region. Although the importance of these mountain wetlands to regional bat communities is not fully understood, our surveys indicate that beaver-impacted wetlands appear to provide suitable foraging habitat for some bat species, including rare species in the region.

Key Words: Anabat, bat survey, West Virginia, wetlands

INTRODUCTION

Many insectivorous bats in North America preferentially forage over riparian areas and open water bodies, due to insect abundance and ease of foraging in a

less cluttered micro-environment (1, 2, 3). Indeed, bat abundance is positively related to the presence of such lacustrine and riverine habitats (4). Because of the high prey density combined with water's acoustic properties that make echolocation function more efficiently, it is not surprising that greatest bat activity is typically recorded over non-turbulent lacustrine sites (3, 5, 6, 7, 8). Nonetheless, few surveys or foraging studies have investigated the importance of freshwater palustrine areas for bat communities (7, 8).

Within the central Appalachians of West Virginia, nine of the 11 regularly-occurring bat species roost in forested habitats (snags or trees; 9). In the heavily forested central Appalachians, permanently open habitats are uncommon (10). However, palustrine, open-canopied sites are locally abundant in Randolph and Tucker counties, and often contain small ephemeral ponds or slower, first-order streams that may be optimal for foraging (11). It is not uncommon for bats to roost in nearby forests and commute to open foraging sites, such as these wetlands (12).

Bat studies have been conducted in nearby managed forests, including the Fernow Experimental Forest (Tucker County; 13), the Monongahela National Forest (Pendleton, Pocahontas, Randolph, and Tucker counties), and the Mead Westvaco Ecosystem Research Forest (Randolph County; 10, 14, 15). During these studies nine species of bats were recorded, including the federally listed Indiana bat (*Myotis sodalis*). Although the Allegheny Highlands may fall within the Indiana bat's maternity range, the species is locally uncommon in the summer months except for the presence of males in close proximity (< 10 km) to a few minor hibernacula caves in the region (14). Nearly all Indiana bats were detected while foraging in forested riparian areas or captured near their hibernacula (10, 13).

Despite these studies in the region's forests, no surveys have investigated bat use of palustrine areas. Given the lack of palustrine surveys, our goal was to provide baseline data for activity of all bat species in these wetlands, and to document the presence of rare or uncommon bat species foraging in semi-aquatic habitats.

METHODS

We performed acoustical surveys of bats at 14 high elevation wetlands in Tucker and Randolph counties, West Virginia in the summer of 2002 (Table I). These sites are part of a larger wetland characterization study by Francl et al. (11) and are generally open bog- or fen-like habitats dominated by low-lying mosses, grasses, and sedges, or patchy shrub-scrub vegetation. Site elevations ranged from 918-1111 m, and wetland size varied from 0.08-30 ha (Table I).

Table I. Locality information for 14 wetland sites in West Virginia, surveyed for bats in 2002.

Site Name	*Code*	*County (WV)*	*Latitude (North)*	*Longitude (West)*	*Elevation (m)*	*Area (ha)*
Canaan Valley State Park, Abe Run Trail	ABER	Tucker	39° 00.930'	79° 27.800'	960	3.0
Canaan Valley NWR, Beall Tract	BEAL	Tucker	39° 04.273'	79° 24.776'	954	1.2
Big Run Bog	BIGR	Tucker	39° 07.017'	79° 34.554	982	15.0
Condon Run	COND	Randolph	38° 56.540'	79° 40.000'	918	3.0
Canaan Valley NWR, Herz Tract	HERZ	Tucker	39° 02.268'	79° 25.358'	983	10.0
Canaan Loop, Main Rd.	MAIN	Tucker	39° 04.371'	79° 28.363'	1111	30.0
Moore Run	MOOR	Randolph	39° 00.072'	79° 39.623'	991	2.0
Canaan Loop, North Rd.	NORT	Tucker	39° 04.140'	79° 29.059'	1076	15.0
Canaan Loop, Powerline	POWR	Tucker	39° 04.959'	79° 27.784'	1099	0.08
Canaan Loop, Red Run	REDR	Tucker	39° 04.125'	79° 29.455'	1085	0.4
Canaan Loop, Trail 101	TRL1	Tucker	39° 05.197'	79° 28.896'	1038	0.4
Canaan Loop, Trail 109/108	TRL2	Tucker	39° 04.823'	79° 28.847'	1067	0.2
Canaan Loop, Trail 109/701	TRL3	Tucker	39° 04.466'	79° 29.487'	1085	1.3
Yellow Creek	YELL	Randolph	38° 57.742'	79° 40.600'	952	2.5

We actively surveyed bats using the Anabat system, which consisted of an Anabat II detector, Zero Crossings Analysis Interface Module (ZCAIM), and laptop computer (Titley Electronics, Ballina, New South Wales, Australia; 16). Surveys of 2-4 sites per night were performed over four nights, from 2100 until 0130 each evening. One stationary observer recorded calls for 20 minutes at each site in June and August 2002 with active monitoring to maximize quality and quantity of bat calls (17, 18). Survey points within wetlands were chosen to be least obstructed by vegetation, so that detection area was maximized, and clutter mini-

mized (19). Temperature, humidity, and wind speed also were recorded.

Recorded echolocation calls were filtered prior to analysis (20) and identified to species using Analook 4.7j and Analyze 2.3 software (21, 22). Additionally, we utilized a key to bat calls of West Virginia, based on frequency, curvature, and slope characteristics (M.A. Menzel, West Virginia University, unpublished data). Calls with < 3 individual call pulses were not deemed identifiable (18). Because bat detectors do not distinguish among individual calls, we did not use the data to estimate abundance; rather, we noted species presence and relative activity levels among sites (7).

RESULTS

We recorded 177 calls at 14 sites during two survey periods on 4 sampling nights. Of these calls, 154 were identifiable to genus, and 153 to species. Seven species were identified in these surveys (Figure 1). Little brown bats constituted the majority (131 calls; 73.6%) of identifiable calls, 111 of them recorded at a single site, Big Run Bog. Many feeding buzzes were recorded, indicating active foraging at this site. Little brown bats also were detected at the greatest number of sites (eleven). The remaining six species were recorded 10 times or less across all sites.

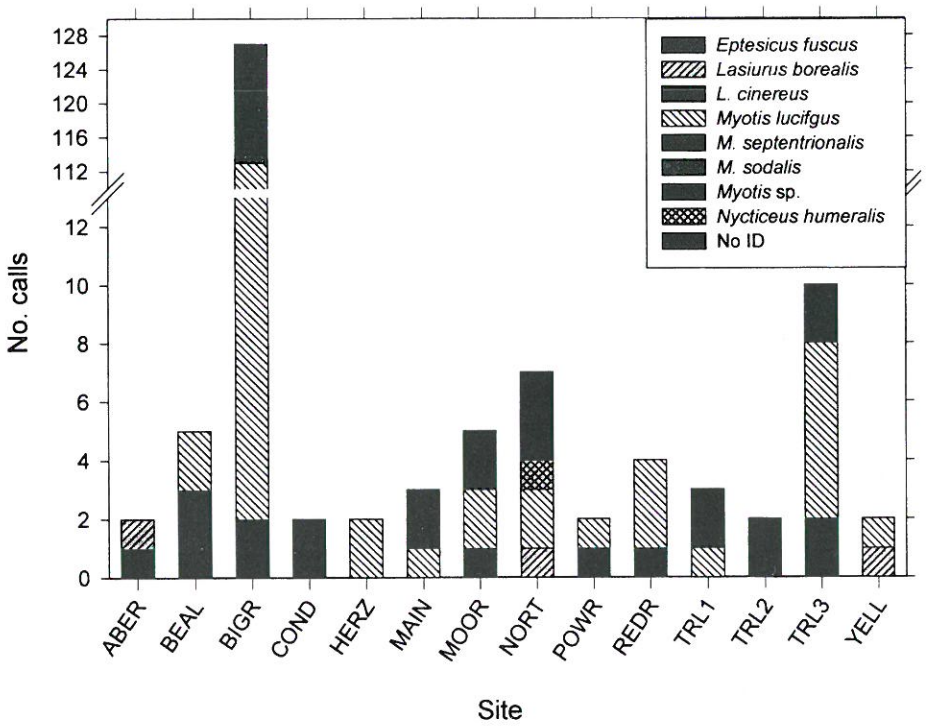

Figure 1. Total number of Anabat calls identified per species in June and August 2002 bat surveys at 14 wetlands in West Virginia. Site codes listed in Table I.

DISCUSSION

Previous research indicated that bat abundance is positively related to presence of lacustrine and riverine habitats (4). Studies of preferred habitats in Maine showed that bats appear to avoid wetlands lacking ponds (7). Our study of palustrine habitats in the central Appalachians concurs with this research, recording minimal bat use at all sites. The exception is Big Run Bog, which contains a permanent 2-ha beaver pond (tannin-rich water, maximum depth > 1 m), above which the bats were actively foraging. We predict that the prey abundance was greatest at this site, and that echolocation ability was efficient over this calm water (23). At the remaining palustrine sites, the lack of open water and cool, acidic conditions did not likely provide an abundance of prey items for bats. It is likely that, given the regional climate conditions, bats may spend more time foraging at lower elevations, where temperatures are slightly higher and invertebrates might be more active. However, lower activity levels at these wetlands do not negate their ecological value; indeed, bat species richness across all sites was relatively high and the presence of several uncommon species emphasizes the value of such palustrine habitats.

Of note is the one Indiana bat identified at Big Run Bog. Because their call is similar to the abundant little brown bats in the area and their ability to produce echolocation signatures are similar to Indiana bats, positive identification is not without the chance of error. However, it is not unreasonable to believe this species is present at the site, because Indiana bats are monitored around Big Springs Cave at the Fernow Experimental Forest, ca. 16 km (10 mi) from Big Run Bog (13). Big Springs Cave is a known winter hibernaculum of approximately 200 of the species, and areas within 8 km (ca. 5 mi) are considered part of the male bats' home ranges in the summer (13).

We also recorded an evening bat (*Nycticeius humeralis*) during our August survey. This bat is not typically found in mountainous regions in the Mid-Atlantic or Southeast, and is probably an accidental migrant in the area (9; M.A. Menzel, West Virginia University, unpublished data; Craig Stihler, West Virginia Department of Natural Resources, personal communication).

We acknowledge several limitations in this study and suggest modifications for future surveying work. First, we suspect the number of calls recorded was lower than expected due to suboptimal weather conditions. The June surveying period was hindered by rainstorms three of four nights, and surveys were performed just prior to the rain events (humidity 61-98%). During the August surveying period, the temperature dropped below 10°C (50°F) during half of the surveys. It is likely that bat foraging activity was affected by these conditions, because insect biomass and abundance typically declines with cooler ambient air and water temperatures (3, 24). We suggest that evenings with warmer, less humid conditions be chosen for survey dates. We also recommend that more surveys be performed at each site in order to assess true community composition. Perhaps calculations of a species accumulation curve might help us obtain an acceptable level of completeness (25).

Secondly, we acknowledge the limitations of Anabat surveys. As opposed to mist-netting, species identification can be problematic (26). Calls can be variable

within species and useful data, e.g., gender and age ratios, absolute abundance, are not available (17, 27, 28). However, mist-netting is labor-intensive and less effective than Anabat in detecting some bat species (29). Additionally, if the goal is to assess bat species richness, active Anabat monitoring is a time-efficient and effective monitoring strategy (18) if coupled with mist-netting to minimize the biases of each surveying technique and maximize species detection.

The full importance of these mountain bogs and fens to regional bat communities is not known. However, based on our surveys, beaver-impacted wetlands such as Big Run Bog appear to provide suitable foraging habitat for some bat species. We recognize that open areas, like these wetlands, amidst heavily forested habitats are important to big brown bats (*Eptesicus fuscus*), little brown bats (*Myotis lucifugus*), hoary bats (*Lasiurus cinereus*), and possibly eastern pipistrelles (*Pipistrellus subflavus*; 10, 30).

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