Summer 2008 Bat Mist-netting Report

for the Buckeye II Wind Farm

in Champaign County, Ohio

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Executive Summary

During the summer of 2008, Stantec Consulting (Stantec) conducted a bat mist-netting survey to characterize activity of bats in the vicinity of the proposed Buckeye II Wind facility in Champaign County, Ohio (Project). The surveys have been included as part of the planning process of the Project, developed by Champaign Wind LLC, (Champaign Wind). The Project will include erection of a wind farm located primarily on open agricultural lands. Results of these surveys were first reported in February 2008 as part of the planning process for the Buckeye Wind Energy Project, developed by Buckeye Wind LLC. Thirty-four net-nights of mist-netting surveys were completed between 17 June and 25 July, 2008. Two hundred and ninety-eight bats representing seven species were captured at 17 mist-net sites that were distributed over an approximately 21,755.9 hectare (ha; 84.0 square miles [mi^2]) area (referred to as the "study area" for the purposes of this report). The average capture rate was 4.0 bats per net per night (b/n/n).

Two lactating females of each of the following species were radio-tagged at the request of the Ohio Department of Natural Resources (ODNR): little brown myotis (*Myotis lucifugus*), northern myotis (*Myotis septentrionalis*), big brown bat (*Eptesicus fuscus*), and tri-colored bat (*Perimyotis subflavus*). Two reproductive adult females, and one non-reproductive adult male Indiana myotis (*Myotis sodalis*) were also captured and radio-tagged in the northern portion of the study area.

Radio-tagged bats were tracked to their daytime roost locations (day-roosts) while transmitters were active. Seven Indiana myotis, five northern myotis, three tri-colored bat, two big brown bat, and one little brown myotis day-roosts were successfully located. Two Indiana myotis were successfully tracked to their day-roosts each day until the radio-transmitter failed or became unattached from the bat; five roosts were located for one female Indiana myotis, and two roosts were located for the captured male. Due to property access issues, roosts belonging to one of the two Indiana myotis females could not be located. Roost locations for this female were approximated using triangulation of radio signals.

All eighteen located day-roosts were monitored at sunset on at least one occasion to count the number of bats emerging from the roost. The highest roost emergence counts by species were 28 Indiana myotis, 26 northern myotis, 19 big brown bats, 6 little brown myotis, and 3 tri-colored bats. Four emergence counts were conducted simultaneously by different observers at four of the five female Indiana myotis roosts on 24 July. This resulted in a cumulative count of 43 bats, which likely consisted of adult female and juvenile Indiana myotis exiting the roosts.

Each radio-tagged Indiana myotis was tracked during its nighttime activities to assess the extent of activity areas. Triangulated nighttime locations of each bat were used to calculate home range and core activity area estimates. The home range estimates for the male and two female Indiana myotis were 2599.5 ha (10.0 mi^2), 1020.4 ha (3.9 mi^2), and 609.1 ha (2.4 mi^2), respectively. The core activity area estimates for these three bats were 355.2 ha (1.4 mi^2), 141.7 ha (0.6 mi^2), and 105.6 ha (0.4 mi^2), respectively. As a result of the captured and radio-tagged Indiana bats, Champaign Wind focused the

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development of the Project to about 13,500 ha (21 mi^2) in the southern portions of the study area. Despite a relatively even sampling effort throughout the study area, Indiana myotis were only captured and radio-tracked within the northernmost portion of the study area. However, in 2009, consultants for a wind energy development adjacent to the study area also captured Indiana bats during mist-net surveys. As a result of those captured Indiana bats, the Project will seek incidental take coverage through the Endangered Species Act.

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PN 175632001

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1. Introduction

This report has been prepared to summarize results of summer 2008 bat mist-netting surveys conducted by Stantec Consulting (Stantec), within an area that will include the Buckeye II Wind Farm (Project), developed by Champaign Wind LLC (Champaign Wind). Results of these surveys were first reported in February 2008 as part of the planning process for the Buckeye Wind Energy Project, developed by Buckeye Wind LLC (Buckeye Wind). Both Champaign Wind and Buckeye Wind are wholly owned subsidiaries of EverPower Wind LLC (EverPower). The primary objective of the mist-netting survey was to document the presence or probable absence of Indiana myotis (*Myotis sodalis*) within the study area during their breeding season. If Indiana myotis were captured, an additional objective was to collect information on their spatial use of the study area and to locate and estimate the size of their maternity roosts. A secondary objective of the mist-netting survey was to collect similar information on bats which are not state or federally listed as endangered or threatened, as specifically requested by the ODNR.

The scope and methodology of the survey were developed cooperatively by Stantec, the Ohio Department of Natural Resources (ODNR), and the Reynoldsburg Ohio Ecological Services Field Office of the United States Fish and Wildlife Service (OH USFWS). The work plan that established the protocol for the survey was approved by the ODNR and the OH USFWS in May, 2008. Because the Indiana myotis is a federally endangered species whose range includes the study area, the survey was designed to maximize the chances of documenting the presence or probable absence of this species in the study area. Following is a brief description of the proposed wind project, study area, mist-netting methods, and results of mist-netting surveys. Champaign Wind met with ODNR on November 10, 2011 to receive any comments regarding the surveys completed and summarized in this report as they relate to the Buckeye II Project.

1.1. Project Context

The proposed Project is located in central Ohio's Champaign County. The facility would include construction of turbine towers and pads, electrical collection lines, and access roads that will be widely spread throughout approximately 13,500 acres (21 square miles [$mi^{2]}$) of privately owned predominantly agricultural lands in the townships of Union, Urbana, Salem, Goshen, Wayne and Rush.

The Project is expected to consist of 56 turbines, up to four (4) meteorological (met) towers and associated access roads, electric collection lines, and an electrical substation. The turbines will have a capacity rating of up to 2.5 MW (depending on final turbine model selected for the site) and be mounted on tubular steel towers. The height specifications of proposed turbines have not yet been determined, but turbines would have a maximum height of 150 m (492 ft) as measured from the ground to the tip of the blade at its highest point.

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In advance of permitting activities for the Project, Stantec was contracted to conduct bat mist-netting surveys, in addition to several other wildlife surveys conducted during 2007 and 2008. This survey, along with other studies conducted by Stantec in the study area, will provide data to help assess the potential impacts to birds and bats from the proposed Project.

1.2. Study Area

The study area (Figure 1-1) is a 21,755.9 ha (84 mi^2) mosaic of active agricultural lands, mostly corn and soybean, interspersed with relatively small stands of mixed hardwood forest. It lies on an approximately 396 m (1,300 ft) plateau that rises 91 to 152 m (300 to 500 ft) above the surrounding landscape. The local topography is characterized by small rolling hills. Many areas are underlain by karst geological features, or those formed by the dissolution of layers of soluble bedrock that creates subterranean drainages and sinkholes. The northern portion of the study area has more karst topography features and a greater density of woodlots bordering agricultural fields than the southern portion. Land use in the area includes active agricultural operations, low density residential developments, and some tourist activity at historical sites.

The area is composed of predominantly agricultural habitat, with scattered areas of upland and riparian forests, as well as shrub habitats. Most of the forest stands are mixed hardwood dominated by oaks (*Quercus* spp.), maples (*Acer* spp.), hickories (*Carya* spp.), and ash (*Fraxinus* spp.), with few conifer trees. Many stands are even-aged, while some are more structurally diverse. Many stands contain both live and dead trees and provide potential habitat for bats. The majority, if not all, of the turbines and associated access roads and transmission lines currently proposed are to be located in open agricultural settings.

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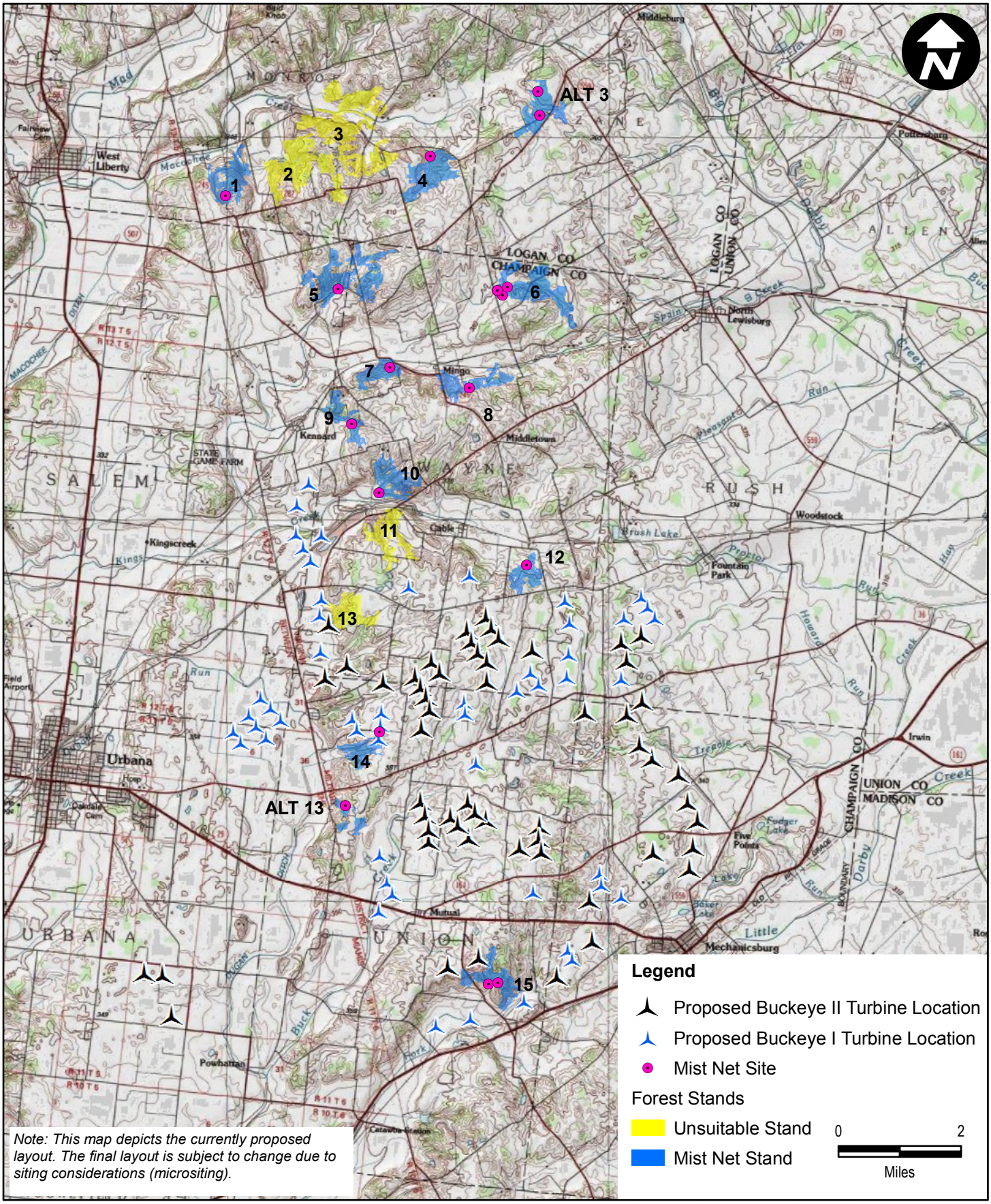

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Sheet Title: *Study Area and Bat Mist-net Site Locations*

Project: *Buckeye II Wind Farm, Ohio*

Date:	February 2012
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2. Methods and Materials

2.1. Mist-net Capture and Telemetry Techniques

The scope and methodology of the bat mist-netting survey were developed cooperatively with the ODNR and the OH USFWS and were in accordance with the methods outlined in the USFWS Indiana myotis sampling protocol (USFWS 2007). Bats were captured in 38 millimeter diameter polyester mist-nets (Avinet, Inc., Dryden, NY) placed over streams, small bodies of water, forest roads, and trails. Surveys were initially targeted to be performed within 15 forest stands identified from aerial photography by the OH USFWS as having the best potential habitat to support Indiana myotis within the study area (Figure 1-1).

Based on field investigations of the habitat within stands selected by the OH USFWS, four stands (Stands 2, 3, 11, and 13; Figure 1-1) were eliminated from consideration due to either inadequate netting opportunities or lack of property access. Only two alternate stands were found to replace these that were appropriate for netting (Alternate Stands 3, and 13; Figure 1-1). Within the 13 forest stands that were sampled, 17 capture sites were selected that consisted of a minimum of two nets set at each site.

Nets ranged from 2.6 to 18.0 m (8.5 to 59 ft) in length and were vertically stacked up to three nets high (7.8 m [25.6 ft]) in order to more completely fill the flight corridor. Nets were opened approximately 30 minutes before sunset and remained open for a minimum of five hours. Surveys occurred on nights with minimum temperatures greater than 10° Celsius (C; 50° Fahrenheit [F]), with little to no wind, and no precipitation.

Captured bats were identified to species, and the age, sex, reproductive condition, weight, and right forearm length of each bat was measured and recorded for all individuals. In order to better understand the breeding activity of bats in the study area, the ODNR requested that up to two reproductive females of each of the following species be radio-tagged: little brown myotis (*Myotis lucifugus*), northern myotis (*Myotis septentrionalis*), big brown bats (*Eptesicus fuscus*), tri-colored bat (*Perimyotis subflavus*), evening bat (*Nycticeius humeralis*), Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), and eastern small-footed myotis (*Myotis leibii*). The ONDR also requested that up to four adult male and female Indiana myotis be radio-tagged, if captured.

Radio-tagged individuals were fitted with 0.35-0.52 gram radio-transmitters (model LB-2N, Holohil Systems Ltd., Carp, Ontario). Increase in wing loading was limited to five percent of an individual's body mass for Indiana myotis, and seven percent for other species. Radio-transmitters were attached between the shoulder blades using liquid bonding cement (Torbot®, Cranston, Rhode Island). Bats were held for approximately 15-20 min to allow the glue to set properly.

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Radio-tagged bats were tracked to their day-roosts each day using TRX-2000S telemetry receivers (Wildlife Materials, Inc., Murphysboro, IL) and three-element yagi antennas (Advanced Telemetry Systems, Inc., Isanti, Minnesota). Day-tracking was ceased after three consecutive nights of no movement from a bat (indicating the transmitter had fallen off inside the roost), a transmitter was recovered, or no signal could be obtained for several consecutive days near the transmitter's expiration date. The location of each roost was recorded using a Global Positioning System (GPS), and a detailed account of each bat's daily behavior (roost switching) was recorded.

Due to the focus on Indiana myotis, all radio-tagged Indiana myotis were tracked during their nighttime activities from approximately sunset to midnight for several nights to estimate nighttime locations. On these nights, two to three observers were positioned at designated telemetry stations where signals could be obtained. Azimuths were recorded at 3-5 minute intervals, tracking an individual bat for up to 15 minutes before switching to another individual. Two azimuths per location were recorded and entered into the program Locate III (Nams 2005) to generate estimated locations.

2.2. Day-roosts

Radio-tagged bats were sequentially identified with letters following the chronology of capture, with Bat "A" being the first bat radio-tagged in the survey, followed by Bat "B", and so forth. If more than one day-roost was located for a radio-tagged bat, roosts were also identified sequentially using numbers. Together, the bat ID followed by the roost ID were used to identify each roost used by a particular bat (i.e., roost A3 was Bat A's third roost to which it was tracked). The following habitat characteristics that have been measured in other peer-reviewed studies (Baker and Lacki 2006, Lacki and Schwierjohann 2001, Perry and Thill 2007, Kurta *et al*. 2002, Rabe *et al*. 1998) were collected at each day-roost: diameter at breast height (dbh [cm]), bark coverage (%), amount of exfoliating bark (% of bark cover), decay-stage (Hunter 1990), snag height (m), distance to nearest snag ≥ 10 cm dbh (m), distance to nearest live tree greater than roost tree in height (m), distance to nearest live tree ≥ 10 cm dbh (m), height of nearest live tree ≥ 10 cm dbh, canopy cover (%), mid-story cover (%), and canopy height (m).

2.3. Emergence Counts

All bats observed exiting day-roosts were counted on at least one occasion to estimate the number of bats using the roost (emergence counts). Counts of emerging bats began 30 minutes prior to sunset and ended when ambient light levels declined past the point where the observer could accurately discern bats exiting or entering roosts.

2.4. Indiana Myotis Home Ranges and Core Areas

Indiana myotis home range and core activity areas were estimated from telemetry and capture locations using the fixed kernel method (Seaman *et al*. 1999, Seaman and Powell 1996, Worton 1989). The kernel method is a non-parametric statistical model which uses a probability density estimator to equate density of animal locations to the

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amount of time an animal spends in an area. Kernel estimators are based on probability "kernels" which are regions around each location containing some likelihood of animal presence. Thus, a 95% kernel represents an area which has a 95% probability for an animal to occur there.

The width of the kernel is based on a smoothing parameter (h), which was derived using the least-squares cross validation (LSCV) method. We chose the kernel method because it works well with small amounts of data, is robust to autocorrelation (i.e., statistical non-independence of telemetry locations), is nonparametric (i.e., does not have to meet the assumption of normal distribution), allows multiple centers of activity, and results in a utilization distribution (UD)[1], rather than a simple home range outline (Lacki *et al*. 2007, Kernohan *et al.* 2001).

Nighttime telemetry locations, the capture location, and day-roost locations were used to the generate home range (95% kernels) and core areas (50% kernels) for Indiana myotis using the Animal Movement Extension (Hooge and Eichenlaub 1997) for ArcView 3.2 (ESRI Corporation, Redlands, CA). Each day-roost represented a single location in these calculations, regardless how often the bat visited that roost, in order to focus home range estimates on nighttime activities (Johnson *et al*. 2007).

3. Results

3.1. Mist-net Capture Results

Stantec captured 298 bats during 75 net-nights, averaging 4.0 b/n/n (Table 3-1). Seven species were documented in the study area, with big brown bats consisting of 66.1% of all captures, followed by northern myotis (12.8%), red bats (12.1%), little brown myotis (6.0%), hoary bats (1.0%), tri-colored bats (1.0%), and Indiana myotis (1.0%). Reproduction of all seven species was documented through the capture of reproductive females.

Eleven bats were fitted with radio-transmitters during the course of the survey (Figure 3-1[2]; Table 3-2). This included two lactating females of each of the following species: Indiana myotis, little brown myotis, northern myotis, big brown bat, and tri-colored bat. One male Indiana myotis was radio-tagged in addition to the 2 reproductive Indiana myotis. Three species that were requested to be radio-tagged by the ODNR were not captured during mist-netting surveys: evening bat, Rafinesque's big-eared bat, and eastern small-footed myotis.

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[1] A UD is a grid where the value for each cell represents the probability of the animal occurring in that cell.

[2] Note that Figure 3-1 does not include capture and radio-tagging locations of Indiana myotis at the request of the ODNR.

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Table 3-1. Capture results from summer 2008 bat mist-netting surveys at the proposed Buckeye II Wind Farm in Champaign County, Ohio. Values in parentheses represent juvenile bats; values not in parentheses represent adults.

Species	Site Number (Stand Number)																	All Sites
	1 (6)	2 (Alt 13	3 (6)	4 (15)	5 (15)	6 (5)	7 (12)	8 (Alt 3)	9 (10)	10 (4)	11 (Alt 3	12 (14)	13 (1)	14 (9)	15 (8)	16 (6)	17 (7)	
Little Brown Myotis																		
Males	0	0	0	0	0	4	0	0	0	1	0 (1)	0	0	1	1	5 (1)	0	12 (2)
Females	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	4
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern Myotis																		
Males	1	3	4	0	1	1	0	5	1	0	1	0	2	0	0	2	0	21
Females	1	2	0	1	1	0	1	3	0	1	4	0	0	0	0	2 (1)	0	16 (1)
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Indiana Myotis																		
Males	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Females	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Big Brown Bat																		
Males	1	2	1	0	1	7 (2)	2 (2)	4 (4)	1 (2)	5 (2)	7 (11)	4	0	1 (6)	3 (6)	12 (4)	0	51 (39)
Females	3	2	0	1	0	14 (2)	0	2	3	9	12 (7)	4	0	2 (2)	14 (1)	20 (7)	1	87 (19)
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Red Bat																		
Males	1	0	0	2	0	2	0	0	0	1 (1)	0	1	0	1	0	0 (3)	0	8 (4)
Females	1	0	0	1	0	0	2 (2)	0	0	4	0	0	0	0 (2)	1	3 (4)	0	12 (8)
Unknown	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	4
Hoary Bat																		
Males	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Females	0	0	0	0	0	1	0	0	0	0 (1)	0	0 (1)	0	0	0	0	0	1 (2)
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tri-colored Bat																		
Males	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Females	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	2
Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All Species*																		
Males	3	5	5	2	2	15 (2)	2 (2)	9 (4)	2 (2)	7 (3)	8 (12)	5	2	3 (6)	4 (6)	19 (8)	0	93 (45)*
Females	6	4	0	3	1	16 (2)	3 (2)	5	3	15 (1)	16 (7)	4 (1)	0	2 (4)	15 (1)	28 (12)	1	122 (30)*
Unknown	1	1	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	5

* Totals do not include three captured Indiana myotis

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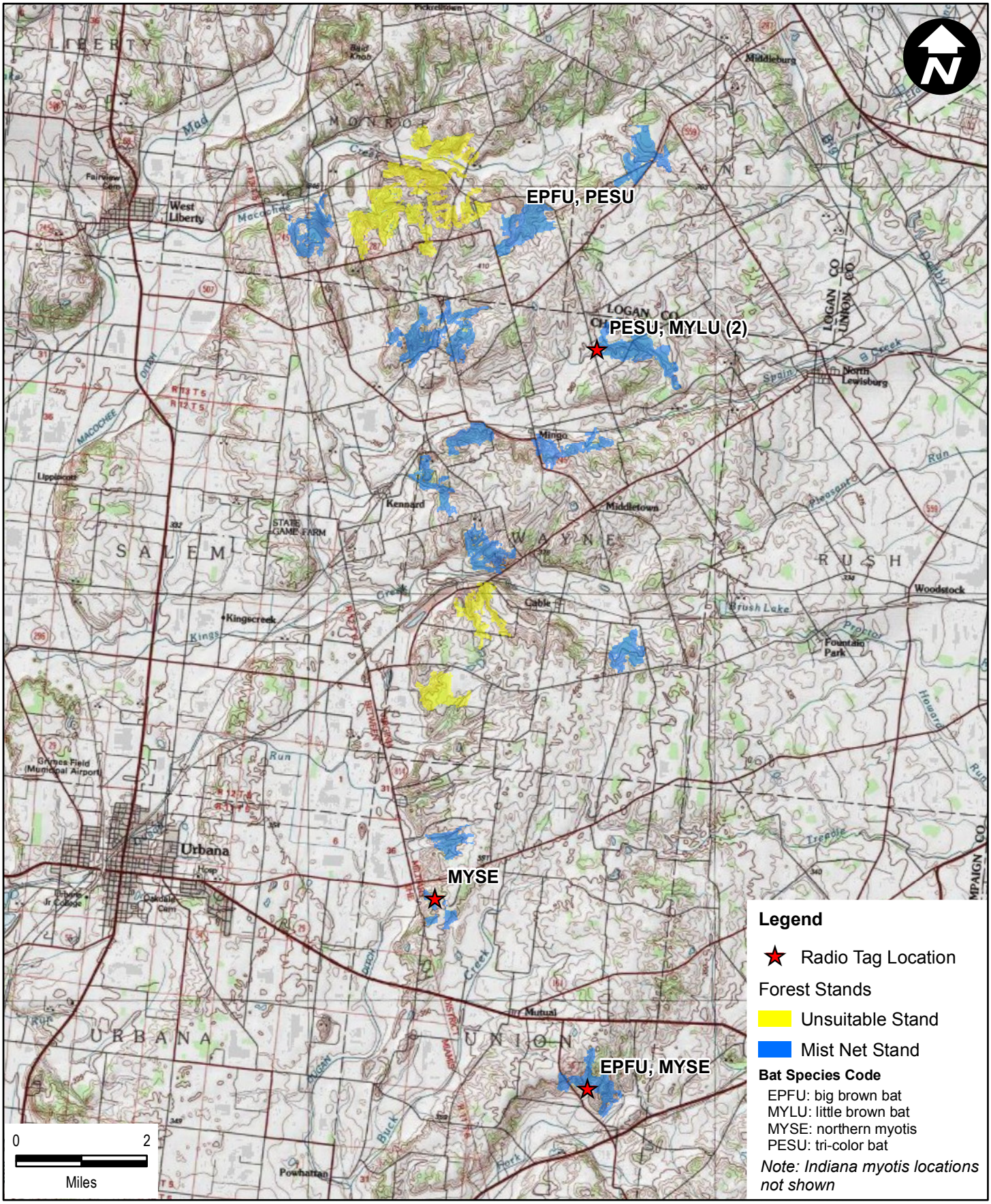

Prepared By: Stantec

Sheet Title: *Bat Radio-tagging Location Map*

Project: *Buckeye II Wind Farm, Ohio*

Date:	February 2012
Scale:	1" = 2 Miles
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Figure:	3-1

Table 3-2. Bats radio-tagged during summer 2008 bat mist-netting surveys at the proposed Buckeye II Wind Farm in Champaign County, Ohio.

Date	Species	Bat ID	Sex	Age	Repro	Days Tracked	Arm Band
06/20/08	Northern myotis	A	Female	Adult	Lactating	5	
06/26/08	Northern myotis	B	Female	Adult	Lactating	6	
06/29/08	Big brown bat	C	Female	Adult	Lactating	6	
07/13/08	Indiana myotis	D	Male	Adult	Non-scrotal	8	12401
07/16/08	Tri-colored bat	E	Female	Adult	Lactating	7	
07/16/08	Indiana myotis	F	Female	Adult	Lactating	7	12402
07/16/08	Indiana myotis	G	Female	Adult	Lactating	11	12403
07/16/08	Big brown bat	H	Female	Adult	Lactating	7	
07/22/08	Tri-colored bat	I	Female	Adult	Lactating	7	
07/22/08	Little brown myotis	J	Female	Adult	Lactating	6	
07/22/08	Little brown myotis	K	Female	Adult	Post-lactating	7	

3.2. Day-roosts

Day-tracking of the 11 radio-tagged bats resulted in the location of 18 day-roosts, with no two bats tracked to the same day-roost (Figure 3-2[3]; Tables 3-3 and 3-4). Day-roosts were physically located on 55 of 77 overall roost-days. Seven day-roosts could not be physically located due to landowners declining access to their property and their locations were therefore estimated using triangulation of radio signal bearings. No signal could be received from radio-tagged bats on six roost-days and thus day-roosts could not be found or triangulated for those days. Day-roosts were not located on nine roost-days due to staffing issues.

One female Indiana myotis (Bat F) spent all of the time that her transmitter was active on two land parcels that we did not have access to. As a result, roosts belonging to Bat F were triangulated for all seven days that her radio-transmitter was active. Each day-roost located using the triangulation method is treated as a distinct location throughout this report, although it is possible that roosts in close proximity to one another could have actually been the same roost. Habitat measurements for located roosts are reported in Table 3-3. *Myotis* species and tri-colored bats were tracked to eight different tree species (Table 3-3).

Radio-tagged bat species were generally tracked to different types of day-roosts. With the exception of one northern myotis roost, all *Myotis* species were tracked to dead or dying trees. Three trees used as day-roosts could not be identified to species because of extensive loss of bark. Both tri-colored bats were tracked to live white ash (*Fraxinus*

[3] Note that Figure 3-2 does not include roost locations of Indiana myotis at the request of the ODNR.

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americana). Among *Myotis* species, northern myotis used both cavity and bark roosts, while Indiana and little brown myotis roosted exclusively under exfoliating bark. Big brown bats were tracked to two man-made structures. Bat C was tracked to a bat box attached to the side of a home, and Bat H was tracked to a barn.

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Table 3-3. Day-roosts of radio-tagged bats captured during mist-netting surveys at the proposed Buckeye II Wind Farm in Champaign County, Ohio.

Bat Species	Roost ID	Bat ID	Sex	Reproductive Condition	Tree Species	Decay Stage	DBH (cm)	Roost Tree Height (m)	Roost Type	Bark Coverage (%)	Bark Exfoliating (%)	Canopy Cover (%)	Canopy Height (m)	Mid-story Cover (%)	Dist Nrst Taller Live Tree (m)	Dist Nrst Live Tree (m)	HT Nrst Live Tree (m)	Dist Nrst Snag (m)	Live Trees w/in 20m	Snags w/in 20m
Northern myotis	A1	A	F	Lactating	Black Locust	4	21.5	6.0	Cavity	0.2	0.5	0.3	10.0	0.7	3.0	3.0	10.0	3.5	23	11
Northern myotis	A2	A	F	Lactating	Boxelder	5	16.7	7.5	Cavity	0.0	0.0	0.0	11.0	0.0	10.0	10.0	5.5	7.0	18	5
Northern myotis	A3	A	F	Lactating	Black Cherry	1	53.0	15.0	Unknown	1.0	0.0	0.1	10.0	0.2	7.5	6.0	7.0		8	0
Northern myotis	B1	B	F	Lactating	Am. Elm	4	42.0	16.0	Unknown	0.8	0.4	0.8	20.0	0.3	2.0	2.0	20.0	7.0	80	6
Northern myotis	B2	B	F	Lactating	White Oak	4	39.0	16.0	Bark	0.6	0.4	0.9	20.0	0.8	-	-	-	-	-	-
Big brown bat	C1	C	F	Lactating	N/A	N/A	N/A	N/A	Bat Box	N/A	N/A	N/A	N/A	N/A	6.8	6.8	8.0	>100	10	0
Indiana myotis	D1	D	M	Non-scrotal	Unk	4	29.2	8.4	Bark	0.6	0.4	0.5	25.0	0.5	11.3	2.1	11.3	6.5	7	2
Indiana myotis	D2	D	M	Non-scrotal	Ash Spp.	4	64.3	20.7	Bark	0.8	0.4	0.6	17.4	0.4	10.7	5.6	17.4	16.3	14	5
Tri-colored Bat	E1	E	F	Lactating	White Ash	1	28.2	20.0	Unknown	1.0	0.0	0.8	20.0	0.9	2.0	2.0	20.0	13.0	43	7
Tri-colored Bat	E2	E	F	Lactating	Hickory Spp.	1	24.0	16.1	Unknown	1.0	0.0	0.8	17.7	0.8	2.3	2.3	17.7	6.2	-	-
Indiana myotis	G1	G	F	Lactating	Silver Maple	4	52.5	24.1	Bark	0.8	0.4	0.9	30.5	0.9	1.5	1.5	30.3	11.1	24	2
Indiana myotis	G2	G	F	Lactating	Silver Maple	3	56.3	26.5	Bark	0.9	0.1	0.2	30.5	0.3	14.7	0.5	N/A	14.5	27	2
Indiana myotis	G3	G	F	Lactating	Silver Maple	4	33.1	19.7	Bark	0.9	0.2	0.2	28.4	0.2	0.6	0.6	27.3	4.5	22	3
Indiana myotis	G4	G	F	Lactating	Maple Spp.	4	56.8	18.1	Bark	0.9	0.1	0.1	18.1	0.2	4.9	4.9	22.9	8.4	32	3
Indiana myotis	G5	G	F	Lactating	Sugar Maple	4	34.5	12.0	Bark	0.8	0.4	0.1	22.9	0.2	8.3	8.3	22.9	12.7	26	1
Big brown bat	H1	H	F	Lactating	N/A	N/A	N/A	N/A	Barn	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tri-colored Bat	I1	I	F	Lactating	White Ash	2	41.0	11.6	Unknown	1.0	0.3	1.0	18.1	90.0	6.0	1.0	-	-	-	-
Little brown myotis	J1	J	F	Lactating	Oak Spp.	4	56.0	27.7	Bark	0.5	0.9	0.3	25.6	70.0	5.6	1.5	-	18.0	50	2

* A dash indicates that data were not collected for that particular roost; N/A indicates that the data type was not appropriate that roost

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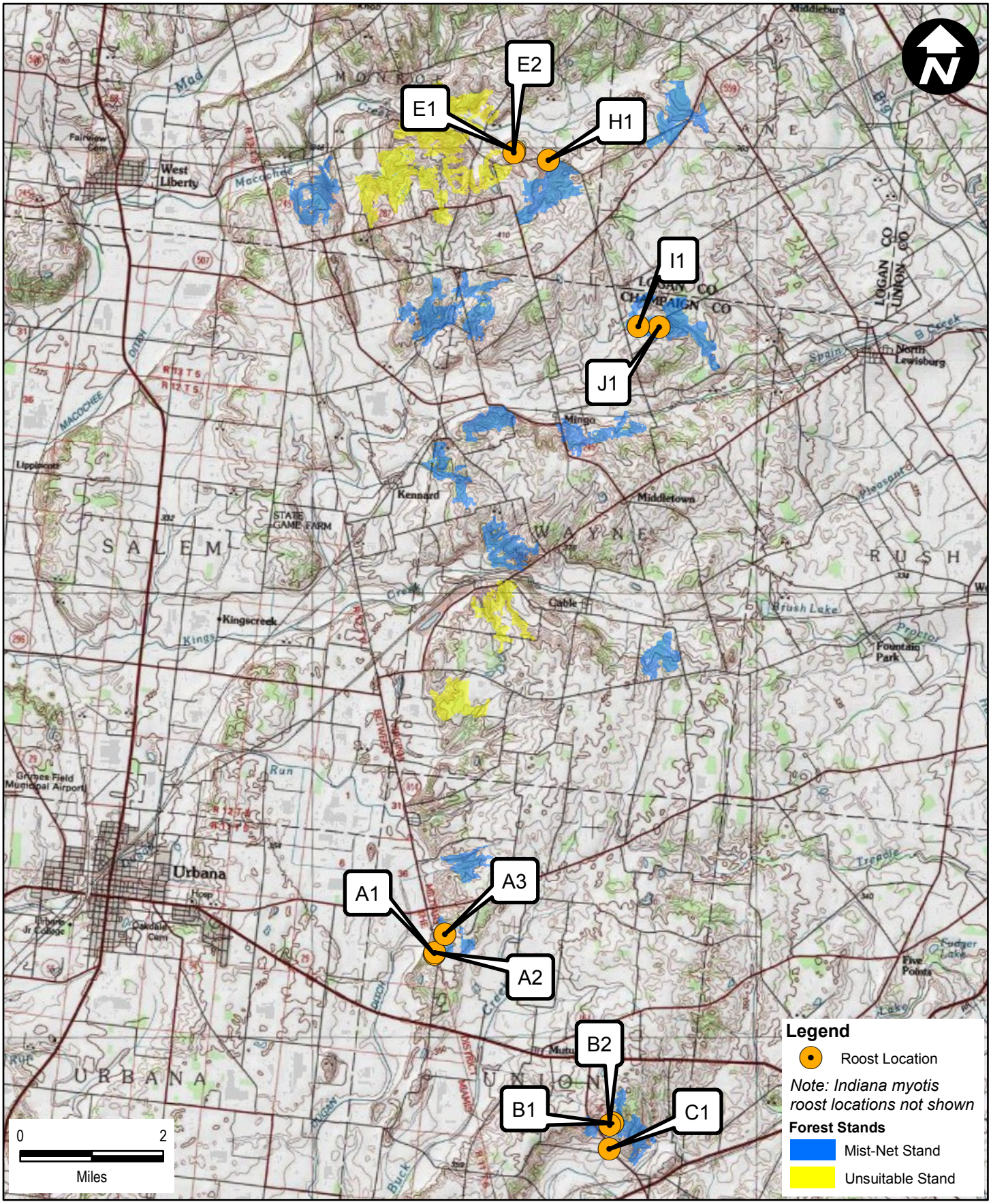

Prepared By:

Stantec

Sheet Title:

Bat Day-Roost Location Map

Project:

Buckeye II Wind Farm, Ohio

Date:	February 2012
Scale:	1" = 2 Miles
Proj. No.:	173632001
Figure:	3-2

Roost switching behavior and distances between day-roosts and capture locations also varied among radio-tagged bat species. Both big brown bats stayed in the same roost all days that they were tracked. This was also the case for one tri-colored bat, while the other tri-colored bat only switched roosts once. However, several *Myotis* species switched roosts on more than one occasion (Table 3-4). The furthest distance traveled between a capture site and day-roost was by a tri-colored bat (3,827 m; 12,555 ft), and the furthest mean distance traveled between day-roosts was by a male Indiana myotis (4,198 m; 13,773 ft).

Table 3-4. Roost switching behavior for 11 radio-tagged bats captured during mist-netting surveys at the proposed Buckeye II Wind Farm in Champaign County, Ohio.

Species	Bat ID	Sex	Repro. Condition	No. of Roosts	Mean Length of Residency	Mean Dist. from Roosts to Capt. Site (m)	Mean Dist. To Next Roost (m)
Northern myotis	A	Female	Lactating	3	1.7	562.9	469.5
Northern myotis	B	Female	Lactating	2	2.5	237.9	N/A[a]
Big brown bat	C	Female	Lactating	1	2.0	402.1	N/A[a]
Indiana myotis	D	Male	Non-scrotal	2	4.0	2217.9	4197.9
Tri-colored Bat	E	Female	Lactating	2	3.5	3827.0	47.9
Indiana myotis	F	Female	Lactating	6	1.0[b]	2441.6	892.8
Indiana myotis	G	Female	Lactating	5	1.4	999.7	48.5
Big brown bat	H	Female	Lactating	1	7.0	221.4	N/A[a]
Tri-colored Bat	I	Female	Lactating	1	N/A[a]	240.8	N/A[a]
Little brown myotis	J	Female	Lactating	1	N/A[a]	711.5	N/A[a]
Little brown myotis	K	Female	Post-lactating	1	Unknown	Unknown	Unknown

[a] Mean could not be determined because individual did not switch roosts, or could not be located in alternate roosts
[b] Day-roosts for bat F could not be physically located and were located using triangulation

3.3. Emergence Counts

It is generally assumed that bats exiting maternity roosts are predominately reproductive females (and juveniles later in the summer) of the same species, although this has not been found to hold true in all instances (Gumbert *et al.* 2002). Emergence counts were conducted on at least one evening for all day-roosts which could be physically located (Table 3-5). The highest emergence counts for Indiana myotis, northern myotis, little brown myotis, big brown bat, and tri-colored bat were 28, 26, 6, 19, and 3, respectively. Four emergence counts were conducted simultaneously by different observers at four of the five roosts used by Indiana myotis female Bat G on 24 July. This resulted in a cumulative count of 43 bats, which likely consisted of adult female and juvenile Indiana myotis.

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Table 3-5. Results of emergence counts conducted outside day-roosts located at the proposed Buckeye II Wind Farm in Champaign County, Ohio.

Date	Bat Species	Roost ID	Number of Bats
06/21/08	Northern myotis	A1	16
06/24/08	Northern myotis	A2	7
06/25/08	Northern myotis	A3	23
06/30/08	Northern myotis	B1	0
06/29/08	Northern myotis	B2	25
06/30/08	Northern myotis	B2	22
07/01/08	Northern myotis	B2	26
07/02/08	Northern myotis	B2	25
07/02/08	Big brown bat	C1	10
07/07/08	Big brown bat	C1	19
07/17/08	Indiana myotis	D1	0
07/16/08	Indiana myotis	D2	2
07/17/08	Tri-colored bat	E1	1
07/18/08	Tri-colored bat	E1	3
07/17/08	Indiana myotis	G1	11
07/24/08	Indiana myotis	G1	28
07/18/08	Indiana myotis	G2	7
07/24/08	Indiana myotis	G2	0
07/19/08	Indiana myotis	G3	3
07/24/08	Indiana myotis	G4	10
07/24/08	Indiana myotis	G5	5
07/20/08	Big brown bat	H1	15
07/29/08	Tri-colored bat	I1	1
07/28/08	Little brown myotis	J1	6

3.4. Indiana Myotis Home Range and Core Areas

Night tracking of Indiana myotis resulted in 154 successful triangulations in 241 attempts to locate bats (64% success rate). The fewest number of locations (*n* = 28) were collected for Bat D, followed by Bat F (*n* = 31), and Bat G (*n* = 91). Home range and core area estimates varied considerably among the three individuals (Table 3-6), with the largest areas (2,599.5 ha [10.0 mi^2] 95% kernel, 335.2 ha [1.3 mi^2] 50% kernel) belonging to Bat D.

Indiana myotis capture locations, nighttime telemetry locations, and day-roosts were concentrated in the northern portion of the study area. Due to the sensitivity of endangered species locations, we have reported the combined home range area[4] of all three Indiana myotis captured during the survey (Figure 3-3).

[4] The combined home range area for Indiana myotis was reported at the request of the ODNR.

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Table 3-6. Home range and core area estimates for three adult Indiana myotis radio-tagged at the proposed Buckeye II Wind Farm in Champaign County, Ohio.

Bat ID	Species	Sex	Reproductive Condition	95% KHR (ha)	50% KHR (ha)	No. of Locations
D	Indiana myotis	Male	Non-scrotal	2599.5	335.2	28
F	Indiana myotis	Female	Lactating	1020.4	141.7	31
G	Indiana myotis	Female	Lactating	609.1	105.5	95

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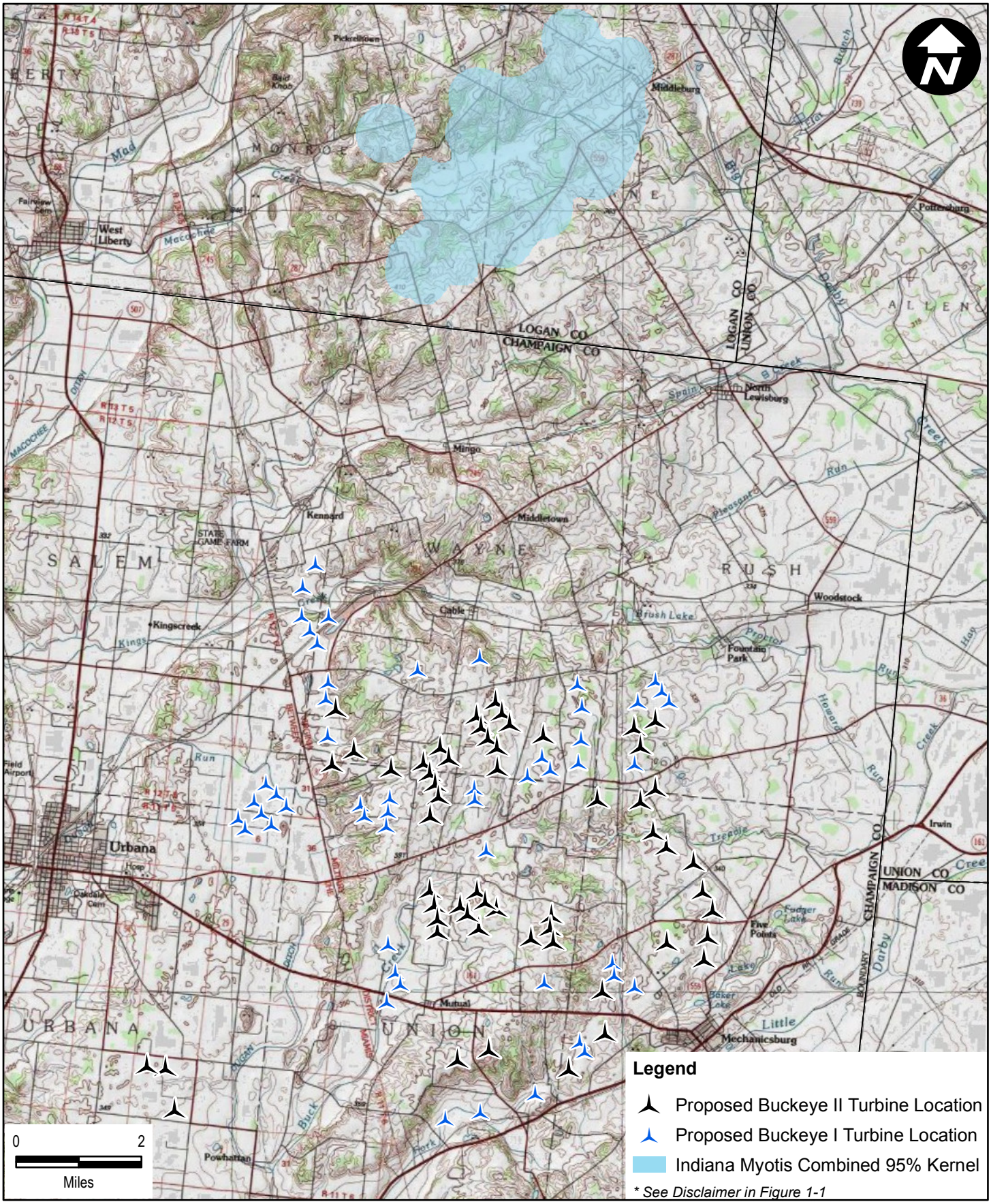

Prepared By:

Stantec

Sheet Title:

Indiana Myotis Activity Area Map

Project:

Buckeye II Wind Farm, Ohio

Date:	February 2012
Scale:	1" = 2 Miles
Proj. No.:	175632001
Figure:	3-3

4. Discussion

4.1. Mist-net Capture Results

The primary objective of the survey was to document the presence or probable absence of Indiana myotis during their breeding season. An additional objective was to provide data on the other species of bats using the study area. Indiana myotis were documented in a small portion of the study area in the northernmost region (Figure 3-3). Six other bat species were documented in the study area. Deriving meaning from these data, other than probable presence or absence, can be confounded by many factors. Environmental conditions such as temperature, wind speed, relative humidity, and precipitation can influence both bat and insect (prey) activity (see Hayes 2000 and cited references).

Capture results are also affected by the timing of a mist-net survey; changes in bat behavior have been found to be related to different seasonal and reproductive conditions. The success of a capture site is also closely tied to the physical characteristics of the site itself (i.e., some sites serve as better 'natural traps'), resulting in unequal efficacy among sites. For these reasons reason, it is difficult to relate mist-net capture results to local bat population size or activity levels, or to compare results from this survey to those conducted in other areas.

It is also difficult to document certain bat species using mist-netting surveys (Weller and Lee 2007). Some species fly at heights well above the average mist-net set (Hayes and Gruver 2000; Hayes 2000) and others migrate long distances, such as the silver-haired bat (*Lasionycteris noctivagans*; Cryan 2003), and may pass through an area only during migration. For these reasons, documenting these species using mist-surveys is not always possible and can take extensive effort (Weller and Lee 2007). Two species whose accepted normal geographic range includes Champaign County (BCI 2001) were not captured during mist-net surveys: the silver-haired bat and the evening bat. Capture of these species in Ohio is uncommon and it is unlikely that either species is abundant (if present) in the study area.

Three other species, Rafinesque's big-eared bat, the gray myotis, and the eastern small-footed myotis are not known to occur in west-central Ohio. These three species are unlikely to occur in the study area during any time of the year based on their biology and habitat requirements (Best and Jennings 1997, BCI 2001).

4.2. Day-roosts

The main objective of the telemetry survey was to collect information on the habitat and spatial use of the study area by Indiana bats. An additional objective was to collect similar information on seven species of bats which are not state or federally listed as endangered or threatened, as specifically requested by the ODNR. Of these seven non-

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listed species identified by the ODNR, four were captured in the mist net survey and were able to be tracked.

Telemetry was performed on five of the seven captured bat species, including the Indiana myotis. Radio-tagged bats were tracked to their day-roosts to collect habitat information on their maternity roosts. These bats used a variety of day-roost types during the course of survey, including bark roosts (Indiana, little brown, and northern myotis), cavity roosts (northern myotis), and man-made structures (big brown bats). These types of roosts have also been found to be used by these species in other studies (Barclay and Kurta 2007, Kurta and Baker 1990, Kurta 2005, Whitaker 1998, Perry and Thill 2007, Caceres and Barclay 2000, Lacki and Schwierjohann. 2001, Foster and Kurta 1999, Broders and Forbes 2004). Observed roosts switching behavior and distances traveled for radio-tagged bats in this survey is also consistent with previous studies (see summary in Barclay and Kurta 2007).

4.3. Emergence Counts

Emergence counts outside day-roosts of little brown myotis, Indiana myotis, northern myotis, big brown bats, and tri-colored bats are consistent with what has been documented to date in peer-reviewed studies of these species. None of the emergence counts documented in the study area could be considered exceptionally large for any of the five species. Published emergence count data from the three *Myotis* species and big brown bats typically range from 20-100 individuals (Broders and Forbes 2004, Caceres and Barclay 2000, Foster and Kurta 1999, Kurta 2005, Kurta and Baker 1990, Lacki and Schwierjohann 2001), although much larger roosts have also been found to occur. Although few published reports document the roosting behavior of tri-colored bats, maternity colony size for this species appears to be smaller (<30 bats) than that for *Myotis* species and big brown bats (Perry and Thill 2007, Whitaker 1998).

Interpretation of emergence count data should take into account the reproductive cycle of colonial roosting bats. Emergence counts in this study were conducted in mid- to late-July, which coincides with the approximate timing of parturition (i.e., birthing) (Kurta *et al*. 1996). Colonial summer roosting is most important during fetal development and after parturition while pups are still being nursed. After parturition, colonial behavior has decreasing benefits for reproductive females. Once pups are volant (i.e., able to fly), summer colonies typically begin to 'break apart'; as a result emergence counts at maternity roosts may begin to decline (Kurta *et al*. 1996). However, once juveniles are volant, emergence counts may increase, as counts could include juvenile bats. Thus, if the cumulative count of 43 Indiana myotis on 24 July occurred after parturition, it is likely that this count included an unknown number of juvenile bats.

4.4. Indiana Myotis Home Ranges and Core Areas

The number of telemetry locations used to generate home range and core area estimates in this study is similar to sample sizes in many peer-reviewed studies (Adam *et al*. 1994, Menzel and Menzel 2001, Elmore *et al*. 2005, Watrous *et al*. 2006). Thirty

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locations is the minimum sample size recommended by Seaman *et al*. (1999) to calculate kernel home ranges. However, sample-sizes of less than 30 have been accepted in peer-reviewed bat research (Adam *et al*. 1994, Elmore *et al*. 2005, Watrous *et al*. 2006) due to the inherent difficulty associated with tracking bats. Of the three Indiana myotis radio-tagged, only Bat D had fewer than 30 locations (*n* = 28).

Areas with high densities of locations (the 50% core area in this study) have been equated to foraging areas in some bat studies, but this may be an erroneous assumption (Johnson *et al*. 2007, Lacki *et al*. 2007). Bats must engage in several important behaviors after leaving their day-roost each night including, but not limited to, foraging, commuting, night-roosting, and drinking. With the exception of night-roosting, it cannot be known which behavior a bat is engaged in at the time of observation (triangulation). In light of this, we report our results as 95% home range and 50% core areas, and make no assumptions regarding shape, size, or location of foraging areas.

The mean home range size of the three Indiana myotis in this study (1,410 ha; 3,484 acre) is larger than the mean home range estimates in five other peer-reviewed Indiana myotis studies (Table 4-1). However, only two of the five studies used the same method of estimating home range; two used the kernel method, while three used the minimum convex polygon (MCP) method. Different methods of home range estimation can affect the size of the resulting estimated home ranges and makes comparability among studies limited.

Table 4-1. Comparison of peer-reviewed estimates of Indiana myotis home ranges to that observed in the study area.

Author	State	Home Range Estimator	Number of Bats	Mean Home Range (ha)	SE
Brack 2006	VA	MCP	11*	361.0	78.4
Menzel *et al.* 2005	IL	Kernel	11	144.7	18.4
Romme *et al.* 2002	MO	MCP	9*	667.0	331.3
Sparks *et al.* 2005	IN	MCP	11	334.8	65.7
Watrous *et al.* 2006	VT	Kernel	14	83.0	0.2
Buckeye Wind Project	*OH*	*Kernel*	*3**	*1409.7*	*606.7*

* Included males and females (all others include females only).

Because bats in this study could not be located approximately 36 percent of the time, it cannot be known how their activity patterns during this time might have affected their home range estimates. Signals of radio-tagged bats were often lost after midnight or 1:00 AM. There are several reasons that could have contributed to unsuccessful attempts to located radio-tagged bats, including topographic or geologic features (i.e., caves) that block radio signals, observer error, and dispersion of bats outside the range of reception.

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5. Conclusions

The presence of Indiana myotis was confirmed in a small portion of the study area in the northeast region, where three Indiana myotis were captured and radio-tracked. The mist-netting survey was designed cooperatively with the ODNR and the OH USFWS to maximize the chances of capturing Indiana myotis. This was done by placing mist-netting sites within forest stands selected by the OH USFWS that represented the most suitable habitat within the study area for Indiana myotis. Four of the original 15 stands were unsuitable for mist-netting, and two alternate stands were selected in the field. The number and placement of the mist-netting sites within the 13 forest stands were relatively evenly dispersed throughout the study area (Figure 1-1).

Despite this even sampling effort, Indiana myotis were only captured and radio-tracked within the northeast portion of the study area (Figure 3-3). The home range and core areas of the three radio-tagged Indiana myotis overlapped two of the 13 suitable forest stands where mist-netting was performed. Although it is not possible to determine with absolute certainty, the lack of Indiana myotis captures in the other 11 forest stands suggests their probable absence during the summer reproductive season in this portion of the study area. This could be related to differences in the availability of habitat for roosting or foraging activities, such as density of snags, amount and/or connectivity of forest cover, availability of water or other features that support high insect abundance, among many other potential reasons. Despite the results of this study, in 2009 consultants for a wind energy development adjacent to the study area also captured Indiana bats during mist-net surveys. As a result of those captured Indiana bats, the Project will seek incidental take coverage through the Endangered Species Act.

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