

## BAT COMMUNITIES IN HIGHLY IMPACTED AREAS: COMPARING CAMP ATTERBURY TO THE INDIANAPOLIS AIRPORT

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**ABSTRACT.** Little information is available about how bats respond to landscape-scale disturbances. Herein is presented a comparison of two distinct forms of managed lands. Camp Atterbury is an active military training area near Edinburgh, Indiana. It is subject to human disturbances such as live fire weapons exercises and troop movements; however, its forested habitats are relatively intact. In contrast, the Indianapolis International Airport conservation area is a much more developed and patchy habitat along the developing edge of suburban Indianapolis. During 2002, mist-net surveys were conducted at both sites, capturing the same seven species. Species associated with buildings (big brown bat, *Eptesicus fuscus*; and little brown myotis, *Myotis lucifugus*) were more commonly captured at the airport, whereas at Camp Atterbury, the forest-dwelling northern myotis (*Myotis septentrionalis*) was captured more often.

**Keywords:** Bats, Indiana, Camp Atterbury, Indianapolis International Airport, managed lands

Conservation activities aimed at North American bats are hampered by a lack of understanding of how bats respond to different land-use practices (Kurta & Teramino 1992; Sparks et al. 1998; Pierson 1998; Miller et al. 2003; Sparks 2003). This paper compares the bat fauna of an active military reservation, Camp Atterbury Joint Maneuver Training Center, to the bat fauna of properties managed for conservation by the Indianapolis International Airport. These areas are both located in central Indiana (Fig. 1). Forests of this region are dominated by oak-hickory, beech-maple and bottomland hardwood forest complexes (Kiser 2002). Management of federally-endangered Indiana myotis (*Myotis sodalis*) is one of the goals at both of these properties.

**Study areas.**—Both Camp Atterbury and the airport are heavily impacted by human disturbance. Camp Atterbury encompasses 13,408 ha, located approximately 56 km south of Indianapolis, in parts of Bartholomew, Brown, and Johnson counties (Kiser 2002). It is an active military facility managed primarily for military training, including live fire ex-

ercises involving weapons ranging from small arms to 155 mm howitzers, and battalion-scale troop maneuvers. The approximately 10,719 ha of forest on the facility are managed for a variety of activities including: commercial timber harvest, wildlife habitat protection, watershed protection, recreation, and aesthetics (Watson 1997). The remaining land cover consists of mowed fields, old fields, early successional shrubby uplands, wetlands, roads, parking lots, barracks, and other anthropogenic structures.

The Indianapolis International Airport conservation properties are at the southwestern edge of the Indianapolis metropolitan area in Hendricks and Marion counties (Sparks et al. 1998; Sparks 2003; Whitaker et al. 2004). Habitats consist primarily of numerous small woodlots surrounded by a matrix of agricultural fields in the south and neighborhoods and commercial properties in the north. A narrow (approximately 30 m wide) riparian forest occurs along the banks of the East Fork of White Lick Creek, a medium-sized perennial stream that bisects the study area. The airport study area is transversed by numerous small roads and four multi-lane divided highways.

### METHODS

Results of mist-net surveys conducted at pre-existing sites on both areas during June

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Figure 1.—Locations of the study sites at Camp Atterbury, the Indianapolis Airport, and Prairie Creek.

and July of 2002 were compared. Fifteen stations were netted a total of 23 times at Atterbury, and 10 stations were netted a total of 19 times at the airport. Surveys were conducted approximately three times per week. Nine days was the shortest interval between consecutive nettings at an individual site. No station was sampled more than three times. Netting stations were placed along flyways created by forest openings associated with water sources such as ponds, road cuts, and (most frequently) streams. A net night was defined as one station surveyed, with two multitier 9 m mist-nets used in such a way as to maximize the amount of flyway covered. Netting at both sites was conducted throughout available management areas, except the “impact area” at Camp Atterbury. This area is targeted during live-fire exercises and is unsafe to enter due to potential unexploded ordnance. Surveys at both sites are part of larger research programs, and thus only data collected when both areas were being sampled simultaneously were analyzed.

For each captured bat the species, sex, re-

productive class (Racey 1988), and age (Anthony 1988) were determined. Each bat was also weighed, banded with a uniquely-numbered tag, examined for parasites, and measured for right forearm length. A series of Mann-Whitney  $U$  tests was used to compare the number of each species captured per night at the airport to number of that species captured per net night at Camp Atterbury. The average species richness (defined as number of species caught per night for each site) was compared, and the abundance of bats (i.e., total number of bats per net night) was determined. All statistical analyses were performed using SPSS 11.5 for Windows, Standard Version with a rejection level of  $\alpha = 0.05$ .

## RESULTS

In 23 net nights 106 bats were captured at Atterbury, compared to 103 bats in 19 net nights at the airport. The same seven species were caught at the two study areas, but their abundances differed substantially between the two sites (Table 1). Two species (big brown bat, *Eptesicus fuscus*; and little brown myotis, *Myotis lucifugus*) that are commonly associated with buildings were significantly more common at the airport (56 *E. fuscus* and 14 *M. lucifugus* captured) than at Camp Atterbury (18 *E. fuscus* and 2 *M. lucifugus* captured). Conversely, the forest-dwelling northern myotis (*Myotis septentrionalis*) was more prevalent at Camp Atterbury (27 captured, versus 3 captured at the airport). No significant difference was found in the capture rates of Indiana myotis, red bat (*Lasiurus borealis*), evening bat (*Nycticeius humeralis*), or eastern pipistrelle (*Pipistrellus subflavus*). The mean number of bats per net night was similar at either site (4.609 for Camp Atterbury, and 5.421 for the airport,  $U = 199.5$ ,  $P = 0.629$ ), as was mean species richness (2.435 for Camp Atterbury, and 2.790 for the airport,  $U = 190.5$ ,  $P = 0.472$ ).

## DISCUSSION

Despite markedly different landscapes, bat communities of Camp Atterbury and the airport are similar. During this study we recorded the same seven species at both sites, and found significant differences in capture rates for only three species. Both the big brown bat and the little brown myotis commonly roost in structures such as buildings and bridges

Table 1.—Bats captured in mist-netting surveys of Camp Atterbury Joint Maneuver Training Center and the Indianapolis International Airport conservation properties.

Bat species	Camp Atterbury 23		Airport 19		<i>U</i>	<i>P</i>
	Number of bats	Bats caught per night	Number of bats	Bats caught per night		
<i>Eptesicus fuscus</i>	18	0.783	56	2.947	113.0	0.005
<i>Lasiurus borealis</i>	27	1.174	11	0.579	170.0	0.184
<i>Myotis lucifugus</i>	2	0.087	14	0.737	118.5	0.001
<i>Myotis septentrionalis</i>	27	1.174	3	0.158	131.5	0.010
<i>Myotis sodalis</i>	6	0.261	9	0.474	186.0	0.298
<i>Nycticeius humeralis</i>	8	0.348	2	0.105	192.0	0.301
<i>Pipistrellus subflavus</i>	18	0.783	8	0.421	205.0	0.689
Total	106	4.609	103	5.421	199.5	0.629

(Whitaker & Hamilton 1998). Due to the greater density of such structures, higher capture rates of these species would be expected at the airport.

We were, however, surprised that only northern myotis were more commonly captured at Camp Atterbury. Camp Atterbury is primarily forested, and as such, it is presumed that it would provide high quality habitat for forest species. We suspected that federally-endangered Indiana myotis and state-endangered evening bats would be more common at Camp Atterbury. In similar work, both these species and northern myotis were less frequently captured at the airport than at a more pristine area (Fig. 1) along Prairie Creek in Vigo County, Indiana (Sparks et al. 1998). These results were interpreted at the time as indicating that these three species were particularly susceptible to forest destruction and fragmentation. However, at Camp Atterbury, only northern myotis were more frequently captured. We suspect that this difference is the result of two factors. First, Camp Atterbury is intermediate in forest content and connectivity between the airport and Prairie Creek. Second, mist-net surveys are affected by many factors, particularly location of roosts. Since data used in the airport/Prairie Creek comparison were collected, both evening bat and Indiana myotis roosting locations have moved closer to netting locations at the airport, and consequently both bats are being captured more frequently now than in the past (Whitaker et al. 2004). At Camp Atterbury, conversely, most evening bat roosts were located outside the base, while many Indiana myotis roosts were located

within the impact area, which we were unable to survey (Whitaker & Gummer 2002). Given the short foraging ranges of evening bats (Duchamp et al. 2004), it is also likely many evening bats roosting within the impact area never reached netsites.

At both Camp Atterbury and the airport, managers are challenged with conserving bats in habitats primarily used for other purposes. These two areas provide an important opportunity to explore effects of management activities on bats at multiple levels. Of particular interest would be behavioral studies aimed at determining how bats respond to unusual disturbances present at the two sites. For Camp Atterbury, this would include responses of bats to military exercises. At the airport, efforts should be targeted at examining interactions between bats and development.

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